You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. JOSEPH'S GROUP OF INSTITUTIONS

OMR, CHENNAI - 119

B.E. COMPUTER SCIENCE AND ENGINEERING

REGULATION – 2021

Batch 2021-25

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

1. **Profession:** Graduates excel in computer technology in order to pursue higher education and research, or have a successful career in industries or as entrepreneurs.
2. **Technophile:** Graduates will have the ability and attitude to adapt emerging technological changes in the field of Computer Science and Engineering.
3. **Team Player:** Possess an ability to collaborate as a team member and team leader to affect technical solutions for computing systems, providing improved function and outcomes.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional

engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs):

1. **Efficacy:** Ability to apply mathematical methodologies and foundational concepts of Computer Science and Engineering to solve computational tasks, model the real world problem using appropriate data structure and algorithm with suitable programming languages.

2. **Potentiality to design:** Analyze, design and evaluate a computer based system by applying software engineering principles and practices for developing quality software for scientific and business applications.

3. **Technical expertise:** Adapt to modern engineering technologies and thereby build robust, reliable, maintainable, scalable, innovative and efficient computing systems by considering social, environmental, economic, and security constraints

MAPPING OF PROGRAM OUTCOMES (POs) WITH

PROGRAM EDUCATIONAL OBJECTIVES (PEOs) & PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Outcomes (POs)	Program Educational Objectives (PEOs)			Program Specific Outcomes (PSOs)		
	Profession	Technophile	Team Player	Efficacy	Potentiality to design	Technical expertise
Engineering knowledge	3	3	1	3	3	3
Problem analysis	3	3	2	3	3	2
Design/development of solutions	3	3	2	3	3	3
Conduct investigations of complex problems	3	3	3	3	3	2
Modern tool usage	2	3	1	3	3	3
The engineer and society	2	2	2	2	2	3
Environment and sustainability	2	2	2	2	2	3
Ethics	3	2	3	2	2	2
Individual and team work	3	2	3	2	2	2
Communication	3	2	3	2	2	3
Project management and finance	2	2	2	3	3	2
Life-long learning	3	3	2	3	2	3

Correlation Level 1, 2 or 3 as defined below:

1: Slight (Low)

2: Moderate (Medium)

3: Substantial (High)

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES (REGULAR COURSES)

A broad relation between the Course Outcomes and Program Outcomes (POs) and Program Specific Outcomes (PSOs) are given in the following table

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Communicative English		√	√	√	√		√			√			√		√
	Engineering Mathematics – I	√	√	√	√	√				√	√	√	√	√	√	√
	Engineering Physics	√	√	√	√	√	√	√		√	√		√	√	√	√
	Engineering Chemistry	√	√	√	√		√	√	√	√	√		√	√	√	√
	Problem Solving and Python Programming	√	√	√	√	√					√	√	√	√	√	√
	Engineering Graphics	√	√	√	√	√	√			√	√	√	√		√	√
	Python Programming Laboratory	√	√	√	√	√					√	√	√	√	√	√
	Physics and Chemistry Laboratory	√	√	√	√		√		√	√	√			√	√	√
II	Professional English		√	√	√	√		√	√	√	√			√		√
	Engineering Mathematics -II	√	√	√	√	√	√	√			√	√	√	√	√	√
	Physics for Information Science	√	√	√	√	√	√			√	√		√	√	√	√
	Environmental Science and Engineering	√	√	√	√	√	√	√	√	√	√		√	√	√	√
	Basic Electrical, Electronics and Measurement Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Programming in C	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Engineering Practice Laboratory	√	√	√			√						√	√	√	√
	Programming in C Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
III	Probability and Statistics	√	√	√	√	√	√	√				√	√	√	√	√
	Digital Principles and Logic Design (Lab Integrated)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Data Structures	√	√	√	√	√	√				√	√	√	√	√	√
	Object Oriented Programming	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Computer Architecture	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Software Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Data Structures Laboratory using C	√	√	√	√	√			√	√	√	√	√	√	√	√
	Object Oriented Programming Laboratory	√	√	√	√	√			√	√	√	√	√	√	√	√

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
IV	Discrete Mathematics	√	√	√	√	√	√				√	√	√	√	√	√
	Design and Analysis of Algorithms	√	√	√	√	√				√		√	√	√	√	√
	Operating Systems	√	√	√	√	√					√	√	√	√	√	√
	Database Design and Management (Lab Integrated)	√	√	√	√	√					√	√	√	√	√	√
	Computer Networks	√	√	√	√	√	√					√	√	√	√	√
	Microprocessors and Microcontrollers	√	√	√	√	√	√				√	√	√	√	√	√
	Operating Systems Laboratory	√	√	√	√	√					√	√	√	√	√	√
	Networks Laboratory	√	√	√	√	√				√	√	√	√	√	√	√
	Professional Skills Laboratory		√	√	√	√		√	√	√	√			√	√	√
V	Algebra and Number Theory	√	√	√	-	√	-	-	√	√	√	-	√	√	√	√
	Internet Programming	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Object Oriented Analysis and Design	√	√	√	√	√	-	-	√	√	√	√	√	√	√	√
	Artificial Intelligence (Lab Integrated)	√	√	√	√	√	√	-	-	√	√	√	√	√	√	√
	Internet Programming Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Object Oriented Analysis and Design Laboratory	√	√	√	√	√	√	-	√	√	√	√	√	√	√	√
VI	Compiler Design	√	√	√	√	√	√	-	-	√	√	√	√	√	√	√
	Mobile Computing	√	√	√	√	√	√	√	-	√	√	√	√	√	√	√
	Distributed Systems	√	√	√	√	√	√	-	-	-	√	√	√	√	√	√
	Data Science and Analytics	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Mobile Application Laboratory	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Mini Project – I	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VII	Graph Theory	√	√	-	√	-	-	-	-	-	-	-	√	√	-	-
	Cloud Computing	√	-	√	√	√	√	√	√	√	-	√	√	√	√	√
	Cryptography and Network Security	√	√	√	√	-	√	√	√	-	-	-	√	√	√	-
	Edge Computing	√	√	√	√	√	√	√	√	-	-	√	√	√	√	√
	Cloud Computing Laboratory	√	√	√	√	√	-	-	-	-	-	√	√	√	√	√
	Project Work Phase I	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VIII	Project Work Phase II	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES (ELECTIVE COURSES)

A broad relation between the Course Outcomes and Program Outcomes (POs) and Program Specific Outcomes (PSOs) are given in the following table

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
V	Computer Graphics	√	√	√	√	√	-	-	√	-	-	√	√	√	√	√
	Machine Learning Techniques	√	√	√	√	-	-	√	√	-	-	√	√	√	√	√
	Computer Vision	√	√	√	√	√	-	-	-	-	√	-	√	√	√	√
	Multicore Architecture	√	√	√	√	-	-	-	√	√	-	√	√	√	√	√
	Fundamentals of Digital Image Processing	√	√	√	√	-	-	-	√	√	-	√	√	√	√	√
VI	Theory of Computation	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Software Testing	√	√	√	√	√	√	√	-	-	√	√	√	√	√	√
	Advanced Java Programming	√	√	√	√	√	-	-	-	√	√	√	√	√	√	√
	Deep Learning	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Professional Ethics in Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VII	Software Project Management	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Virtualization Techniques	√	-	√	√	√	√	√	-	-	-	√	√	√	√	√
	Principles of Management	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	GPU Architecture and Programming	√	√	√	√	√	-	-	-	-	-	√	-	√	√	√
	Resource Management Techniques	√	√	√	√	√	-	-	√	-	-	-	-	√	-	√
VII	Soft Computing	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Quantum Computing	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Software Architecture	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	Multimedia and Graphics Packages	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Human Computer Interaction	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VIII	Natural Language Processing	√	√	√	√	√	√	-	-	√	√	√	√	√	√	√
	Microcontroller Based System Design	√	√	√	√	√	√	√		√	√	√	√	√	√	√
	Forensics and Cyber Law	√	√	√	√	√	√	√			√	√	√	√	√	√
	Data Warehousing and Data Mining	√	√	√	√	√			√		√	√	√	√	√	√
	Software Quality Assurance	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VIII	Software Defined Networks	√	√	√	√	√	-	-	-	-	√	√	√	√	√	√
	iOS Application Development	√	√	√	√	√	√	-	√	-	√	√	√	√	√	√
	Network Simulation using NS3	√	√	√	√	√	-	-	√	-	-	√	√	√	√	√
	Blockchain Technologies	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Information Retrieval Techniques	√	√	√	√	√	√	-	-	-	√	√	√	√	√	√

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	4	3	1	0	4
3	PH1103	Engineering Physics **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	6	2	0	4	4
PRACTICAL								
7	GE1107	Python Programming Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	4	0	0	4	2
Total				**30**	**17**	**1**	**12**	**24**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics -II **(Common to all Branches of B.E. / B. Tech Programmes Except AI-DS & AI-ML)**	BSC	4	3	1	0	4
3	PH1252	Physics for Information Science **(Common to CSE, IT, AI-DS & AI-ML)**	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
5	BE1251	Basic Electrical, Electronics and Measurement Engineering **(Common to CSE, IT, AI-DS & AI-ML)**	ESC	3	3	0	0	3
6	CS1206	Programming in C **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
PRACTICAL								
7	GE1207	Engineering Practice Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
8	CS1208	Programming in C Laboratory **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	4	0	0	4	2
Total				**27**	**18**	**1**	**8**	**23**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1351	Probability and Statistics **(Common to CSE, IT & AI-DS)**	BSC	4	3	1	0	4
2	CS1301	Digital Principles and Logic Design (Lab Integrated) **(Common to CSE & IT)**	ESC	5	3	0	2	4
3	CS1302	Data Structures **(Common to CSE, IT, AI-DS, AI-ML & ECE Semester IV)**	PCC	3	3	0	0	3
4	CS1303	Object Oriented Programming **(Common to CSE & IT)**	PCC	3	3	0	0	3
5	CS1304	Computer Architecture **(Common to CSE & IT)**	PCC	3	3	0	0	3
6	CS1305	Software Engineering **(Common to CSE & IT)**	PCC	3	3	0	0	3
PRACTICAL								
7	CS1307	Data Structures Laboratory using C **(Common to CSE, IT & ECE Semester IV)**	PCC	4	0	0	4	2
8	CS1308	Object Oriented Programming Laboratory **(Common to CSE & IT)**	PCC	4	0	0	4	2
Total				**29**	**18**	**1**	**10**	**24**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1453	Discrete Mathematics **(Common to CSE, IT & AI-DS)**	BSC	4	3	1	0	4
2	CS1401	Design and Analysis of Algorithms **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
3	CS1402	Operating Systems **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
4	CS1403	Database Design and Management (Lab Integrated) **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	5	3	0	2	4
5	CS1404	Computer Networks	PCC	3	3	0	0	3
6	EC1601	Microprocessors and Microcontrollers **(Common to CSE and ECE Semester VI)**	ESC	3	3	0	0	3
PRACTICAL								
7	CS1407	Operating Systems Laboratory **(Common to CSE, IT & AI-ML)**	PCC	4	0	0	4	2
8	CS1408	Networks Laboratory	PCC	4	0	0	4	2
9	HS1310	Professional Skills Laboratory **(Common to CSE & AI-DS)**	HSMC	2	0	0	2	1
Total				**31**	**18**	**1**	**12**	**25**

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1501	Algebra and Number Theory **(Common to CSE & IT)**	BSC	4	3	1	0	4
2	CS1501	Internet Programming	PCC	3	3	0	0	3
3	CS1502	Object Oriented Analysis and Design **(Common to CSE & IT)**	PCC	3	3	0	0	3
4	CS1503	Artificial Intelligence (Lab Integrated)	PCC	5	3	0	2	4
5		Open Elective - I	OEC	3	3	0	0	3
6		Professional Elective - I	PEC	3	3	0	0	3
PRACTICAL								
7	CS1507	Internet Programming Laboratory	PCC	4	0	0	4	2
8	CS1508	Object Oriented Analysis and Design Laboratory **(Common to CSE & IT)**	PCC	4	0	0	4	2
Total				**25**	**18**	**1**	**10**	**24**

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CS1601	Compiler Design	PCC	3	3	0	0	3
2	CS1602	Mobile Computing	PCC	3	3	0	0	3
3	CS1603	Distributed Systems	PCC	3	3	0	0	3
4	CS1604	Data Science and Analytics	PCC	3	3	0	0	3
5		Open Elective - II	OEC	3	3	0	0	3
6		Professional Electives - II	PEC	3	3	0	0	3
PRACTICAL								
7	CS1607	Mobile Application Laboratory	PCC	4	0	0	4	2
8	CS1608	Mini Project - I	EEC	4	0	0	4	2
Total				**26**	**18**	**0**	**8**	**22**
9		Value Added Course	EEC	Two Weeks				2
10		Audit Course (Optional)	AC					

For Value Added Courses, the grades earned by the students will be recorded in the Mark Sheet, However, the same shall not be considered for the computation of CGPA.

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CS1701	Graph Theory	PCC	3	3	0	0	3
2	CS1702	Cloud Computing	PCC	3	3	0	0	3
3	CS1703	Cryptography and Network Security **(Common to CSE & IT)**	PCC	3	3	0	0	3
4	CS1709	Edge Computing	PCC	3	3	0	0	3
5		Professional Electives - III	PEC	3	3	0	0	3
6		Professional Electives - IV	PEC	3	3	0	0	3
PRACTICAL								
7	CS1707	Cloud Computing Laboratory	PCC	4	0	0	4	2
8	CS1708	Project Work Phase - I	EEC	4	0	0	4	2
9	CS1716	Internship	EEC					1
Total				**26**	**18**	**0**	**8**	**22**

#Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

***Credit Course-Evaluation is Fully Internal**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective - V	PEC	3	3	0	0	3
2		Professional Elective - VI	PEC	3	3	0	0	3
PRACTICAL								
3	CS1807	Project Work Phase – II	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 180

HUMANITICS SCIENCE AND MANAGEMENT COURSES (HSMC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	HS1101	Communicative English	3	3	0	0	3
2	HS1201	Professional English	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	3	3	0	0	3
4	HS1310	Professional Skills Laboratory	2	0	0	2	1

BASIC SCIENCE COURSES (BSC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	MA1102	Engineering Mathematics - I	4	3	1	0	4
2	PH1103	Engineering Physics	3	3	0	0	3
3	CY1104	Engineering Chemistry	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	4	0	0	4	2
5	MA1202	Engineering Mathematics -II	4	3	1	0	4
6	PH1252	Physics for Information Science	3	3	0	0	3
7	MA1351	Probability and Statistics	4	3	1	0	4
8	MA1453	Discrete Mathematics	4	3	1	0	4
9	MA1501	Algebra and Number Theory	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	GE1105	Problem Solving and Python Programming	3	3	0	0	3
2	GE1106	Engineering Graphics	6	2	0	4	4
3	GE1107	Python Programming Laboratory	4	0	0	4	2
4	BE1251	Basic Electrical, Electronics and Measurement Engineering	3	3	0	0	3
5	GE1207	Engineering Practice Laboratory	4	0	0	4	2
6	CS1301	Digital Principles and Logic Design (Lab Integrated)	5	3	0	2	4
7	EC1601	Microprocessors and Microcontrollers	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1206	Programming in C	3	3	0	0	3
2	CS1208	Programming in C Laboratory	4	0	0	4	2
3	CS1302	Data Structures	3	3	0	0	3
4	CS1303	Object Oriented Programming	3	3	0	0	3
5	CS1304	Computer Architecture	3	3	0	0	3
6	CS1305	Software Engineering	3	3	0	0	3
7	CS1307	Data Structures Laboratory using C	4	0	0	4	2
8	CS1308	Object Oriented Programming Laboratory	4	0	0	4	2
9	CS1401	Design and Analysis of Algorithms	3	3	0	0	3
10	CS1402	Operating Systems	3	3	0	0	3
11	CS1403	Database Design and Management (Lab Integrated)	5	3	0	2	4
12	CS1404	Computer Networks	3	3	0	0	3
13	CS1407	Operating Systems Laboratory	4	0	0	4	2
14	CS1408	Networks Laboratory	4	0	0	4	2
15	CS1501	Internet Programming	3	3	0	0	3
16	CS1502	Object Oriented Analysis and Design	3	3	0	0	3
17	CS1503	Artificial Intelligence (Lab Integrated)	5	3	0	2	4
18	CS1507	Internet Programming Laboratory	4	0	0	4	2
19	CS1508	Object Oriented Analysis and Design Laboratory	4	0	0	4	2
20	CS1601	Compiler Design	3	3	0	0	3
21	CS1602	Mobile Computing	3	3	0	0	3
22	CS1603	Distributed Systems	3	3	0	0	3
23	CS1604	Data Science and Analytics	3	3	0	0	3
24	CS1607	Mobile Application Laboratory	4	0	0	4	2
25	CS1701	Graph Theory	3	3	0	0	3
26	CS1702	Cloud Computing	3	3	0	0	3
27	CS1703	Cryptography and Network Security	3	3	0	0	3
28	CS1709	Edge Computing	3	3	0	0	3
29	CS1707	Cloud Computing Laboratory	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSES (PEC)

PROFESSIONAL ELECTIVE - I

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1511	Computer Graphics	3	3	0	0	3
2	CS1512	Machine Learning Techniques	3	3	0	0	3
3	CS1513	Image Analysis and Computer Vision	3	3	0	0	3
4	CS1514	Multicore Architecture	3	3	0	0	3
5	CS1515	Fundamentals of Digital Image Processing	3	3	0	0	3

PROFESSIONAL ELECTIVE – II

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1611	Theory of Computation	3	3	0	0	3
2	CS1612	Software Testing	3	3	0	0	3
3	CS1613	Advanced Java Programming	3	3	0	0	3
4	CS1614	Introduction to Deep Learning	3	3	0	0	3
5	GE1003	Professional Ethics in Engineering	3	3	0	0	3

PROFESSIONAL ELECTIVE – III

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1711	Software Project Management	3	3	0	0	3
2	CS1712	Virtualization Techniques	3	3	0	0	3
3	CS1713	GPU Architecture and Programming	3	3	0	0	3
4	CS1714	Resource Management Techniques	3	3	0	0	3
5	MG1001	Principles of Management	3	3	0	0	3

PROFESSIONAL ELECTIVE - IV

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1721	Soft Computing	3	3	0	0	3
2	CS1722	Quantum Computing	3	3	0	0	3
3	CS1723	Software Architecture	3	3	0	0	3
4	CS1724	Multimedia and Graphics Packages	3	3	0	0	3
5	CS1725	Human Computer Interaction	3	3	0	0	3

PROFESSIONAL ELECTIVE - V

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1811	Natural Language Processing	3	3	0	0	3
2	CS1812	Microcontroller Based System Design	3	3	0	0	3
3	CS1813	Forensics and Cyber Law	3	3	0	0	3
4	CS1814	Data Warehousing and Data Mining	3	3	0	0	3
5	CS1815	Software Quality Assurance	3	3	0	0	3

PROFESSIONAL ELECTIVE - VI

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1821	Software Defined Networks	3	3	0	0	3
2	CS1822	iOS Application Development	3	3	0	0	3
3	CS1823	Network Simulation using ns3	3	3	0	0	3
4	CS1824	Blockchain Technologies	3	3	0	0	3
5	CS1825	Information Retrieval Techniques	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1608	Mini Project	4	0	0	4	2
2	CS1708	Project work – Phase I	4	0	0	4	2
3	CS1807	Project Work – Phase II	20	0	0	20	10
4		Value Added Course	Two Weeks				2
5	CS1716	Internship					1

Value Added Courses

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	VAC001	INDUSTRIAL INTERNET OF THINGS	3	1	0	2	2
2	VAC002	AUGMENTED REALITY & VIRTUAL REALITY	3	1	0	2	2
3	VAC003	ETHICAL HACKING - CYBER SECURITY	3	1	0	2	2
4	VAC004	BLOCKCHAIN AND CRYPTO CURRENCIES	3	1	0	2	2
5	VAC005	INDUSTRIAL PRACTICES WITH DEVOPS	3	1	0	2	2
6	VAC006	APPLIED MACHINE LEARNING WITH PYTHON	3	1	0	2	2

OPEN ELECTIVE COURSES – I & II

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OBT101	Industrial Biotechnology	3	3	0	0	3
2	OBT104	Bio Sensors	3	3	0	0	3
3	OBT105	Introduction to Nano Science and Nano Technology	3	3	0	0	3
4	OCE102	Introduction to Geographic Information System	3	3	0	0	3
5	OCH101	Hospital Management	3	3	0	0	3
6	OEC103	Basics of Embedded Systems and IoT	3	3	0	0	3
7	OEE101	Basic Circuit Theory	3	3	0	0	3
8	OEE103	Introduction to Renewable Energy Systems	3	3	0	0	3
9	OEI102	Robotics	3	3	0	0	3
10	OMB101	Total Quality Management	3	3	0	0	3
11	OME104	Industrial Safety Engineering	3	3	0	0	3

OPEN ELECTIVE COURSES OFFERED BY CSE

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OCS101	Introduction to C Programming	3	3	0	0	3
2	OCS102	Programming and Data Structures	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	3	3	0	0	3
4	OCS104	Fundamentals of Database Design	3	3	0	0	3
5	OCS105	Data Analytics with R Programming	3	3	0	0	3
6	OCS106	Data Communications and Networking	3	3	0	0	3
7	OCS107	Machine Learning for Intelligent Systems	3	3	0	0	3
8	OCS109	Fundamentals of Database Management systems	3	3	0	0	3

AUDIT COURSES (AC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	2	2	0	0	0
2	AD1002	Value Education	2	2	0	0	0
3	AD1003	Pedagogy Studies	2	2	0	0	0
4	AD1004	Stress Management by Yoga	2	2	0	0	0
5	AD1005	Personality Development Through Life EnlightenmentSkills	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	2	2	0	0	0
8	AD1008	Sanga Tamil LiteratureAppreciation	2	2	0	0	0

* Registration for any of these courses is optional to students

CREDIT SUMMARY

S. No.	SUBJECT AREA	I	II	III	IV	V	VI	VII	VIII	TOTAL CREDIT	PERCENTAGE
1	**HSMC**	3	6		1					**10**	**5.56**
2	**BSC**	12	7	4	4	4				**31**	**17.22**
3	**ESC**	9	5	4	3					**21**	**11.67**
4	**PCC**		5	16	17	14	14	14		**80**	**44.44**
5	**PEC**					3	3	6	6	**18**	**10.00**
6	**OEC**					3	3			**6**	**3.33**
7	**EEC**						3	2	10	**15**	**8.33**
TOTAL CREDIT		**24**	**23**	**24**	**25**	**24**	**22**	**22**	**16**	**180**	**100**

Board Chairman	Dr. A.Chandrasekar	
Dean Academics	Dr. G. Sreekumar	
Principal	Dr. Vaddi Seshagiri Rao	

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
(Common to all Branches of B.E. / B. Tech Programmes)		3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9
Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		CO1
UNIT II	**GENERAL READING AND FREE WRITING**	**9**
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.		CO2
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		CO3
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	**9**
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		CO4
UNIT V	**EXTENDED WRITING**	**9**
Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020 2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015. 3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.
REFERENCE BOOKS
1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011. 2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007 3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005 4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011 5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013 6. John Eastwood et al: Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	3
CO2	-	1	-	2	-	-	-	-	-	3	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	-	2	-	-	3	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	1	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	2	-	1

MA1102	ENGINEERING MATHEMATICS – I	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	3	1	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	**MATRICES**	**9+3**
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		**CO1**
UNIT II	**CALCULUS OF ONE VARIABLE**	**9+3**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		**CO2**
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**9+3**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		**CO3**
UNIT IV	**INTEGRAL CALCULUS**	**9+3**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		**CO4**
UNIT V	**MULTIPLE INTEGRALS**	**9+3**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		**CO5**

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	2	1	1
CO2	3	3	3	2	2	1	-	-	-	-	1	2	2	2	1
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	1	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	2	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	1	2

PH1103	ENGINEERING PHYSICS	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity
- Principles of laser and fiber optics and its various technological applications
- Thermal conduction in solids, heat exchangers and its applications in various devices
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques

UNIT I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity- I-shaped girders - stress due to bending in beams.		**CO1**
UNIT II	**LASER AND FIBER OPTICS**	**9**
Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system.		**CO2**
UNIT III	**THERMAL PHYSICS**	**9**
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		**CO3**
UNIT IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		**CO4**
UNIT V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2013.

REFERENCE BOOKS	
1.	Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2.	Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3.	Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young’s modulus by various methods.
CO2	Principle of laser, Einstein’s coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.
CO3	The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee’s disc method and radial flow of heat.
CO4	The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunneling electron microscopy and its applications.
CO5	The importance of various crystal structures, Miller indices and various growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

To make the student conversant with the

- Principles of water characterization and treatment for industrial purposes
- Principles and applications of surface chemistry and catalysis
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non–conventional energy sources and energy storage device

UNIT I	**WATER AND ITS TREATMENT**	**9**
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by Reverse Osmosis.		**CO1**
UNIT II	**SURFACE CHEMISTRY AND CATALYSIS**	**9**
Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **Catalysis**: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.		**CO2**
UNIT III	**PHASE RULE AND ALLOYS**	**9**
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **Alloys**: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		**CO3**
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **Combustion of fuels**: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		**CO4**
UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015). 2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020). 3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018). 4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).
REFERENCE BOOKS
1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001). 2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008). 3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015). 4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015). 5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media., New Delhi., (2010). 6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	**ALGORITHMIC PROBLEM SOLVING**	**9**
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**
UNIT II	**INTRODUCTION TO PYTHON**	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		**CO2**
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		**CO4**
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/) 2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011. 3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS
1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013 2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016. 3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015. 4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012. 5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013. 6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	2	0	4	4

OBJECTIVES

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To inculcate drawing practice in standardized form whenever technical drawing is needed.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloidal curves – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes when the solid is simply suspended by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of simple solids like prisms, pyramids, cylinder, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections and isometric views of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2017
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
3. S. Ramachandran and K. Pandian, "Engineering Graphics" Airwalk Publications; 8th edition 2014.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	-	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	-	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	-	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	-	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	-	1	1

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

Experiment	CO
1. Write an algorithm and draw flowchart illustrating mail merge concept.	CO1
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	CO1
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	CO1
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	CO1
5. Program to explore string functions and recursive functions.	CO2
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	CO2
7. Demonstrate the use of Dictionaries and tuples with sample programs.	CO2
8. Implement Searching Operations: Linear and Binary Search.	CO2
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	CO2
10. Find the most frequent words in a text of file using command line arguments.	CO3
11. Demonstrate Exceptions in Python.	CO3
12. Applications**:** Implementing GUI using turtle, pygame.	CO3

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES
1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	CO1
2. Determination of Young's modulus of the material of the given beam by uniform bending method.	
3. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	
4. Determination of wavelength of mercury spectra using Spectrometer and grating.	CO2
5. Determination of dispersive power of prism using Spectrometer.	
6. (a) Determination of wavelength and particle size using a laser. (b) Determination of Numerical and acceptance angle of an optical fibre.	
7. Determination of energy band gap of the semiconductor.	
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method	CO1

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Determination of chloride content of water sample by argentometric method.	CO3
2. Estimation of copper content of the given solution by Iodometry.	
3. Determination of strength of given hydrochloric acid using pH meter.	
4. Determination of strength of acids in a mixture of acids using conductivity meter.	CO4
5. Estimation of iron content of the given solution using potentiometer.	
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	
7. Conductometric titration of strong acid vs strong base.	
8. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	CO5
9. Determination of total, temporary & permanent hardness of water by EDTA method.	
10. Determination of DO content of water sample by Winkler's method.	

DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).	**CO3**
2. Estimation of sodium and potassium present in water using flame photometer.	**CO5**
	TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2013.
4. P.C.Jain, Monica Jain, “Engineering Chemistry” 17^{th} Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
5. S.S. Dara, S.S. Umare, “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2020).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
(Common to all branches of B.E. / B. Tech Programmes)		3	0	0	3

OBJECTIVES

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		**CO1**
UNIT II	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		**CO2**
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		**CO3**
UNIT IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		**CO4**
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	-	-	3
CO2	-	1	-	2	-	-	-	-	-	3	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	1	2	-	-	3	-	1
CO4	-	-	-	-	1	-	-	-	2	2	-	-	1	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	2	-	1

MA1202	ENGINEERING MATHEMATICS - II	L	T	P	C
(Common to all branches of B.E. / B. Tech Programmes - Except AI-DS & AI-ML)		3	1	0	4

OBJECTIVES

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I	ORDINARY DIFFERENTIAL EQUATIONS	9+3
Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients		**CO1**
UNIT II	**VECTOR CALCULUS**	**9+3**
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and application in evaluating line, surface and volume integrals		**CO2**
UNIT III	**COMPLEX VARIABLES**	**9+3**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = Z + C, CZ, 1/Z$ - Bilinear transformation		**CO3**
UNIT IV	**COMPLEX INTEGRATION**	**9+3**
Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi circular contour(excluding poles on the real line)		**CO4**
UNIT V	**LAPLACE TRANSFORMS**	**9+3**
Existence conditions – Transforms of elementary functions –Basic properties – Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals –– Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCE BOOKS

1. G Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., ― Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, ―Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., ―Advanced Engineering Mathematics ―Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply various techniques in solving differential equations
CO2	Gradient, divergence and curl of a vector point function and related identities
CO3	Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification
CO4	Analytic functions, conformal mapping and complex integration
CO5	Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	-	-	1	1	3	3	3	3
CO2	3	3	2	3	2	2	1	-	-	-	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	3	3

PH1252	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
	(Common to CSE, IT, AI-DS & AI-ML)	3	0	0	3

OBJECTIVES

- To understand the essential principles of physics of semiconductor device and Electron transport properties.
- To have the necessary understanding in optical properties of materials.
- Grasp the principles of magnetic materials and its applications.
- To understand the basics of Nano-electronic devices.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three-dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids - Electron effective mass – concept of hole- Applications of low resistive and high resistive materials.		**CO1**
UNIT II	**SEMICONDUCTOR PHYSICS**	**9**
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor– Hall effect and devices – Ohmic contacts – Schottky diode-Semiconducting polymers.		**CO2**
UNIT III	**MAGNETIC PROPERTIES OF MATERIALS**	**9**
Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism –Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic hard disc – Spintronics - GMR Sensor (Giant Magnetoresistance) – TMR (Tunnel Magnetoresistance)		**CO3**
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – p-i-n Photodiodes - Avalanche Photodiodes -Optical data storage techniques- Holography – applications.		**CO4**
UNIT V	**NANO DEVICES**	**9**
Electron density in bulk material – Size dependence of Fermi energy – Quantum confinement – Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials – Tunneling: single electron phenomena and single electron transistor – Quantum dot laser - Ballistic transport – Carbon nanotubes: Properties and applications - Material Processing by chemical vapour deposition and Laser Ablation method – Graphene: Properties and applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jasprit Singh, —Semiconductor Devices: Basic Principles, Wiley 2012.
2. Donald Neaman, Dhrubes Biswas , Semiconductor Physics and Devices (SIE), 4th Edition, 2017
3. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., “Physics for Electronics Engineering and Information Science”, McGraw Hill Education (India) Private Limited, 2018.
4. Kasap, S.O. —Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
5. Kittel, C. —Introduction to Solid State Physics‖. Wiley, 2005.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. —Fundamentals of Nanoelectronics. Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. —Nanotechnology: Understanding

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on classical and quantum electron theories, and energy band structures.
CO2	Acquire knowledge on basics of semiconductor physics and its applications in various Devices.
CO3	Get knowledge on magnetic properties of materials and their applications in data storage.
CO4	Have the necessary understanding on the functioning of optical materials for Optoelectronics.
CO5	Understand the basics of quantum structures and their applications in carbon electronics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	2	2	3
CO3	3	3	1	1	2	2	1	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
(Common to all branches of B.E. / B. Tech Programmes)		3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity.		**CO1**
UNIT II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		**CO2**
UNIT III	**NATURAL RESOURCES**	**9**
Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		**CO3**

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		CO4
UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	9
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

BE1251	BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To learn the fundamental laws, network theorems and analyse the electric circuits.
- To study the basic principles of electrical machines and their performance.
- To study the fundamentals of power systems.
- To learn the characteristics of various electron devices and Op Amp integrated circuit.
- To understand the principle and operation of measuring instruments and transducers.

UNIT I	ELECTRIC CIRCUITS ANALYSIS	9
Ohms Law, Kirchhoff's Law-Instantaneous power - Series and parallel circuit: analysis of resistive, capacitive and inductive network, star delta conversion, Nodal analysis and mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, superposition theorem and maximum power transfer theorem. Three phase ac supply –Instantaneous power, Reactive power and apparent power.		**CO1**
UNIT II	**ELECTRICAL MACHINES**	**9**
DC and AC ROTATING MACHINES: Types, Construction, principle, EMF and torque equation, application, Speed Control. Basics of Stepper Motor and Brushless DC motors. Transformers-Introduction, types and construction, working principle of Ideal transformer, EMF equation, All day efficiency calculation.		**CO2**
UNIT III	**FUNDAMENTALS OF POWER SYSTEM**	**9**
Structure of power system. Sources of electrical energy – Non-renewable, Renewable- Storage systems: Batteries-Ni-Cd, Pb -Acid and Li-ion, SOC (State of Charge), DOD (Depth of Discharge)Characteristics. Utilization of electrical power - DC and AC load applications. - Electric circuit Protection-need for earthing, fuses and circuit breakers.		**CO3**
UNIT IV	**ELECTRON DEVICES AND INTEGRATED CIRCUITS**	**9**
PN Junction-VI Characteristics of Diode, Zener diode, Rectifiers, Zener voltage regulator. Transistor configurations – CE amplifier - RC and LC oscillators. Op Amps – Basic characteristics and its applications.		**CO4**
UNIT V	**MEASURING INSTRUMENTS AND TRANSDUCERS**	**9**
Characteristic of measurement-errors in measurement – Principle and working of indicting instrument- Moving Coil meter, Moving Iron meter, Energy meter and watt meter, Cathode Ray Oscilloscope –- Transducers, thermo-electric, RTD, Strain gauge, LVDT, LDR, and piezoelectric transducer.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, fourth Edition, 2019
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCE BOOKS

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. S.Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, sixth edition,2017.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to learn the fundamental laws, theorems of electrical circuits and to analyze them
CO2	Ability to understand the basic construction and operating principle of dc and ac machines.
CO3	Ability to understand the electrical power generation, energy storage and utilization of electric power.
CO4	Ability to understand the characteristics of various electronic devices and Op Amp integrated circuit.
CO5	Ability to understand the principles and operation of measuring instruments and transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO2	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO3	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO4	3	3	3	3	1	1	1	3	3	3	1	3	3	1	3
CO5	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2

<table>
<tr><td>CS1206</td><td colspan="2">PROGRAMMING IN C</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3">(Common to CSE, IT, AI-DS & AI-ML)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ To develop C Programs using basic programming constructs
❖ To develop C programs using arrays, strings and functions
❖ To develop applications in C using pointers
❖ To develop applications in C using structures and union
❖ To develop applications using sequential and random-access file processing.</td></tr>
<tr><td>UNIT I</td><td colspan="5">BASICS OF C PROGRAMMING</td><td>9</td></tr>
<tr><td colspan="5">An overview of C: History of C; Compiler Vs. Interpreter, Structure of a C Program, Compiling a C Program; Basic data types: Modifiers, Variables: Type qualifiers, Storage class specifiers; Constants: Enumeration Constants; Keywords; Operators: Precedence and Associativity; Expressions: Order of evaluation, Type conversion in expression, Casts; Input/Output statements; Assignment statements, Selection statements; Iteration statements; Jump statements; Expression statements; Pre-processor directives: Compilation process.</td><td colspan="2">CO1</td></tr>
<tr><td>UNIT II</td><td colspan="5">ARRAYS, STRINGS AND FUNCTIONS</td><td>9</td></tr>
<tr><td colspan="5">Introduction to Arrays: Declaration, Initialization, Single dimensional array, Two dimensional array, Array manipulations; String operations: length, compare, concatenate, copy; Functions: General form of a function, Function Arguments, Built-in functions, return statement, Recursion</td><td colspan="2">CO2</td></tr>
<tr><td>UNIT III</td><td colspan="5">POINTERS</td><td>9</td></tr>
<tr><td colspan="5">Pointers: Declaring and defining pointers, Pointer operators, Pointer expression; Pointer assignment, Pointer conversions, Pointer arithmetic, Pointer comparisons; Pointers and Arrays: Array of pointers; Multiple indirection; Pointers to function; Problems with pointers; Parameter passing: Pass by value, Pass by reference.</td><td colspan="2">CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="5">STRUCTURES AND UNIONS</td><td>9</td></tr>
<tr><td colspan="5">Structure: Accessing structure members, structure assignments; Nested structures; Pointer and Structures; Array of structures; Passing structures to functions: Passing structure member to function, Passing entire structure to functions; Arrays in structures; Self-referential structures; Dynamic memory allocation; typedef statement, Union and Enumeration.</td><td colspan="2">CO4</td></tr>
<tr><td>UNIT V</td><td colspan="5">FILE PROCESSING</td><td>9</td></tr>
<tr><td colspan="5">File system basics: File pointer, opening and closing a File; reading and writing character; working with String: fputs() and fgets(); rewind(); ferror(); fread() and fwrite(); Erasing files; Types of file processing: Sequential access; Random access: fprintf() and fscanf(), fseek() and ftell(); Command line arguments.</td><td colspan="2">CO5</td></tr>
<tr><td colspan="7" align="right">TOTAL : 45 PERIODS</td></tr>
<tr><td colspan="7">TEXT BOOKS</td></tr>
<tr><td colspan="7">1. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, -The C Programming language‖, Second Edition, Pearson Education, 2006.</td></tr>
</table>

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, -C How to Program, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, -Programming in C, CENGAGE Learning India pvt. Ltd., 2011.
3. Pradip Dey, Manas Ghosh, -Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, -Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C using structures and union.
CO5	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
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CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

GE 1207	ENGINEERING PRACTICES LABORATORY	L	P	T	C
(Common to all branches of B.E. / B. Tech Programmes)		0	0	4	2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13** — **CO1**

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **18** — **CO2**

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning
b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending.
b) Model making – Trays and funnels.
c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump
b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
b) Foundry operations like mould preparation for gear and step cone pulley.
c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III **ELECTRICAL ENGINEERING PRACTICE** **13** 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.		**CO3**
5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.		**CO4**
IV **ELECTRONICS ENGINEERING PRACTICE** **16** 1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.		**CO5**
		TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 sets
2.	Carpentry vice (fitted to work bench)	15 Nos
3.	Standard woodworking tools 15 Sets.	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	5 Nos
2.	Welding booth with exhaust facility.	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre lathe.	2 Nos
6.	Hearth furnace, anvil and smithy tools.	2 Sets
7.	Moulding table, foundry tools.	2 Sets
8.	Power Tool: Angle Grinder.	2 Nos
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	1 each

ELECTRICAL		
1.	Assorted electrical components for house wiring.	15 Sets
2.	Electrical measuring instruments.	10 Sets
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	1 each
4.	Megger (250V/500V).	1 No.
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	2 Nos
ELECTRONICS		
1.	Soldering guns 10 Nos.	10 Nos.
2.	Assorted electronic components for making circuits 50 Nos.	50 Nos.
3.	Small PCBs.	10 Nos.
4.	Multimeters	10 Nos.
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	1 each

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO2	3	2	3	-	-	3	-	-	-	-	-	3	3	3	3
CO3	3	1	2	-	-	2	-	-	-	-	-	3	3	3	3
CO4	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO5	3	2	2	-	-	2	-	-	-	-	-	3	2	2	2

CS1208	PROGRAMMING IN C LABORATORY	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS

Experiment	CO
1. C programming using simple statements and expressions.	CO1
2. Scientific problem-solving using decision making and looping.	
3. Generating different patterns using multiple control statements.	
4. Problems solving using one dimensional array.	
5. Mathematical problem solving using two dimensional arrays.	
6. Solving problems using string functions.	CO2
7. Solving problems with user defined functions.	
8. Solving problems using recursive function.	
9. Solving problems with dynamic memory allocation.	
10. Realtime application using structures and unions.	
11. Realtime problem solving using sequential and random-access file.	CO3
12. Solving problems with command line argument.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by Jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
6. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving string, functions, recursion, pointers, and structures.
CO3	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

MA1351	PROBABILITY AND STATISTICS	L	T	P	C
	Common to CSE, IT & AI-DS	3	1	0	4

OBJECTIVES

- To understand the basic concepts of probability, one- and two-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in engineering applications.
- To acquaint the knowledge of testing of hypothesis for small and large samples, which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I	**PROBABILITY AND RANDOM VARIABLES**	**9+3**
Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		**CO1**
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**9+3**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables).		**CO2**
UNIT III	**RANDOM PROCESSES**	**9+3**
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		**CO3**
UNIT IV	**TESTING OF HYPOTHESIS**	**9+3**
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit.		**CO4**
UNIT V	**DESIGN OF EXPERIMENTS**	**9+3**
One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Ibe, O.C., —Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Indian Reprint, 2014.

REFERENCE BOOKS

1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2017.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4th Edition,Elsevier, 2009.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Get ideas to handle situations involving more than one random variable.
CO3	Gain an understanding and characterizes phenomena which evolve with respect to time in a probabilistic manner and modelling the real-life phenomena.
CO4	Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO5	Do design of experiments, carry them out, and analyze the data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	3	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	3	2	3	3	2	1	-	-	-	2	2	3	2	1
CO5	3	3	2	3	2	2	1	-	-	-	1	2	2	1	1

<table>
<tr><td>CS1301</td><td colspan="2">DIGITAL PRINCIPLES AND LOGIC DESIGN (Lab Integrated)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3">Common to CSE & IT</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ To learn Boolean algebra and simplification of Boolean functions.
❖ To learn to design and analyze different combinational circuits.
❖ To study the basics of synchronous sequential logic, analyze and design sequential circuits.
❖ To learn about basic memory devices and programmable logic devices to build simple digital systems.
❖ To learn to write code in Hardware Definition Language for designing larger digital systems</td></tr>
<tr><td>UNIT I</td><td colspan="5">BOOLEAN ALGEBRA AND LOGIC GATES</td><td>9+6</td></tr>
<tr><td colspan="6">Number Systems: Digital and Binary – Number-Base Conversions – Octal and Hexadecimal Numbers – Complements of Numbers – Signed Binary Numbers - Arithmetic Operations – Binary Codes – Binary Logic - Boolean Algebra – Axiomatic Definition of Boolean algebra - Theorems and Postulates – Boolean Functions – Canonical and Standard Forms – Simplification of Boolean Functions – Digital Logic Gates – Implementation of Universal gates
Lab component:
• Verification of Boolean Theorems using basic gates</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="5">COMBINATIONAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="6">Combinational Circuits – Analysis and Design Procedures - Binary Adders – Subtractor – Multiplier - Decimal Adder - Parity Generator and Checker – Four-bit Binary Parallel Adder - Magnitude Comparator – Decoders – Encoders –Multiplexers – Demultiplexers - Introduction to HDL – HDL Models of Combinational circuits
Lab component:
• Design and implement Half/Full Adder and Subtractor.
• Design and Implementation of Decoders, Encoders, Multiplexers and Demultiplexers</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="5">SYNCHRONOUS SEQUENTIAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="6">Sequential Circuits – Storage Elements: Latches, Flip-Flops – Interconversion of Flip-Flops - Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure – Registers and Counters – HDL Models of Sequential Circuits
Lab component:
• Design and implement shift-registers.
• Design and implement synchronous counters</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="5">ASYNCHRONOUS SEQUENTIAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="6">Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards
Lab component:
• Design and Implementation of Asynchronous Sequential Circuit
• Design and implement of Serial Parity Generator.</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td colspan="5">SYSTEM DESIGN</td><td>9+6</td></tr>
<tr><td colspan="6">RAM – Memory Decoding – Error Detection and Correction – ROM – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Design of Digital System using PLA and PAL
Lab component:
• Coding Combinational circuits using HDL
• Coding Sequential circuits using HDL</td><td>CO5</td></tr>
<tr><td colspan="7" align="right">TOTAL : 75 PERIODS</td></tr>
</table>

TEXT BOOKS

1. M. Morris Mano, Michael D. Ciletti, “Digital Design”, Fifth Edition, Pearson Education, 2013.
2. A. Saha and N. Manna, “Digital Principles and Logic Design”, Infinity Science Press LLC, 2007
3. David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware/Software Interface”, Fifth Edition, Morgan Kaufmann/Elsevier, 2013.

REFERENCE BOOKS

1. Charles H. Roth Jr., “Fundamentals of Logic Design”, Fifth Edition, Jaico Publishing House, 2003.
2. John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007.
3. Donald D. Givone, “Digital Principles and Design”, Tata McGraw Hill, 2003.
4. G. K. Kharate, “Digital Electronics”, Oxford University Press, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Simplify Boolean functions using KMAP
CO2	Design and Analysis of Combinational Logic Circuits
CO3	Design and Analysis of Synchronous Sequential Logic Circuits
CO4	Design and Analysis of Asynchronous Sequential Logic Circuits
CO5	Implement designs using Programmable Logic Devices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO2	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO3	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO4	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO5	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML, ECE Semester IV	3	0	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I	**LINEAR DATA STRUCTURES – LIST**	**9**
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		**CO1**
UNIT II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	**9**
Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.		**CO2**
UNIT III	**NON-LINEAR DATA STRUCTURES – TREES**	**9**
Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.		**CO3**
UNIT IV	**NON-LINEAR DATA STRUCTURES – GRAPHS**	**9**
Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3

CS1303	OBJECT ORIENTED PROGRAMMING	L	T	P	C
	Common to CSE & IT	3	0	0	3

OBJECTIVES

- Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- Design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I	JAVA FUNDAMENTALS	9
Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and StringBuffer		CO1
UNIT II	**OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE**	**9**
Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes.		CO2
UNIT III	**EXCEPTIONS, COLLECTIONS AND STREAMS**	**9**
Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.		CO3
UNIT IV	**CONCURRENT PROGRAMMING AND GUI PROGRAMMING**	**9**
Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag.		CO4
UNIT V	**JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING**	**9**
Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
3. Paul Deitel, Harvey M. Deitel, “Java How to Program”, 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , “Introduction to Java programming”, 7th Edition, Pearson education, 2010.

3. C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	understand the fundamental ideas behind the object-oriented approach to programming
CO2	To inculcate concepts of inheritance to create new classes from existing one & design the classes needed given a problem specification
CO3	Able to create the good application with proper Exception Handling Mechanisms.
CO4	A modern coverage of concurrent programming that focuses on high-level synchronization constructs and the concept of event handling used in GUI.
CO5	An in-depth exposure to the object-oriented programming paradigm, which builds upon programming experience gained in computer science classes.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	-	-	2	1	1	1	2	2	1
CO2	1	1	2	1	1	1	2	1	2	1	1	1	2	2	2
CO3	1	1	1	1	1	-	-	1	2	2	2	1	1	2	2
CO4	1	1	2	-	1	-	1	-	1	1	2	1	3	1	3
CO5	2	2	2	2	2	-	1	1	2	1	2	2	1	2	2

CS1304	COMPUTER ARCHITECTURE	L	P	T	C
Common to CSE, IT & EEE (Elective)		3	0	0	3

OBJECTIVES

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating-point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies and the ways of communication with I/O devices.

UNIT I	BASIC STRUCTURE OF A COMPUTER SYSTEM	9
Eight ideas-Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.		**CO1**
UNIT II	**DATA REPRESENTATION AND ARITHMETIC FOR COMPUTERS**	**9**
Signed number representation, Addition and Subtraction – Multiplication – Division – Fixed- and Floating-Point Representation – Floating Point Operations.		**CO2**
UNIT III	**DATA PATH AND CONTROL UNIT**	**9**
A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.		**CO3**
UNIT IV	**PARALLELISM**	**9**
Parallel Processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.		**CO4**
UNIT V	**MEMORY AND PERIPHERAL DEVICES**	**9**
Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. M. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky and NaraigManjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012

REFERENCE BOOKS

1. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Tenth Edition, Pearson Education, 2016.
2. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
3. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
4. Jim Ledin, “Modern Computer architecture and Organization”, Packt Publishing,2020.
5. Douglas Comer, “Essentials of Computer Architecture”,Taylor and Francis Group 2020

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics structure of computers, operations and instructions.
CO2	Design arithmetic and logic unit.
CO3	Understand pipelined execution and design control unit.
CO4	Understand parallel processing architectures.
CO5	Understand the various memory systems and I/O communication

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO2	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO3	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO4	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO5	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2

CS1305	SOFTWARE ENGINEERING	L	T	P	C
	Common to CSE & IT	3	0	0	3

OBJECTIVES

- To understand the phases in a software project.
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies.
- To learn various testing, SQA and maintenance measures.

UNIT I	**SOFTWARE PROCESS AND AGILE DEVELOPMENT**	**9**
Introduction: The Evolving Role of Software, Software Characteristics, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile Process-Extreme programming-XP Process.		**CO1**
UNIT II	**REQUIREMENTS ANALYSIS AND SPECIFICATION**	**9**
Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirement’s elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.		**CO2**
UNIT III	**SOFTWARE DESIGN**	**9**
Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.		**CO3**
UNIT IV	**TESTING AND MAINTENANCE**	**9**
Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging –Software Implementation Techniques: Coding Practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.		**CO4**
UNIT V	**PROJECT MANAGEMENT AND SQA**	**9**
Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan, SQA-Concepts, Cost of Quality, Software Quality Group (SQA)		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Roger S. Pressman, ―Software Engineering – A Practitioner's Approach‖, Seventh Edition, McGraw-Hill International Edition, 2010.
2. Ian Sommerville, ―Software Engineering‖, 9th Edition, Pearson Education Asia, 2011..

REFERENCE BOOKS

1. Rajib Mall, ―Fundamentals of Software Engineering Third Edition, PHI Learning PrivateLimited, 2009.
2. Pankaj Jalote, ―Software Engineering, A Precise Approach‖, Wiley India, 2010.
3. Kelkar S.A., ―Software Engineering‖, Prentice Hall of India Pvt Ltd, 2007.
4. Fairley R., ―Software Engineering Concepts‖, Tata McGraw Hill, New Delhi, 2008.
5. Harry Hariom Choudhary , ―Java Coding Standards‖, Amazon Kindle, USA, 2013. 3. Bernard Homes., ―Fundamentals of Software Testing‖, Wiley & Sons, USA, 2012.
6. Stephen R.Schach, ―Software Engineering‖, Tata McGraw-Hill Publishing Company Limited,2007.
7. http://nptel.ac.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the key activities in managing a software project and process models.
CO2	Concepts of requirements engineering and Analysis Modeling.
CO3	Apply systematic procedure for software design and deployment.
CO4	Compare and contrast the various testing and maintenance.
CO5	Manage project schedule, SQA, estimate project cost and effort required.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	3	2	3	3	3	3	3	2	2
CO2	3	3	3	3	2	2	3	2	3	3	3	3	2	3	3
CO3	2	3	3	3	3	2	3	2	3	3	3	3	2	3	3
CO4	3	2	3	3	3	2	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	3	2	3	3	3	3	3	2	2

<table>
<tr><td>CS1307</td><td>DATA STRUCTURES LABORATORY USING C</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">Common to CSE, IT & ECE Semester IV</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td colspan="6">OBJECTIVES
❖ To introduce the concepts of primitive data structures.
❖ To understand the process in linear and non-linear data structures.
❖ To introduce the concepts of sorting, searching and hashing.</td></tr>
<tr><td colspan="6">LIST OF EXPERIMENTS</td></tr>
<tr><td colspan="5">1. IMPLIMENTATION OF LIST
Write C programs to
a) Array implementation of Stack ADTs.
b) Array implementation of Queue ADTs.</td><td rowspan="3">CO1</td></tr>
<tr><td colspan="5">2. LIST ADT
Array implementation of List ADT.</td></tr>
<tr><td colspan="5">3. IMPLEMENTATION OF STACK AND QUEUE
Write C programs to
a) Design and implement Single Linked List.
b) Design and implement Stack and its operations using List.
c) Design and implement Queue and its operations using List.</td></tr>
<tr><td colspan="5">4. APPLICATIONS OF LINEAR DATA STRUCTURE
Write C programs for the following:
a) Design and implement polynomial ADT using list
b) Uses Stack operations to convert infix expression into postfix expression.
c) Uses Stack operations for evaluating the postfix expression.</td><td rowspan="3">CO2</td></tr>
<tr><td colspan="5">5. APPLICATIONS OF TREE
a) Write a C program to Design and implement binary tree.
b) Traverse the above binary tree recursively in pre-order, post-order & in-order.</td></tr>
<tr><td colspan="5">6. IMPLEMENTATION OF TREE
Write a C program to Design and implement binary search tree.</td></tr>
<tr><td colspan="5">7. IMPLEMENTATION OF ADVANCED TREE
a) Design and Implement AVL tree using Templates.
b) Design and Implement heap tree using Templates.</td><td rowspan="4">CO3</td></tr>
<tr><td colspan="5">8. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS
Write C programs for the following:
a) Design and Implement Dijkstra‘s algorithm
b) Design and Implement Floyd Warshall algorithm.</td></tr>
<tr><td colspan="5">9. IMPLEMENTATION OF MINIMUM SPANNING TREE
Write C programs for the following:
a) Design and Implement Kruskal’s algorithm.
b) Design and Implement Prim’s algorithm.</td></tr>
<tr><td colspan="5">10. GRAPH TRAVERSAL & APPLICATIONS
Write C programs to implement the following algorithms:
a) Depth first search.
b) Breadth first search.
c) Toplogical Sorting.</td></tr>
<tr><td colspan="5">11. SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION</td><td>CO3</td></tr>
</table>

a) Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
   i. Insertion sort
   ii. Selection sort
   iii. Quick sort
   iv. Merge sort

b) Write C programs for implement linear search and binary search.

c) Write C programs for implement Hashing – any two collision techniques

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Mark Allen Weiss, ―Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, ―Data Structures Using C‖, Second Edition , Oxford University Press, 2011.

WEB REFERENCES

1. https://www.mygreatlearning.com/blog/data-structures-using-c/
2. https://www.faceprep.in/data-structures/data-structures-programs/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Write functions to implement linear and non-linear data structure operations
CO2	Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval and the concepts of sorting, searching and hashing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

CS1308	OBJECT ORIENTED PROGRAMMING LABORATORY	L	P	T	C
	Common to CSE & IT	0	0	4	2

OBJECTIVES

- ❖ Implement Object Oriented programming concept using basic syntaxes of control Structures, strings and function for developing skills of logic building activity.
- ❖ Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem
- ❖ Identify and describe common abstract user interface components to design GUI in Java using Swing.
- ❖ Understanding the Network Programming in Java.

LIST OF EXPERIMENTS

1. Write a Java program that prints all real solutions to the quadratic equation ax^2 +bx + c = 0. Read in a, b, c and use the quadratic formula. If the discriminate b^2 -4ac is negative, display a message stating that there are no real solutions.	**CO1**
2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence	
3. Write a Java program that counts the number of objects created by using static variable	
4. Write a Java program to create a student class with following fields a) Hall ticket number b) Student Name c) Department Create ‘n’ number of Student objects where ‘n’ value is passed as input to constructor	
5. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number Of Sides ( ) that shows the number of sides in the given geometrical figures	
6. Write a JAVA program which has a) A Interface class for Stack Operations b) A Class that implements the Stack Interface and creates a fixed length Stack. c) A Class that implements the Stack Interface and creates a Dynamic length Stack. d) A Class that uses both the above Stacks through Interface reference and does the Stack operations that demonstrates the runtime binding.	**CO2**
7. Complete the following: a) Create a package named shape. b) Create some classes in the package representing some common shapes like Square, Triangle, and Circle. c) Import and compile these classes in other program.	
8. Write a program in Java for String handling which performs the following: a) Checks the capacity of StringBuffer objects. b) Reverses the contents of a string given on console and converts the resultant string in upper case. c) Reads a string from console and appends it to the resultant string of ii.	
9. Write a Java program to make frequency count of words in a given text	

10. Write a Java program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).	
11. Write a Java program to read copy content of one file to other by handling all file related exceptions	
12. Write a Java program that creates three threads. First thread displays "Good Morning" everyone second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.	
13. Write a java Program to create a window when we press a) M or m the window displays Good Morning b) A or a the window displays Good After Noon c) E or e the window displays Good Evening d) N or n the window displays Good Night	**CO3**
14. Create a GUI program in java with the following components. a) A frame with Flow layout. b) Add the following components on to the frame. i. Two Text Field ii. A button with the label display c) Allow the user to enter data into the JTextField d) When the button is clicked paint the frame by displaying the data entered in the JTextField e) Allow the user to properly close the frame	
15. Develop a program for executing the remote command using TCP Socket	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Herbert schildt , The complete reference, 11th edition, Tata Mc Graw Hill, New Delhi. 2018.

WEB REFERENCES

1. https://www.startertutorials.com/corejava/resources
2. https://docs.oracle.com/javase/tutorial/
3. https://wiki.c2.com/?JavaLinks

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved
CO2	To be able to make an understanding to developing Strings and exception handling, Multithreading and File Handling
CO3	Identify, Design & develop Network Programming with Sockets and Graphical user interfaces using principal Java Swing classes based on MVC architecture.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)	PROGRAM SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	2	-	-	2	2	2	-	2	2	3	2
CO2	3	3	3	2	2	-	-	2	2	2	1	2	3	3	2
CO3	3	3	3	2	2	-	-	2	2	2	1	2	2	3	2

MA1453	DISCRETE MATHEMATICS	L	T	P	C
	Common to CSE, IT & AI-DS	3	1	0	4

OBJECTIVES

- To introduce Mathematical Logic, Inference Theory and proof methods.
- To provide fundamental principles on combinatorial counting techniques.
- To introduce graph models, their representation, connectivity and traverse ability.
- To explain the fundamental algebraic structures, groups and their algebraic properties.
- To introduce partial ordering and some functions on a set.

UNIT I	**LOGIC AND PROOFS**	**9+3**
Propositional Logic – Propositional Equivalences – Normal Forms - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.		**CO1**
UNIT II	**COMBINATORICS**	**9+3**
Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations -Generating Functions - Solving Linear Recurrence Relations Using Generating Functions– Inclusion – Exclusion – Principle and Its Applications.		**CO2**
UNIT III	**SETS AND FUNCTIONS**	**9+3**
Set -Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.		**CO3**
UNIT IV	**GRAPHS**	**9+3**
Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.		**CO4**
UNIT V	**ALGEBRAIC STRUCTURES**	**9+3**
Groups – Subgroups – Homomorphisms – Isomorphism - Normal Subgroup and Coset – Lagrange’s Theorem.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2012.
2. Tremblay J.P. and Manohar R, “Discrete Mathematical Structures with Applications to Computer Science”, Tata McGraw Hill Pub. Co. Ltd, Thirtieth Reprint, New Delhi, 2011.

REFERENCE BOOKS

1. Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education, Fifth Edition, New Delhi, 2014
2. Seymour Lipschutz and Mark Lipson,” Discrete Mathematics”, Schaum‘s Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
3. Thomas Koshy,” Discrete Mathematics with Applications”, Elsevier Publications, Boston, 2004.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Construct proofs by using direct proof, proof by contraposition, proof by contradiction. Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositions. Logic helps in arriving inferences for any problem.
CO2	Solve problems on permutation and combination. Prove mathematical theorems using mathematical induction. Demonstrate basic counting principles, compute and interpret the meaning in the context of the particular application which helps to apply the combinatorial techniques in Algorithms and Data structure for analysis and design.
CO3	Understand relations on a set and functions on a set
CO4	Apply the concepts of graph theory in data structures, data mining, image segmentation and in clustering.
CO5	Familiar with algebraic systems, groups, sub groups, Lagrange's theorem and normal subgroups. In Coding algorithms and in theoretical computer science algebraic structures are applied.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO2	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO3	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO4	3	3	2	2	1	1	-	-	-	-	1	2	2	2	1
CO5	3	3	2	2	1	1	-	-	-	-	1	2	2	1	1

CS1401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To learn the general framework for analyzing algorithm efficiency
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

UNIT I	**INTRODUCTION**	**9**
Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – The Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Nonrecursive and Recursive Algorithms – Empirical Analysis of Algorithms.		**CO1**
UNIT II	**DECREASE AND CONQUER AND DIVIDE-AND-CONQUER**	**9**
Decrease-and-Conquer– Insertion Sort – Binary Search – Computing a Median and the Selection Problem – Divide-and-Conquer – Merge Sort – Quicksort – The Closest –Pair and Convex –Hull Problems by Divide-and-Conquer.		**CO2**
UNIT III	**DYMANIC PROGRAMMING AND GREEDY TECHNIQUE**	**9**
The Knapsack Problem and Memory Functions – Optimal Binary Search Trees – Warshall's Algorithm – Floyd's Algorithm – Greedy Technique – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman Trees and Codes.		**CO3**
UNIT IV	**ITERATIVE IMPROVEMENT**	**9**
Graphical Method – The Simplex Method – The maximum Flow Problem – Maximum Matching in Bipartite Graphs – The Stable Marriage Problem.		**CO4**
UNIT V	**BACKTRACKING, BRANCH-AND-BOUND AND APPROXIMATION ALGORITHMS**	**9**
P, NP, and NP- Complete Problems – Backtracking – n-Queens Problem – Hamiltonian Circuit Problem – Subset-Sum Problem – Branch-and-Bound – Assignment Problem – Knapsack Problem – Traveling Salesman Problem – Approximation Algorithms for the Traveling Salesman Problem and the Knapsack Problem.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education, 2011.
3. Donald E. Knuth, “Art of Computer Programming, Volume I - Fundamental Algorithms”, Third Edition, Addison Wesley, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to investigate an algorithm’s efficiency with respect to running time
CO2	Design and implement problems using algorithmic design techniques such as decrease and conquer and divide and conquer
CO3	Ability to understand the design techniques such as Dynamic programming and Greedy technique
CO4	Ability to understand the iterative design techniques
CO5	Understand the variations among tractable and intractable problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO2	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO3	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO4	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO5	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2

CS1402	OPERATING SYSTEMS	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I	**OPERATING SYSTEM OVERVIEW**	**9**
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.		**CO1**
UNIT II	**PROCESS MANAGEMENT**	**9**
Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		**CO2**
UNIT III	**STORAGE MANAGEMENT**	**9**
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Need for Page Replacement, Page Replacement Algorithm, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		**CO3**
UNIT IV	**FILE SYSTEMS AND I/O SYSTEMS**	**9**
Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.		**CO4**
UNIT V	**CASE STUDY**	**9**
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, —Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS

1. RamazElmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, ―Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education
6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.
7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.
8. http://nptel.ac.in/.
9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Analyze various scheduling algorithms.
CO2	Understand deadlock, prevention and avoidance algorithms.
CO3	Compare and contrast various memory management schemes.
CO4	Understand the functionality of file systems.
CO5	Perform administrative tasks on Linux Servers and Compare iOS and Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1403	DATABASE DESIGN AND MANAGEMENT (Lab Integrated)	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	3	0	2	4

OBJECTIVES

- To learn the fundamentals of data models, ER diagrams and to study SQL and relational database design.
- To familiarize relational model with Relational Database design and Normal Forms.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To understand the implementation techniques by learning file organization and Query Optimization.
- To understand the concepts of distributed databases, Object Oriented databases and XML databases.

UNIT I	**INTRODUCTION TO RELATIONAL DATABASES**	**9 + 6**
Purpose of Database System – Views of data – Data Models – Database System Architecture Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping– Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features **Lab Component** • Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements .Database Querying – Simple queries, Nested queries, Sub queries and Joins • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views, Synonyms, Sequences. • Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)		**CO1**
UNIT II	**RELATIONAL DATABASE DESIGN**	**9 + 6**
Embedded SQL– Dynamic SQL - Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **Lab Component** • Simple Embedded SQL Program to demonstrate the concepts. • Database Design using normalization and Implementation for any application.		**CO2**
UNIT III	**TRANSACTIONS**	**9 + 6**
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery. **Lab Component** • Usage of Transaction control language commands like commit, rollback and save point. • Develop Programs using BEFORE and AFTER Triggers for INSERT, DELETE and UPDATE statements		**CO3**
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9 + 6**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing. Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation. **Lab Component** • Implementation of B tree and B+ Tree. • Develop programs to demonstrate hashing techniques.		**CO4**
UNIT V	**ADVANCED TOPICS**	**9 + 6**
Distributed Databases: Architecture, Data Storage, Data Fragmentation - Replication and		**CO5**

Allocation Techniques for Distributed Database Design. Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery.

Lab Component

- Database Connectivity with Front End Tools
- Case Study using real life database applications.

PRACTICALS: 30 PERIODS	THEORY: 45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson, Seventh Edition, Global Edition,2016
2. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill,2012.
3. Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, An Introduction to Cloud Databases, O'Reilly Media, Inc.,2019.

REFERENCE BOOKS

1. C.J.Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education,2004.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Map ER model to Relational model to perform database design effectively
CO2	Able to understand the various normal forms and to minimize the redundancy in the relations
CO3	Able to know the logic behind the transaction processing, concurrency control and to recover system from failures.
CO4	Able to organize, index the files and to optimize the given queries
CO5	Able to know the concepts of distributed databases, Object Oriented databases and XML databases

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

CS1404	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols.

UNIT I	**INTRODUCTION AND PHYSICAL LAYER**	**9**
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		**CO1**
UNIT II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		**CO2**
UNIT III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		**CO3**
UNIT IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		**CO4**
UNIT V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open-Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	2	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3

EC1601	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller
- To design a microcontroller-based system

UNIT I	**THE 8086 MICROPROCESSOR**	**9**
Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming - Interrupts and interrupt service routines.		**CO1**
UNIT II	**8086 SYSTEM BUS STRUCTURE**	**9**
8086 signals – Basic configurations – System bus timing –System design using 8086 – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors-80186,80286,80386,80486 and Pentium processors.		**CO2**
UNIT III	**I/O INTERFACING**	**9**
Memory Interfacing and I/O interfacing – Parallel communication interface (8255) – Serial communication interface (8251) – D/A Interface and Waveform generation- A/D Interface – Timer (8253) – Keyboard /display controller (8279) – Interrupt controller (8259) – DMA controller (8237).		**CO3**
UNIT IV	**MICROCONTROLLER**	**9**
Architecture of 8051 – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming - Interrupts.		**CO4**
UNIT V	**INTERFACING MICROCONTROLLER**	**9**
Programming 8051 Timers – Serial Port Programming – LCD & Keyboard Interfacing – ADC Interface – DAC Interface and Waveform generation – External Memory Interface – Stepper Motor Interface – Introduction to PIC microcontroller, Comparison of Microprocessor, Microcontroller & PIC Microcontroller.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals " 3rd edition, Tata McGrawHill,2012
2. Kenneth J.Ayala, "The 8051 Microcontroller-Architecture, Programming and Applications" West Publishing company, 3rd edition.)
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011. (UNIT IV-V)

REFERENCE BOOKS	
1. DoughlasV.Hall, —Microprocessors and Interfacing, Programming and Hardware,TMH,2012	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand and execute 8086 microprocessor Assembly language programs
CO2	Design and implement 8086 microprocessor based system
CO3	Interface 8086 microprocessor with Memory chips and I/O devices
CO4	Write and execute 8051 microcontroller Assembly language programs
CO5	Design and implement 8051 microcontroller-based systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2

CS1407	OPERATING SYSTEMS LABORATORY	L	T	P	C
	Common to CSE & IT	0	0	4	2

OBJECTIVES

- To learn basic Unix commands, shell programming and to implement various Process Management functions such as IPC and Scheduling.
- To implement Process Synchronization, Deadlock Detection and Avoidance and Memory Allocation methods.
- To implement Paging Techniques and File Management Techniques.

LIST OF EXPERIMENTS

Experiment	CO
1. Simulation of Unix Commands like cp, ls, grep, cd, mkdir, cat, rm etc.,	CO1
2. Implementation of Shell Programs.	
3. Implementation of CPU Scheduling Algorithms.	
4. Implementation of Producer Consumer problem using Semaphore.	
5. Implementation of Inter-process Communication using Shared memory.	
6. Implementation of Threading and Synchronization Applications.	CO2
7. Implementation of Bankers Algorithm for Deadlock Avoidance.	
8. Implementation of Deadlock Detection Algorithm.	
9. Implementation of Contiguous Memory Allocation.	
10. Implementation of Memory Management scheme using Paging.	CO3
11. Implementation of Page Replacement Algorithms.	
12. Implementation of Directory Structures.	
13. Implementation of File Allocation Strategies.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, —Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.
2. William Stallings, “Operating Systems – Internals and Design Principles”, 7 th Edition, Prentice Hall, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications with shell programming and Scheduling mechanisms.
CO2	Design and develop applications for synchronization, deadlock avoidance and detection.
CO3	Develop applications for implementing Paging and File management concepts.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2

CS1408	NETWORKS LABORATORY	L	P	T	C

	0	0	4	2

OBJECTIVES

- To learn and use network commands.
- To learn socket programming.
- To implement various functions of datalink layer.
- To implement and analyze various network protocols.
- To use simulation tools to analyse the performance of various network protocols.

LIST OF EXPERIMENTS

Experiment	CO
1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.	CO1
2. Create a socket for HTTP web client program to download a web page	
3. Using TCP/IP sockets, develop a) Echo client and echo server b) Client – Server chat c) File transfer	
4. Simulation of DNS translation of domain name using UDP sockets	
5. Write a code simulating ARP /RARP protocols	CO2
6. Implement the datalink layer framing methods such as character stuffing and bit-stuffing.	
7. Write a program to accept binary as input and perform computation for CRC.	
8. a) Study of Network simulator (NS) b) Simulation of Congestion Control Algorithms using NS.	CO3
9. Study of TCP/UDP performance using Simulation tool.	
10. Simulation of Distance Vector/ Link State Routing algorithm to show the suitable path for transmission.	
11. Performance evaluation of Routing protocols using Simulation tool.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with C/Java compiler 30 Nos.

(or)

Server with C/Java compiler supporting 30 terminals or more.

REFERENCE BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. Computer Networking: A Top-Down Approach, 7th edition, by James Kurose and Keith Ross

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement various protocols using TCP and UDP
CO2	Implement various functions of datalink layer.
CO3	Compare the performance of different transport layer protocols and analyze various routing algorithms to select optimal and economical network.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	2	2	2	3	3	3	3
CO2	3	3	3	3	2	-	-	-	2	2	2	3	3	3	3
CO3	3	3	3	3	2	-	-	-	2	2	2	3	3	3	3

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
	Common to CSE & AI-DS	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I	**6**
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	**CO1**
UNIT II	**6**
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—— Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	**CO2**
UNIT III	**6**
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc	**CO3**
UNIT IV	**6**
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	**CO4**
UNIT V	**6**
Recognizing differences between groups and teams- managing time managing stress-networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes	**CO5**
	TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	2	1	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	1	2	-	-	-	-	2
CO4	-	-	-	-	1	-	-	-	2	2	-	-	-	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	2	2

MA1501	ALGEBRA AND NUMBER THEORY	L	T	P	C
	Common to CSE & IT	3	1	0	4

OBJECTIVES

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To introduce and apply the concepts of rings, finite fields and polynomials.
- To understand the basic concepts in number theory
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject

UNIT I	**ALGEBRAIC STRUCTURES**	**9+3**
Groups - Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism		**CO1**
UNIT II	**POLYNOMIALS OVER FIELDS**	**9+3**
Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields		**CO2**
UNIT III	**DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS**	**9+3**
Division algorithm – Base - b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM		**CO3**
UNIT IV	**DIOPHANTINE EQUATIONS AND CONGRUENCES**	**9+3**
Linear Diophantine equations – Congruence‘s – Linear Congruence‘s - Applications: Divisibility tests - Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems		**CO4**
UNIT V	**CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS**	**9+3**
Wilson‘s theorem – Fermat‘s little theorem – Euler‘s theorem – Euler‘s Phi functions – Tau and Sigma functions		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
2. Koshy, T., ―Elementary Number Theory with Applications‖, Elsevier Publications, New Delhi, 2002

REFERENCE BOOKS

1. Lidl, R. and Pitz, G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
2. Niven, I., Zuckerman.H.S., and Montgomery, H.L., ―An Introduction to Theory of Numbers, John Wiley and Sons , Singapore, 2004.
3. San Ling and Chaoping Xing, ―Coding Theory – A first Course‖, Cambridge Publications, Cambridge, 2004

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand and apply the basic notions of groups, rings, fields which will then be used to solve related problems.
CO2	Explore of advanced algebraic techniques and demonstrating accurate and efficient use of the same with context to extending concept related to polynomials.
CO3	Understand the basic concepts in number theory and approach into the analysis of numbers
CO4	Apply the basic ideas of number theory to real world problems by the way of congruence and Linear Diophantine equations and Chinese remainder theorem.
CO5	Understand the three classical theorems, apply the same to solve the non - trivial problems related to the field and have strong foundation in dealing with numbers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO2	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2

CS1501	INTERNET PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the structure of the Internet and the Web.
- To study and apply the Hyper Text Mark-up Language (HTML) and to explore the Document Object Model (DOM).
- To Understand CSS & JAVASCRIPT
- To Server-Side Scripting – PHP
- To Understand Database Handling, Content Management System

UNIT I	**WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0**	**9**
Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image --Iframes – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls – CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.		**CO1**
UNIT II	**CLIENT SIDE PROGRAMMING**	**9**
Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,-Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files – Http Request – SQL.		**CO2**
UNIT III	**SERVER SIDE PROGRAMMING**	**9**
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example – JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.		**CO3**
UNIT IV	**PHP AND XML**	**9**
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions – File handling – Cookies – Connecting to Database. XML: Basic XML- Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS)		**CO4**
UNIT V	**WEB APPLICATION PROGRAMMING**	**9**
Asynchronous Web Programming, Synchronous and Asynchronous web programming, AJAX, and JQuery, Web service and API development using PHP		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Prentice Hall, 5th Edition, 2011.

REFERENCE BOOKS

1. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
2. Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”,Pearson Education, 2011.
3. Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, 2011.
4. UttamK.Roy, “Web Technologies”, Oxford University Press, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Construct a basic website using HTML and Cascading Style Sheets.
CO2	Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3	Develop server side programs using Servlets and JSP.
CO4	Construct simple web pages in PHP and to represent data in XML format.
CO5	Use AJAX and web services to develop interactive web applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1502	OBJECT ORIENTED ANALYSIS AND DESIGN	L	P	T	C
Common to CSE & IT		3	0	0	3

OBJECTIVES

- To capture the requirements specifications of an intended software system
- To design software with static and dynamic UML diagrams
- To map the design properly to code
- To improve the software design with design patterns
- To test the software against its requirements specifications

UNIT I	INTRODUCTION	9
Introduction to OOAD with OO Basics - Unified Process – UML diagrams, Use Cases – Case study – the Next Gen Point of Sale (POS) system, Inception Use case Modelling, use case modeling - Relating Use cases – include, extend and generalization.		CO 1
UNIT II	**STATIC MODELLING**	**9**
Class Diagram - Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes - Domain Modeling using class diagrams - Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition.		CO 2
UNIT III	**DYNAMIC MODELLING**	**9**
Dynamic Diagrams - UML interaction diagrams - System sequence diagram – Collaboration diagram - Communication diagram - State machine diagram and Modelling – State Diagram - Activity diagram, Implementation Diagram - UML package diagram - Component and Deployment Diagrams		CO 3
UNIT IV	**DESIGN PATTERNS**	**9**
GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller. Design Patterns – Creational – Factory method – Structural – Bridge – Adapter – Behavioral– Strategy – Observer, Applying Gang of Four design patterns – Mapping design to code		CO 4
UNIT V	**TESTING**	**9**
Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans, Revisiting and consolidating all salient points and key insights based on the team projects.		CO 5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd. Edition, Pearson Education, 2005.
2. Carol Britton, Jill Doake, "A Student Guide to Object-oriented Development", Elsevier Butterworth-Heinemann, 2005

REFERENCE BOOKS

1. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third Edition, Addison Wesley, 2003.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns: Elements of Reusable Object-Oriented Software", Pearson, 2015.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify and map basic software system requirements in UML
CO2	Express software design with UML diagrams
CO3	Design and implement software systems using OO methodology
CO4	Improve software design using design patterns
CO5	Test the software system developed against the intended requirements

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1503	ARTIFICIAL INTELLIGENCE (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES

- To impart basic knowledge about Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing intelligent agents
- To understand the application of AI namely Robotics

UNIT I	**INTRODUCTION**	**9 + 6**
Introduction–Definition – Foundation and History of AI - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Agents and Environments – Nature of Environments - Structure of Agents - Typical Intelligent Agents **Lab Component:** • Demonstration of 8-Queen's problem • Implementation of Water Jug Problem		**CO1**
UNIT II	**PROBLEM SOLVING METHODS**	**9 + 6**
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning **Lab Component:** • Path Search problem to find a path from point A to point B using A* Search Algorithm • Usage of Hill Climbing Search Algorithm to find a solution for Travelling Salesman Problem		**CO2**
UNIT III	**KNOWLEDGE REPRESENTATION**	**9 + 6**
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for categories – Reasoning with Default Information. **Lab Component:** • Create a First Order Logic solver • Develop a Forward Chaining Inference Engine.		**CO3**
UNIT IV	**SOFTWARE AGENTS**	**9 + 6**
Architecture for Intelligent Agents – Examples - Agent communication – Speech Acts - KQML-KIF - FIPA ACL - Argumentation among Agents – Trust and Reputation in Multi-agent systems. **Lab Component:** • Develop a Simple Agent for the Vacuum-Cleaner world problem • Create a Tic Tac Toe Game program		**CO4**

UNIT V	APPLICATIONS	9 + 6
AI applications – Language Models – Information Retrieval – Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware - Perception – Planning – Moving **Lab Component:** • Simulation of Turtle moving • Simulation of Game playing		CO5

PRACTICALS:30 PERIODS	THEORY :45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Russell S and Norvig P, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Gerhard Weiss, - Multi Agent Systems , Second Edition, MIT Press, 2013.

REFERENCE BOOKS

1. Tim Jones M - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Bratko I - Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement basic AI Algorithms.
CO2	Use appropriate search algorithms to solve AI based problems.
CO3	Represent a problem using first order and predicate logic.
CO4	Implement Various intelligent systems.
CO5	Gain knowledge on the functions of Robots.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3

CS1507	INTERNET PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To develop an ability to design and implement static and dynamic website
- To design interactive web pages using Scripting languages.
- To learn server side programming using servlets, PHP and JSP with database connectivity.
- To develop web pages using XML/XSLT

LIST OF EXPERIMENTS

Experiment	CO
1. To create an html page with different types of frames such as floating frame, navigation frame& mixed frame	CO1
2. Develop static pages (using only HTML) of an online Book store. The pages should resemble: www.amazon.com the website should consist the following pages. Home page, Registration and user Login, User profile page, Books catalog, Shopping cart, Payment By credit card, order confirmation	CO1
3. Design a web page using CSS (Cascading Style Sheets) which includes the following: a) Use different font, styles: In the style definition you define how each selector should work (font, color etc.). Then, in the body of your pages, you refer to these selectors to activate the styles. b) Set a background image for both the page and single elements on the page. c) Control the repetition of the image with the background-repeat property.	CO1
4. To create a html page to show online exam using JavaScript.	CO2
5. Validate the registration, user login, user profile and payment by credit card pages using JavaScript.	CO2
6. Write an XML file to display the Book information with Title, Author Name, ISBN, Publisher, Edition and Price . a) Write a Document Type Definition (DTD) to validate the above XML file. Display the XML file as follows. b) The contents should be displayed in a table. The header of the table should be in color GREY. And the Author names column should be displayed in one color and should be capitalized and in bold. Use your own colors for remaining columns. c) Write XML schema and XSL for the XML file.	CO2
7. A web application that lists all cookies stored in the browser on clicking “list cookies” button, add cookies if necessary	CO2
8. Consider a case where we have two web Services- an airline service and a travel agent and the travel agent is searching for an airline. Implement this scenario using Web Services and Data base.	CO2
9. Write a PHP program to input previous reading and present reading and prepare an electricity bill using the following conditions	CO2

Units Consumed	Rate
<100	Rs. 3/ Unit
Between 100 and 200	Rs. 4/ Unit
Between 200 and 300	Rs. 5/ Unit
>300	Rs. 6/ Unit

10. Implement the following web application using a) Servlets b) PHP c) JSP I. A user validation web application, where user submits the login name and password to server. These are checked against the data already available in database and if the data matches a successful login page is returned. Otherwise a failure message is shown to the user. II. Modify the above program to use an xml file instead of database. III. Modify the above program to use AJAX to show the result on the same page below the submit button.	**CO2**

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Web Design with HTML, CSS, JavaScript and jQuery Set 1st Edition.
2. Learning PHP, MySQL & JavaScript: With jQuery, CSS & HTML5 (Learning PHP, MYSQL, Javascript, CSS & HTML5).
3. Murach's PHP and MySQL (3rd Edition).
4. Learn JavaScript VISUALLY with Interactive Exercises.
5. JavaScript and JQuery: Interactive Front-End Web Development.
6. PHP and MySQL for Dynamic Web Sites: Visual QuickPro Guide.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design screen-based user interfaces, with graphics, textual components, and navigation systems to achieve a unified, functional environment that results in static web pages
CO2	Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's.
CO3	Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1508	OBJECT ORIENTED ANALYSIS AND DESIGN LABORATORY	L	P	T	C
	Common to CSE & IT	0	0	4	2

OBJECTIVES

- To capture the requirements specification for an intended software system
- To draw the UML diagrams for the given specification
- To map the design properly to code
- To test the software system thoroughly for all scenarios
- To improve the design by applying appropriate design patterns.

LIST OF EXPERIMENTS

Draw standard UML diagrams using an UML modeling tool for a given case study and map design to code and implement a 3 layered architecture. Test the developed code and validate whether the SRS is satisfied.

1. Identify a software system that needs to be developed.	**CO1**
2. Document the Software Requirements Specification (SRS) for the identified system.	
3. Identify use cases and develop the Use Case model.	**CO2**
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.	
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams	
6. Draw relevant State Chart and Activity Diagrams for the same system.	
7. Implement the system as per the detailed design	
8. Test the software system for all the scenarios identified as per the use case diagram	**CO3**
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.	
10. Implement the modified system and test it for various scenarios	

SUGGESTED DOMAINS FOR MINI-PROJECT

- Passport automation system.
- Book bank
- Exam registration
- Stock maintenance system.
- Online course reservation system
- Airline/Railway reservation system
- Software personnel management system
- Credit card processing
- e-book management system
- Recruitment system
- Foreign trading system
- Conference management system
- BPO management system
- Library management system
- Student information system

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", Third Edition, Addison Wesley, 2003.
2. Craig Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd. Edition, Pearson Education, 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the requirement of the project.
CO2	Design and implement the project
CO3	Perform testing of implemented project.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1601	COMPILER DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the various phases of compiler.
- To learn the various parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement code generator.
- To understand code optimization.

UNIT I	INTRODUCTION TO COMPILERS AND LEXICAL ANALYSIS	9
Translators - Compilation and Interpretation - Language processors - Compiler Construction Tools - Structure of a compiler - Lexical Analysis - Role of Lexical Analyzer - Specification of Tokens - Recognition of Tokens - Lex - Design of Lexical Analyzer for a sample Language- Finite Automata - Regular Expressions to Automata - Minimizing DFA		**CO1**
UNIT II	**SYNTAX ANALYSIS**	**9**
Need and Role of Parser - Context Free Grammars - Top-Down Parsing - Recursive Descent Parser - Predictive Parser- LL(1) Parser-Shift Reduce Parser-LR Parser - LR(0) Items - Construction of SLR Parsing Table - LALR Parser - Error Handling and Recovery in Syntax Analyzer – YACC.		**CO2**
UNIT III	**INTERMEDIATE CODE GENERATION**	**9**
Syntax Directed Definitions - Evaluation Orders for Syntax Directed Definitions - Intermediate Languages: Syntax Tree, Three Address Code - Types and Declarations, Translation of Expressions- Type Checking		**CO3**
UNIT IV	**RUN-TIME ENVIRONMENT AND CODE GENERATION**	**9**
Storage Organization- Stack Allocation Space- Access to Non-local Data on the Stack- Heap Management – Basic blocks and flow graphs-Issues in Code Generation - Design of a Simple Code Generator.		**CO4**
UNIT V	**CODE OPTIMIZATION**	**9**
Principal Sources of Optimization - Peep-hole Optimization - DAG - Optimization of Basic Blocks -Global Data Flow Analysis - Efficient Data Flow Algorithm		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Second Edition, Pearson Education, 2009.

REFERENCE BOOKS

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation‖, Morgan Kaufmann Publishers – Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler‖, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design‖, Tata McGraw Hill Education Publishers, 2010

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the different phases of compiler and identify the tokens using lexical analyzer.
CO2	Apply different parsing algorithms to develop the parsers for a given grammar.
CO3	Understand Syntax-directed translation and formulate the Intermediate Code.
CO4	Categorize the Intermediate Code into basic blocks and generate code
CO5	Apply various optimization techniques for dataflow analysis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1602	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system.
- To be familiar with the network layer protocols and Ad-Hoc networks.
- To know the basis of transport and application layer protocols.
- To gain knowledge about different mobile platforms and application development.

UNIT I	**INTRODUCTION**	**9**
Introduction to Mobile Computing - Mobile Computing Vs Wireless networking - Applications of Mobile Computing - Structure of Mobile Computing Applications - Generations of Mobile Communication Technologies - MAC Protocols - Wireless MAC Issues – SDMA - TDMA- FDMA - CDMA.		**CO1**
UNIT II	**MOBILE TELECOMMUNICATION SYSTEM**	**9**
Introduction to Cellular Systems – GSM: Services & Architecture – Protocols – Connection Establishment – Handover – Routing – Mobility Management – Security; GPRS- UMTS – Architecture – Handover – Security.		**CO2**
UNIT III	**MOBILE NETWORK LAYER**	**9**
Mobile IP – Features – Key Mechanisms –Route Optimization - DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV, Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.		**CO3**
UNIT IV	**MOBILE TRANSPORT AND APPLICATION LAYER**	**9**
Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML – WAP 2.0.		**CO4**
UNIT V	**MOBILE PLATFORMS AND APPLICATIONS**	**9**
Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, Windows Phone – M-Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jochen Schiller, -Mobile Communications, PHI, Second Edition,2009.
2. Prasant Kumar Pattnaik, RajibMall,-Fundamentals of Mobile Computing, second Edition, PHILearning Pvt.Ltd, New Delhi –2015.

REFERENCE BOOKS

1. Dharma PrakashAgarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd,2005.
2. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, —Principles of Mobile Computing, Springer,2003.
3. William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems, Second Edition,Tata McGraw Hill Edition,2006.
4. Toh C K, —AdHoc Mobile Wireless Networks, First Edition, Pearson Education,2002.
5. Android Developers :http://developer.android.com/index.html.
6. Apple Developer :https://developer.apple.com.
7. Windows Phone DevCenter :http://developer.windowsphone.com.
8. BlackBerry Developer :http://developer.blackberry.com.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basics of mobile telecommunication systems.
CO2	Illustrate the generations of telecommunication systems in wireless networks.
CO3	Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.
CO4	Understand the functionality of Transport and Application layers.
CO5	Develop a mobile application using android/ios/Windows SDK.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	3	1	2	-	1	2	1	3	3	2	2
CO2	1	2	2	2	2	1	2	-	1	2	1	2	2	3	2
CO3	2	2	3	3	2	1	2	-	1	2	-	3	2	3	3
CO4	1	1	1	1	2	-	1	-	-	1	-	2	3	3	3
CO5	2	-	3	-	2	-	-	-	-	2	2	3	3	3	3

CS1603	DISTRIBUTED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems.
- To learn distributed mutual exclusion and deadlock detection algorithms.
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
- To learn the characteristics of peer-to-peer and distributed shared memory systems.

UNIT I	INTRODUCTION TO DISTRIBUTED SYSTEMS	9
Introduction: Definition –Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Design issues and challenges. A model of distributed computations: A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts –Past and future cones of an event –Models of process communications. Logical Time: A framework for a system of logical clocks –Scalar time –Vector time – Physical clock synchronization: NTP.		CO1
UNIT II	**MESSAGE ORDERING & SNAPSHOTS**	**9**
Message ordering and group communication: Message ordering paradigms –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) – Total order. Global state and snapshot recording algorithms: Introduction –System model and definitions –Snapshot algorithms for FIFO channels.		CO2
UNIT III	**DISTRIBUTED MUTEX & DEADLOCK**	**9**
Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport‘s algorithm – Ricart-Agrawala algorithm – Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp‘s classification – Algorithms for the single resource model, the AND model and the OR model.		CO3
UNIT IV	**RECOVERY & CONSENSUS**	**9**
Checkpointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated checkpointing algorithm – Algorithm for asynchronous checkpointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure –free system – Agreement in synchronous systems with failures.		CO4
UNIT V	**P2P & DISTRIBUTED SHARED MEMORY**	**9**
Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models: Strict consistency - Sequential consistency - Causal consistency –Shared memory Mutual Exclusion.		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore and Tim Kindberg, ―Distributed Systems Concepts and Design‖, Fifth Edition, Pearson Education, 2012.

REFERENCE BOOKS

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Mukesh Singhal and Niranjan G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.
3. Tanenbaum A.S., Van Steen M., ―Distributed Systems: Principles and Paradigms‖, Pearson Education, 2007.
4. Liu M.L., ―Distributed Computing, Principles and Applications‖, Pearson Education, 2004.
5. Nancy A Lynch, ―Distributed Algorithms‖, Morgan Kaufman Publishers, USA, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Elucidate the foundations and issues of distributed systems
CO2	Understand the various synchronization issues and global state for distributed systems
CO3	Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems
CO4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems
CO5	Describe the features of peer-to-peer and distributed shared memory systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
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CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1604	DATA SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the fundamental concepts of data science and analytics
- To learn various techniques for mining data streams
- To learn Event Modelling for different applications
- To know about Hadoop and Map Reduce procedure

UNIT I	**INTRODUCTION TO DATA SCIENCE AND BIG DATA**	**9**
Introduction to Data Science – Applications - Data Science Process – Exploratory Data analysis – Collection of data – Graphical presentation of data – Classification of data – Storage and retrieval of data – Big data – Challenges of Conventional Systems - Web Data – Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error		**CO1**
UNIT II	**DATA ANALYSIS**	**9**
Correlation – Regression – Probability – Conditional Probability – Random Variables – Analysis using Mean, Median, Mode, Standard Deviation, Skewness, Kurtosis- Regression Modeling - Multivariate Analysis - Bayesian Modeling - Inference and Bayesian Networks - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics		**CO2**
UNIT III	**DATA MINING TECHNIQUES**	**9**
Rule Induction - Neural Networks: Learning and Generalization - Competitive Learning - Principal Component Analysis and Neural Networks - Fuzzy Logic: Extracting Fuzzy Models from Data - Fuzzy Decision Trees - Stochastic Search Methods- Neuro-Fuzzy Modelling – Association rule mining – Clustering – Outlier Analysis – Sequential Pattern Mining – Temporal mining – Spatial mining – Web mining		**CO3**
UNIT IV	**MINING DATA STREAMS**	**9**
Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions		**CO4**
UNIT V	**FRAMEWORKS AND VISUALIZATION**	**9**
Map Reduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – Cloud databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques – Social Network Analysis – Collective Inferencing – Egonets - Systems and Applications		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007
2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012
4. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier, Reprinted 2008

REFERENCE BOOKS

1. Rachel Schutt, Cathy O'Neil, “Doing Data Science”, O'Reilly Publishers, 2013
2. Foster Provost, Tom Fawcet, “Data Science for Business”, O'Reilly Publishers, 2013
3. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications“, Wiley Publishers, 2014
4. S. N. Sivanandam, S. N Deepa, “Introduction to Neural Networks Using Matlab 6.0”, Tata McGraw- Hill Education, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Work with big data platform and its analysis techniques
CO2	Design efficient algorithms for mining the data from large volumes
CO3	Model a framework for Human Activity Recognition
CO4	Development with cloud databases
CO5	Apply visualization techniques to present the data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1607	MOBILE APPLICATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Know the components and structure of mobile application development frameworks for Android based mobiles.
- Understand how to work with various mobile application development frameworks.
- Learn the basic and important design concepts and issues of development of mobile applications.

LIST OF EXPERIMENTS

1.	Develop an application for changing the font, color and size of the given text that uses GUI components, Font and Colors	CO1
2.	Develop an application for collecting student's information that uses Layout Managers and event listeners.	
3.	Implement a native Calculator to perform various operations using appropriate GUI Components.	
4.	Write an application that display line, circle, rectangle and other 2D graphical primitives on the screen.	
5.	Develop an application for implementing payroll system by connecting the database where the actual data is stored and retrieved.	CO2
6.	Develop an application that makes use of RSS Feed.	
7.	Implement an application that implements multi-threading	
8.	Develop a native application that uses GPS location information.	
9.	Implement an application that writes data to the SD card.	CO3
10.	Implement an application that creates an alert upon receiving a message.	
11.	Develop an application to send an email.	
12.	Write a mobile application that creates alarm clock.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
3. DiMarzio J F, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016.
4. Anubhav Pradhan, Anil V Deshpande, "Composing Mobile Apps" using Android, Wiley 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Create, test and debug Android application by setting up Android development environment.
CO2	Demonstrate methods for storing, sharing and retrieving data in Android applications.
CO3	Analyze the performance of android applications to understand the role of permissions and security.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1701	GRAPH THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic graph terminologies and types of graphs.
- To appreciate graph theoretic terms related to trees and cut-sets.
- To understand the geometric, combinatorial properties of graphs and basic concepts of directed graphs.
- To understand the matrix representation of graphs and the colouring, covering and partitioning of graphs.
- To solve a nontrivial practical problem with the help of high-speed electronic computers.

UNIT I	**INTRODUCTION**	**9**
Introduction - Graph Terminologies - Types of Graphs – Isomorphism- Sub Graphs – Walks, Paths and Circuits – Connected Graphs and Components - Isomorphic Graphs – Operations on Graphs - Euler graphs - Hamiltonian Graph.		**CO1**
UNIT II	**TREES AND CUT-SETS**	**9**
Trees -Properties- Distance and Centers - Types - Rooted Tree- Labeled Tree - Unlabeled Tree - Spanning Tree – Cut-sets - Properties - Fundamental Circuits and Cut-sets- Connectivity and Separability.		**CO2**
UNIT III	**PLANAR, DUAL GRAPHS AND DIRECTED GRAPHS**	**9**
Planar Graph - Representation - Detection - Dual Graph - Geometric and Combinatorial Dual – Directed Graphs – Types- Properties - Euler Digraph.		**CO3**
UNIT IV	**MATRIX REPRESENTATIONS AND CHROMATIC NUMBER**	**9**
Matrix Representation - Incidence matrix- Circuit matrix - Cut-set matrix - Path Matrix- Adjacency Matrix-Properties - Graph Coloring - Chromatic Polynomial - Chromatic Partitioning - Matchings - Coverings.		**CO4**
UNIT V	**GRAPH THEORETIC ALGORITHMS AND COMPUTER PROGRAMS**	**9**
Graph Algorithms: Connectedness and Components- Spanning Tree- Fundamental Circuits- Cut Vertices- Directed Circuits- Shortest Path - Applications overview.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice-Hall of India Pvt.Ltd, 2003.

REFERENCE BOOKS

1. Foulds L R , Graph Theory Applications, Springer ,2016.
2. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication, 2008.
3. West, D. B., Introduction to Graph Theory, Pearson Education, 2011 .
4. John Clark, Derek Allan Holton, A First Look at Graph Theory, World Scientific Publishing Company, 1991.
5. Diestel, R, Graph Theory, Springer 3rd Edition,2006.
6. Kenneth H.Rosen, Discrete Mathematics and Its Applications, Mc Graw Hill , 2007.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Gain knowledge about basic terminologies of graph, types of graph and various applications of graph theory.
CO2	Develop the system which keeps the vertices together and separates the vertices.
CO3	Understand the combinational and geometric graphs.
CO4	Demonstrate the use of matrices in studying graphs and direct consequence of proper coloring of vertices
CO5	Address the computational aspects of graph theory, including graph-theoretic algorithms and computer programs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	1	-	-	-	-	2	2	1	1
CO2	3	3	2	3	2	1	1	-	-	-	-	2	2	1	1
CO3	3	3	2	3	2	1	1	-	-	-	-	2	2	1	1
CO4	3	3	2	3	2	1	1	-	-	-	-	2	2	1	1
CO5	3	3	2	3	2	1	1	-	-	-	-	2	2	1	1

CS1702	CLOUD COMPUTING	L	T	P	C
	Common to CSE & IT	3	0	0	3

OBJECTIVES

- To understand the concept of cloud computing.
- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To understand the emergence of cloud as the next generation computing paradigm.

UNIT I	INTRODUCTION	9
Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Benefits and Disadvantages of Cloud Computing- Elasticity in Cloud – On-demand Provisioning		**CO1**
UNIT II	**CLOUD ENABLING TECHNOLOGIES**	**10**
Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.		**CO2**
UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**8**
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.		**CO3**
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**10**
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.		**CO4**
UNIT V	**CLOUD ADVANCEMENT TECHNOLOGIES**	**8**
Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine –– Open Stack - Cloud Software Environments - Eucalyptus – Open Nebula.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017

REFERENCE BOOKS

1. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.
3. https://kubernetes.io/docs/home/
4. https://docs.mongodb.com/
5. https://aws.amazon.com/documentdb/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2	Learn the key and enabling technologies that help in the development of cloud.
CO3	Understand the architecture of compute and storage cloud, service and delivery models.
CO4	Explain the core issues of cloud computing such as resource management and security.
CO5	Install and use current cloud technologies and choose the appropriate technologies, approaches for implementation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1703	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
(Common to CSE & IT)		3	0	0	3

OBJECTIVES

- To define security attacks, services and mechanisms.
- To review modern symmetric-key ciphers based on algebraic structures.
- To understand asymmetric-key cryptography based on some topics in number theory.
- To define cryptographic data integrity algorithms and mutual trust.
- To discuss various security practices and system security measures.

UNIT I	**FUNDAMENTALS**	**9**
Computer Security Concepts – The OSI Security Architecture - Security Attacks, Services and Mechanisms - Model for network security – Classical Encryption Techniques: Substitution Techniques, Transposition Techniques, Steganography – Legal and Ethical Aspects.		**CO1**
UNIT II	**SYMMETRIC CRYPTOGRAPHY**	**9**
Mathematics of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic- GF (2^n Fields) –The Euclidian Algorithm- Polynomial Arithmetic - Symmetric Key Ciphers: Block Cipher and Data Encryption Standard (DES) - Advanced Encryption Standard (AES) – Block Cipher Operation – Random Bit Generation and Stream Ciphers - RC4.		**CO2**
UNIT III	**PUBLIC KEY CRYPTOGRAPHY**	**9**
Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Chinese Remainder Theorem – Quadratic Congruence- Exponentiation and Logarithm - Asymmetric Key Ciphers: RSA Cryptosystem – Rabin Cryptosystem - Diffie Hellman Key Exchange - ElGamal Cryptosystem – Elliptic Curve Arithmetic - Elliptic Curve Cryptography.		**CO3**
UNIT IV	**CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS AND MUTUAL TRUST**	**9**
Cryptographic Hash Functions – Message Authentication Codes - Digital Signatures –Key Management and Distribution – X.509 Certificates - User Authentication- Kerberos		**CO4**
UNIT V	**INTERNET SECURITY AND SYSTEM SECURITY**	**9**
Electronic Mail security – PGP, S/MIME – IP security – Cloud Security- Wireless Network Security – System Security: Intruders – Malicious software – Firewalls.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 5th Edition, 2011.
2. Behrouz A.Forouzan, Introduction to Cryptography and Network Security, McGraw-Hill Ferouzan Networking Series, 2008.

REFERENCE BOOKS

1. Shyamala C K, N Harini and Dr T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt. Ltd.
2. Charlie Kaufman, Radia Periman and Mike Speciner, Network Security: private Communication in a public World, Prentice Hall, ISBN 0-13-046019-2
3. William Stallings, "Network Security Essentials Applications and Standards", 2nd edition, Pearson Education, 2003.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe the key security requirements of confidentiality, Integrity and availability
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3	Examines of asymmetric key cryptosystem and design principles
CO4	Describe the various cryptographic data integrity algorithms and various aspects of key management and distribution.
CO5	Understand various network Security practices and System level security issues

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

CS1709	Edge Computing	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Understand general concepts of Internet of Things (IoT)
- ❖ Recognize various devices, sensors and applications
- ❖ Analyze and Apply design concept to IoT solutions
- ❖ Evaluate design issues in IoT applications
- ❖ Create IoT solutions using sensors, actuators and Devices.

UNIT I	INTRODUCTION TO IoT	9
Evolution of Internet of Things - Enabling Technologies – IoT Architectures - Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications- IoT Definition - Characteristics of .IoT- Functional Blocks. Web of Things versus Internet of Things. Core IoT functional stack – IoT data management and compute stack.		CO1
UNIT II	**SENSORS AND INTERFACING**	**9**
Introduction to sensors - Transducers, Classification - Roles of sensors in IOT - Various types of sensors - Design of sensors - sensor architecture - special requirements for IOT sensors- Role of actuators - types of actuators. Hardwire the sensors with different protocols such as – COAP – MQTT - 6LoWPAN and Zigbee.		CO2
UNIT III	**IoT PROTOCOLS**	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP– Security		CO3
UNIT IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO**	**9**
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices and Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		CO4
UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT-Google Homes in IoT.		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. ArshdeepBahga, Vijay Madisetti, —Internet of Things – A hands-on approachǁ, Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocolsǁ, Wiley, 2012.

REFERENCE BOOKS

1. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Thingsǁ, Springer, 2011.
2. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspectiveǁ, CRC Press, 2012.
3. Jan Ho¨ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Analyze various protocols for IoT
CO2	Analyze various sensors and control devices to address IoT applications.
CO3	Design a portable IoT using Raspberry Pi
CO4	Deploy an IoT application and connect to the cloud.
CO5	Analyze applications of IoT in real time scenario

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	2	3	3	2	3	-	2	2	3	3
CO2	3	2	3	2	-	2	3	3	2	3	-	2	2	3	3
CO3	3	2	3	2	-	2	3	3	2	3	-	2	2	3	3
CO4	3	2	3	2	-	2	3	3	2	3	-	2	2	3	3
CO5	3	2	3	2	-	2	3	3	2	3	-	2	2	3	3

CS1707	CLOUD COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To install and create virtual machines and transfer of files from one virtual machine to another.
- To develop web applications in cloud and to learn the design and development process involved in creating a cloud-based application
- To implement and use parallel programming using Hadoop

LIST OF EXPERIMENTS

1. Install Virtual box /VMware Workstation with different flavours of Linux or windows OS on top of windows7/8/10.	CO1
2. Install two virtual machines, VM1 with server OS and VM2 with desktop [Ubuntu/centOS], after installing display the IP address and Ping among VMs	
3. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.	
4. Create and run virtual machines on Compute Engine EC2 in Google Cloud Platform [GCP].	
5. Create and run two virtual machines VM1 with Ubuntu OS and VM2 with CentOS and transfer files from one virtual machine to another.	
6. Create hello world app or any other simple web applications using python/java and launch the web application using Google App Engine.	CO2
7. Simulate a cloud scenario using CloudSim and create two data centres with one host and a network topology each and run two cloudlets on them.	
8. Simulate a cloud scenario using CloudSim and to create scalable simulations.	
9. Install Hadoop and set up a single node Hadoop cluster.	CO3
10. Create and run simple applications like wordcount.in the single Hadoop cluster.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Toby Velte, Anthony Velte, Robert Elsenpeter Cloud Computing, A Practical Approach,2009
2. Ted Hunter, Steven Porter, and Legorie Pajan Building Google Cloud Platform Solutions, packt publishing Ltd,2019

WEB REFERENCES

1. http://www.cloudbus.org/cloudsim/
2. https://hadoop.apache.org/docs/r2.9.2/hadoop-project-dist/hadoop-common/SingleCluster.html

COURSE OUTCOMES

Up

on completion of the course, students will be able to

CO1	Configure various virtualization tools such as Virtual Box, VMware workstation and deploy a web application in GCP
CO2	Simulate a cloud environment using cloud sim and install, use a generic cloud environment.
CO3	Manipulate and store large data sets in a parallel environment using Hadoop.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2

PROFESSIONAL ELECTIVE-I

CS1511	COMPUTER GRAPHICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the mathematical basis of computer graphics.
- To train the students to acquire knowledge in Computer Graphics modelling, animation, and rendering.
- To create graphical applications.
- To acquire knowledge about tools and technologies related to graphics.
- To create visually realistic animations.

UNIT I	INTRODUCTION TO COMPUTER GRAPHICS	9
Graphics Display Devices – Graphics Input Primitives and Devices – OpenGL Basic Graphic Primitives – Line Drawing Algorithms DDA and Bresenham – Windows and Viewports – Clipping Algorithms for Lines, Regular Polygons, Circles and Arcs – Parametric Form for a Curve – Visibility Algorithms – Review of Vectors – Representations of Key Geometric Objects – Lines and Planes		**CO1**
UNIT II	**MODELING AND TRANSFORMATIONS OF OBJECTS**	**9**
Introduction to Transformations – Two Dimensional Transformations – 3D Affine Transformations – Homogeneous Coordinates – Matrix Representation – Drawing 3D Scenes Interactively – Introduction to Solid Modeling with Polygonal Meshes – Mesh Approximations to Smooth Objects – Particle Systems and Physically Based Systems		**CO2**
UNIT III	**VIEWING AND VISUAL REALISM**	**9**
Three-Dimensional Viewing – Hidden Surface Removal – Illumination Models-Depth Cueing – Perspective Projections of 3D Objects – Introduction to Shading Models – Flat Shading and Smooth Shading – Adding Texture to Faces – Morphing – To Add Shadows of Objects – OPENGL Shading Language – Manipulating Pixmaps – Manipulating Symbolically Defined Regions – Aliasing and Anti Aliasing Techniques – Creating More Shades and Colours		**CO3**
UNIT IV	**SURFACE DESIGN**	**9**
Describing Curves using Polynomials – Bezier Curves – Blending Functions – The B-Spline Basis Functions – Modeling Curved Surfaces – Rational Splines and NURBS – Interpolation – Modeling Curved Surfaces – Color Theory – Overview of the Ray Tracing Process – Intersecting Rays with other Primitives – Adding Shadows for Greater Realism – Reflections and Transparency – Boolean Operations on Objects – Ray Casting		**CO4**
UNIT V	**ANIMATIONS**	**9**
Design of Animation Sequence – Animation Function – Raster Animation – Key Frame Systems – Motion Specification – Morphing – Tweening – Types of Animation – Fractals – Tools for Animation Creation		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. F. S. Hill, Jr., Stephen M. Kelley, Jr., “Computer graphics using OpenGL”, Pearson Prentice Hall, Third Edition, 2007.
2. Donald D. Hearn, M. Pauline Baker, W. Carithers., “Computer Graphics with Open GL”, Fourth Edition, Pearson Eduction, 2010.

REFERENCE BOOKS

1. Tay Vaughan., “Multimedia: Making it Work”, Ninth Edition, McGraw-Hill Education, 2014.
2. Alan Watt, “3D Computer Graphics”, Third Edition, Pearson Addison Wesley, 2000.
3. Ralf Steinmetz, KlaraNahrstedt, “Multimedia Systems”, Springer, 2004.
4. Mark S. Drew, Zee Nian Li, “Fundamentals of multimedia”, Prentice Hall, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and Implement algorithms related to graphics creation.
CO2	Design and model graphical structures.
CO3	Understand and comprehend the graphical algorithms.
CO4	Design visually realistic graphical applications.
CO5	Design and develop simple and realistic animations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO4	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2

CS1512	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	**INTRODUCTION**	**9**
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – The BiasVarianceTradeoff, FIND– S Algorithm, Candidate - Elimination Algorithm		**CO1**
UNIT II	**SUPERVISED LEARNING**	**9**
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		**CO2**
UNIT III	**UNSUPERVISED LEARNING**	**9**
Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models(LVM) – Latent Dirichlet Allocation (LDA)		**CO3**
UNIT IV	**GRAPHICAL MODELS**	**9**
Bayesian Networks – Conditional Independence – Markov Random Fields – Learning – Naive Bayes Classifiers – Markov Model – Hidden Markov Model.		**CO4**
UNIT V	**ADVANCED LEARNING**	**9**
Reinforcement Learning – Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines – Deep Learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Press, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Second Edition, Springer, 2008.
6. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge about basic concepts of machine learning techniques
CO2	Develop predictive model based on both input and output data
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Ability to address the problem of learning control strategies for autonomous agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

CS1513	Image Analysis and Computer Vision	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To review image processing techniques for computer vision.
- ❖ To understand feature detection and matching.
- ❖ To understand structure from motion.
- ❖ To understand three-dimensional image analysis techniques and motion analysis.
- ❖ To study some applications of computer vision algorithms.

UNIT I	**Image Formation and Processing**	**9**
Geometric primitives and transformations – 2D and 3D transformation -3D Rotations - Photometric image formation – Lighting, Reflectance and shading, Optics – Image Processing – Point operation – Linear Filtering – Fourier Transforms – Wavelets - Geometric transformations.		**CO1**
UNIT II	**Feature detection and matching**	**9**
Points and Patches – Edges – Lines – Active contours – Split and Merge – Mean Shift and mode finding – 2D and 3D feature-based alignment – Pose estimation		**CO2**
UNIT III	**Structure from motion**	**9**
Triangulation - Two-frame structure from motion - Projective (uncalibrated) reconstruction – Factorization - Bundle adjustment - Constrained structure and motion		**CO3**
UNIT IV	**3D VISION**	**9**
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.		**CO4**
UNIT V	**APPLICATIONS**	**9**
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D. L. Baggio et al., ―Mastering OpenCV with Practical Computer Vision Projects‖, Packt Publishing, 2012.

REFERENCE BOOKS

1. E. R. Davies, —Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
2. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
3. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
4. R. Szeliski, —Computer Vision: Algorithms and Applications‖, Springer 2011.
5. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Implement fundamental image processing techniques required for computer vision.
CO2	Implement boundary tracking techniques and perform shape analysis
CO3	Apply Hough Transform for line, circle, and ellipse detections.
CO4	Apply 3D vision techniques and implement motion related techniques.
CO5	Develop applications using computer vision techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

CS1514	MULTICORE ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the challenges in parallel and multi-threaded programming.
- Learn about the various parallel programming paradigms, and solutions.

UNIT I	**MULTI-CORE PROCESSORS**	**9**
Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design		**CO1**
UNIT II	**PARALLEL PROGRAM CHALLENGES**	**9**
Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes)		**CO2**
UNIT III	**SHARED MEMORY PROGRAMMING WITH OpenMP**	**9**
OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.		**CO3**
UNIT IV	**DISTRIBUTED MEMORY PROGRAMMING WITH MPI**	**9**
MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation		**CO4**
UNIT V	**PARALLEL PROGRAM DEVELOPMENT**	**9**
Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Peter S. Pacheco, “An Introduction to Parallel Programming”, Morgan-Kauffman/Elsevier, 2011.
2. 2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris”, Pearson, 2011 (unit 2)

REFERENCE BOOKS

1. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
2. Shameem Akhter and Jason Roberts, “Multi-core Programming”, Intel Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Program Parallel Processors.
CO2	Understand parallel program challenges
CO3	Develop shared memory programming with openMP
CO4	Develop distributed memory programming with MPI
CO5	Design parallel program using openMP

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO3	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO4	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO5	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2

CS1515	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
Common to CSE & IT		3	0	0	3

OBJECTIVES

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I	**DIGITAL IMAGE FUNDAMENTALS**	**9**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.		**CO1**
UNIT II	**IMAGE ENHANCEMENT**	**9**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement		**CO2**
UNIT III	**IMAGE RESTORATION**	**9**
Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering		**CO3**
UNIT IV	**IMAGE SEGMENTATION**	**9**
Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		**CO4**
UNIT V	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010.
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.

REFERENCE BOOKS

1. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau,Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, Digital Image Processing John Wiley, New York, 2002
5. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics and fundamentals of digital image processing.
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement
CO3	Understand the restoration concepts of filtering techniques
CO4	Understand segmentation concepts and feature extraction
CO5	Learn the basics of compression and recognition methods for color models

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

PROFESSIONAL ELECTIVE – II

CS1611	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To understand undecidable problems and NP class problems.

UNIT I	AUTOMATA FUNDAMENTALS	9
Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions		**CO1**
UNIT II	**REGULAR EXPRESSIONS AND LANGUAGES**	**9**
Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata		**CO2**
UNIT III	**CONTEXT FREE GRAMMAR AND LANGUAGES**	**9**
CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata		**CO3**
UNIT IV	**PROPERTIES OF CONTEXT FREE LANGUAGES**	**9**
Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM		**CO4**
UNIT V	**UNDECIDABILITY**	**9**
Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem, The Class P and NP		**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. J.E.Hopcroft, R.Motwani and J.D Ullman, ―Introduction to Automata Theory, Languages and Computations‖, Second Edition, Pearson Education, 2003.

REFERENCE BOOKS

1. H.R.Lewis and C.H.Papadimitriou, ―Elements of the theory of Computation, Second Edition, PHI, 2003.
2. J.Martin, ―Introduction to Languages and the Theory of Computation, Third Edition, TMH, 2003.
3. MichealSipser, ―Introduction of the Theory and Computation, Thomson Brokecole, 1997.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Construct automata, regular expression for any pattern.
CO2	Write Context free grammar for any construct.
CO3	Design Turing machines for any language.
CO4	Propose computation solutions using Turing machines.
CO5	Derive whether a problem is decidable or not

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1612	SOFTWARE TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

UNIT I	**INTRODUCTION**	**9**
Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester‘s Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design –Defect Examples- Developer/Tester Support of Developing a Defect Repository		**CO1**
UNIT II	**TEST CASE DESIGN STRATEGIES**	**9**
Test case Design Strategies – Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing - Random Testing – Requirements based testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Additional White box testing approaches- Evaluating Test Adequacy Criteria		**CO2**
UNIT III	**LEVELS OF TESTING**	**9**
The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing –Compatibility testing – Testing the documentation – Website testing		**CO3**
UNIT IV	**TEST MANAGEMENT**	**9**
People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group- .The Technical Training Program		**CO4**
UNIT V	**TEST AUTOMATION**	**9**
Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOK

1. Srinivasan Desikan and Gopalaswamy Ramesh, ―Software Testing – Principles and Practices‖, Pearson Education, 2006.

REFERENCE BOOKS

1. Ilene Burnstein, ―Practical Software Testing‖, Springer International Edition, 2003.
2. Edward Kit, Software Testing in the Real World – Improving the Process‖, Pearson Education, 1995.
3. Boris Beizer, Software Testing Techniques‖ – 2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, ―Foundations of Software Testing _ Fundamental Algorithms and Techniques‖, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design test cases suitable for a software development for different domains.
CO2	Identify suitable tests to be carried out.
CO3	Prepare test planning based on the document.
CO4	Document test plans and test cases designed.
CO5	Use automatic testing tools and develop and validate test plan

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

CS1613	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn advanced Java programming concepts like interface, threads, Swings etc.
- To develop network programs in Java
- To understand Concepts needed for distributed and multi-tier applications
- To understand issues in enterprise applications development.

UNIT I	**JAVA GUI PROGRAMMING**	**9**
Basics of Swings - Swing Components - Containers and Frames –Layout Manager --Menus and Toolbars - Event Handling		**CO1**
UNIT II	**J2EE CONCEPTS**	**9**
Java EE 5 Platform Overview- Distributed Multi-tiered Applications- Web & Business Components-Java EE Containers – services & types- Java EE Application Assembly & Deployment – Packaging Applications, Java EE modules- Getting Started with Web applications- Model View Controller (MVC)2 Architecture & Packaging – Web application deployment descriptor (web.xml file)- Web Application Archive (*.WAR file) -Ant build tool		**CO2**
UNIT III	**APPLICATIONS IN DISTRIBUTED ENVIRONMENT**	**9**
Remote method Invocation – activation models – RMI custom sockets – Object Serialization – RMI – IIOP implementation – CORBA – IDL technology – Naming Services – CORBA programming Models - JAR file creation		**CO3**
UNIT IV	**MULTI-TIER APPLICATION DEVELOPMENT**	**9**
Server side programming – servlets – Java Server Pages - Applet to Applet communication – applet to Servlet communication - JDBC – Applications on databases – Multimedia streaming applications – Java Media Framework.		**CO4**
UNIT V	**ENTERPRISE APPLICATIONS AND FRAMEWORK**	**9**
Server Side Component Architecture –EJB Introduction-EJB Architecture- Session Beans – Entity Beans – Persistent Entity Beans –Java Frameworks-Strut introduction-HIBERNATE		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Elliotte Rusty Harold, " Java Network Programming", O'Reilly publishers, 3rd Edition 2004 (UNIT II)
2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc., 3rd edition,2006. (UNIT III and UNIT V)
3. Hortsmann& Cornell, "CORE JAVA 2 ADVANCED FEATURES, VOL II", Pearson Education, 2002. (UNIT I and UNIT IV)

REFERENCE BOOKS

1. Dustin R Callaway – "InsideServlets", 2 nd Edition, 2000.
2. Ivan Bayross "Web Enabled Commercial Application Development Using JAVA 2.0, 4." -2006
3. J.Mcgovern,R.Adatia, Y.Fain "J2EE 1.4 Bible" , 2000

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Develop the Java Basics, Platform independency and GUI Concept
CO2	Develop and derive the Swing design pattern.
CO3	Develop J2EE Server side programming concepts
CO4	Develop RMI, CORBA Chat application in Distributed Environment and web applications using Servlet, JSP and Applet
CO5	Develop the enterprise applications development and Strut, Hibernate Framework

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO2	3	3	3	2	1	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO5	3	3	2	2	1	-	-	-	-	1	2	2	3	3	2

CS1614	Introduction to Deep Learning	L	T	P	C
		3	0	0	3

OBJECTIVES

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT I	**INTRODUCTION**	**9**
Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates		**CO1**
UNIT II	**DEEP NETWORKS**	**9**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning		**CO2**
UNIT III	**DIMENSIONALITY REDUCTION AND CONVNET**	**9**
Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet – Convolution and Pooling - Architectures – LeNet, AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.		**CO3**
UNIT IV	**OPTIMIZATION AND GENERALIZATION**	**9**
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.		**CO4**
UNIT V	**GENERATIVE MODEL AND CASE STUDY**	**9**
Generative models: Restrictive Boltzmann Machines (RBMs), Stacking RBMs, Belief nets, Learning sigmoid belief nets, Deep belief nets - Applications in vision, speech and natural language processing		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018

REFERENCE BOOKS

1. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
3. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
4. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know the importance of deep learning in machine learning applications.
CO2	Design and implement deep learning applications
CO3	Design and implement CNN and RNN.
CO4	Understand the use of different deep learning models in image processing.
CO5	Explore the applications of deep learning in various domains.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

GE1003	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values,
- To install Moral and Social Values and Loyalty and to appreciate the rights of others

UNIT I	**HUMAN VALUES**	**9**
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management		**CO1**
UNIT II	**ENGINEERING ETHICS**	**9**
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories		**CO2**
UNIT III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law		**CO3**
UNIT IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination		**CO4**
UNIT V	**GLOBAL ISSUES**	**9**
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCE BOOKS

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt. Ltd., New Delhi 2013.
6. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To become familiar with human values
CO2	To get exposed engineering ethics.
CO3	To learn engineering as social experimentation
CO4	To study safety responsibilities and rights.
CO5	To become familiar with global issues

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	2	3	1	2	2	2	1	3	2
CO2	1	1	1	1	2	2	2	3	1	2	2	2	1	2	3
CO3	1	1	1	1	2	2	2	3	1	2	2	2	1	2	3
CO4	1	1	1	1	2	2	2	3	1	2	2	2	1	3	2
CO5	1	1	1	1	2	2	2	3	1	2	2	2	1	3	3

PROFESSIONAL ELECTIVE – III

CS1711	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization 's strategic goals

UNIT I	**PROJECT EVALUATION AND PROJECT PLANNING**	**9**
Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning		**CO1**
UNIT II	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION**	**9**
Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model		**CO2**
UNIT III	**ACTIVITY PLANNING AND RISK MANAGEMENT**	**9**
Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules		**CO3**
UNIT IV	**PROJECT MANAGEMENT AND CONTROL**	**9**
Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management		**CO4**
UNIT V	**STAFFING IN SOFTWARE PROJECTS**	**9**
Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012

REFERENCE BOOKS

1. Robert K. Wysocki ―Effective Software Project Management‖ – Wiley Publication, 2011.
2. Walker Royce: ―Software Project Management‖- Addison-Wesley, 1998.
3. Gopalaswamy Ramesh, ―Managing Global Software Projects‖ – McGraw Hill Education (India), Fourteenth Reprint 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand Project Management principles while developing software.
CO2	Gain extensive knowledge about the basic project management concepts, framework and the process models.
CO3	Obtain adequate knowledge about software process models and software effort estimation techniques. Estimate the risks involved in various project activities.
CO4	Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
CO5	Learn staff selection process and the issues related to people management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	2	3	3	3	2	2	2	3	3	2
CO2	1	1	1	2	2	2	3	3	3	2	2	2	3	3	2
CO3	1	1	1	2	2	2	3	3	3	2	2	2	3	3	2
CO4	1	1	1	2	2	2	3	3	3	2	2	2	3	3	2
CO5	1	1	1	2	2	2	3	3	3	2	2	2	3	3	2

CS1712	VIRTUALIZATION TECHNIQUES		L	T	P	C
Common to CSE & IT			3	0	0	3

OBJECTIVES

- To understand the concept of virtualization.
- To understand the various issues in virtualization.
- To be familiar with the virtualization of various components/functionalities.
- To compare and analyze various virtual machines products.
- To work with virtualization platforms

UNIT I	**INTRODUCTION**	**9**
System Architectures – Virtual Machine Basics – Process Virtual Machines – System Virtual Machines – Taxonomy of Virtual Machines – Emulation: Basic Interpretation – Threaded Interpretation – Pre-Coded & Direct Interpretation – Binary Translation – Full and Para-Virtualization – Types of Hypervisor – Types of Virtualization		**CO1**
UNIT II	**SERVER VIRTUALIZATION**	**9**
Server Virtualization – Partitioning Techniques – Hardware Virtualization – Virtual Hardware – Types of Server Virtualization – Business Cases for Sever Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform		**CO2**
UNIT III	**NETWORK VIRTUALIZATION**	**9**
Design of Scalable Enterprise Networks – Virtualizing the Campus – WAN Design – WAN Architecture – WAN virtualization – Virtual Enterprise Transport Virtualization – VLANs and Scalability – Theory Network Device Virtualization Layer 2 – VLANs Layer 3 VRF Instances Layer 2 – VFIs Virtual Firewall Contexts Network Device Virtualization – Datapath Virtualization Layer 2: 802.1q – Trunking Generic Routing Encapsulation – IPSec L2TPv3 Label Switched Paths – Control-Plane Virtualization – Routing Protocols – VRF- Aware Routing – Multi-Topology Routing		**CO3**
UNIT IV	**STORAGE VIRTUALIZATION**	**9**
Hardware Devices – SCSI – SCSI Communication – Using SCSI Buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI SAN Backup & Recovery Techniques – RAID – Classic Storage Model – SNIA Shared Storage Model Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual Tape Libraries		**CO4**
UNIT V	**APPLYING VIRTUALIZATION**	**9**
Comparison of Virtualization Technologies: Guest OS, Host OS, Hypervisor, Emulation, Kernel Level – Shared Kernel – Enterprise Solutions: Vmware Server, ESXi, Citrix Xen Server, Microsoft Virtual PC, Microsoft Hyper-V, Virtual Box – Server Virtualization: Configuring Server with Server Virtualization, Adjusting & Tuning Virtual Servers, VM Backup and Migration – Desktop Virtualization: Terminal Services, Hosted Desktop, Web Based Solutions, Localized Virtualized Desktop – Network and Storage Virtualization: VPN, VLAN, SAN and VSAN, NAS		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
2. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
3. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

REFERENCE BOOKS

1. William von Hagen, "Professional Xen Virtualization", Wrox Publications, January, 2008.
2. Kumar Reddy, Victor Moreno, "Network virtualization", Cisco Press, July, 2006.
3. Amy Newman, Kenneth Hess, "Practical Virtualization Solutions: Virtualization from the Trenches", Prentice Hall, October 2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Create a virtual machine and extend it to a virtual network.
CO2	Perform server virtualization.
CO3	Explain the concept of network virtualization.
CO4	Discuss various tasks in storage virtualization.
CO5	Compile all types of virtualization techniques and utilize them in design of virtual machines

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO2	3	3	3	2	1	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO5	3	3	2	2	1	-	-	-	-	1	2	2	3	3	2

CS1713	GPU ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

UNIT I	**GPU ARCHITECTURE**	**9**
Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory		**CO1**
UNIT II	**CUDA PROGRAMMING**	**9**
Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions		**CO2**
UNIT III	**PROGRAMMING ISSUES**	**9**
Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors		**CO3**
UNIT IV	**OPENCL BASICS**	**9**
OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples		**CO4**
UNIT V	**ALGORITHMS ON GPU**	**9**
Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, —Heterogeneous computing with OpenCL‖, 3rd Edition, Morgan Kauffman, 2015

REFERENCE BOOKS

1. Nicholas Wilt, —CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —CUDA by Example: An Introduction to General Purpose GPU Programming‖, Addison - Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. http://www.nvidia.com/object/cuda_home_new.html
5. http://www.openCL.org

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe GPU Architecture
CO2	Write programs using CUDA, identify issues and debug them
CO3	Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
CO4	Write simple programs using OpenCL
CO5	Identify efficient parallel programming patterns to solve problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2

CS1714	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Be familiar with resource management techniques.
- Learn to solve problems in linear programming and Integer programming.
- Be exposed to CPM and PERT.

UNIT I	**LINEAR PROGRAMMING**	**5**
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Resource allocation problems – Simplex method – Sensitivity analysis		**CO1**
UNIT II	**DUALITY AND NETWORKS**	**8**
Definition of dual problem – Primal – Dual relationships – Dual simplex methods – Post optimality analysis – Transportation and assignment model – Shortest route problem		**CO2**
UNIT III	**INTEGER PROGRAMMING**	**8**
Cutting plane algorithm – Branch and bound methods, Multistage (Dynamic) programming		**CO3**
UNIT IV	**CLASSICAL OPTIMISATION THEORY**	**12**
Unconstrained external problems, Newton – Ralphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems		**CO4**
UNIT V	**OBJECT SCHEDULING**	**12**
Network diagram representation – Critical path method – Time charts and resource leveling – PERT		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOK

1. H.A. Taha, “Operation Research”, Prentice Hall of India, 2002
2. V. Sundaresan, K.S. Ganapathy Subramanian, K. Ganesan, “Resource Management Techniques”, A.R. Publications.

REFERENCE BOOKS

1. Paneer Selvam, „Operations Research‟, Prentice Hall of India, 2002
2. Anderson “Quantitative Methods for Business”, 8th Edition, Thomson Learning, 2002.
3. Winston “Operation Research”, Thomson Learning, 2003.
4. Vohra, “Quantitative Techniques in Management”, Tata McGraw Hill, 2002.
5. Anand Sarma, “Operation Research”, Himalaya Publishing House, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Solve optimization problems using simplex method.
CO2	Solve dual and primal problems
CO3	Apply integer programming and linear programming to solve real-life applications
CO4	Solve unconstrained optimization problems
CO5	Use PERT and CPM for problems in project management

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	1	1	1	2	1	1	2	3	2	2
CO2	3	3	3	3	3	1	1	1	2	1	1	2	3	2	2
CO3	3	3	3	3	3	1	1	1	2	1	1	2	3	2	2
CO4	3	3	3	3	3	1	1	1	2	1	1	2	3	2	2
CO5	3	3	3	3	3	1	1	1	2	1	1	2	3	2	2

MG1001	PRINCIPLE OF MANAGEMENT	L	T	P	C
Common to CSE & AI-DS		3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9
Definition of Management – Science or Art – Manager vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.		**CO1**
UNIT II	**PLANNING**	**9**
Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		**CO2**
UNIT III	**ORGANISING**	**9**
Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority –77 centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management		**CO3**
UNIT IV	**DIRECTING**	**9**
Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.		**CO4**
UNIT V	**CONTROLLING**	**9**
System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

REFERENCE BOOKS

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Familiar with Management and Organizations task
CO2	Decision Making and Planning
CO3	Know about HRM, Performance Management, HR planning.
CO4	Communication and Motivational Theories
CO5	Familiar with controlling of process and reporting

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO2	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO4	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO5	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2

PROFESSIONAL ELECTIVE - IV

CS1721	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Get familiarized with different architectures and training algorithms of neural networks.
- Get exposed to the various neural modelling and control techniques with case study using simulation tool box.
- Gain Knowledge on fuzzy set theory and fuzzy rules.
- Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box

UNIT I	**ARTIFICIAL NEURAL NETWORK**	**9**
Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perception – Limitation – Multi layer perception – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning		**CO1**
UNIT II	**NEURAL NETWORKS FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect Neuro control schemes – Adaptive Neuro controller – Familiarization with neural network toolbox		**CO2**
UNIT III	**FUZZY SET THEORY**	**9**
Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions		**CO3**
UNIT IV	**FUZZY LOGIC FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox		**CO4**
UNIT V	**HYBRID CONTROL SCHEMES**	**9**
Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Case study – Familiarization with ANFIS toolbox		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000.

REFERENCE BOOKS

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989
2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992.
3. EthemAlpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.
4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand basics of deep learning
CO2	Implement various deep learning models
CO3	Realign high dimensional data using reduction techniques
CO4	Analyze optimization and generalization in deep learning
CO5	Explore the deep learning applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

CS1722	QUANTUM COMPUTING	L	T	P	C
Common to CSE & IT		3	0	0	3

OBJECTIVES

- To introduce the fundamentals of quantum computing
- The problem-solving approach using finite dimensional mathematics

UNIT I	**COMPLEX NUMBERS AND VECTORS**		**9**
Complex numbers and its geometrical representations, Complex vector spaces, inner products and Hilbert spaces, Hermitian and unitary matrices, Tensor products of vector spaces, Quantum bits, Bloch sphere representation of a qubit, multiple qubits, Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis		**CO1**	
UNIT II	**QUANTUM MECHANICS**		**9**
Quantum Circuits: Single qubit gates, multiple qubit gates, design of quantum circuits. Classical gates versus quantum gates		**CO2**	
UNIT III	**QUANTUM INFORMATION AND CRYPTOGRAPHY**		**9**
Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem		**CO3**	
UNIT IV	**QUANTUM ALGORITHMS**		**9**
Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search		**CO4**	
UNIT V	**NOISE AND ERROR CORRECTION**		**9**
Graph states and codes, Quantum error correction, fault-tolerant computation		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOKS

1. Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008.

REFERENCE BOOKS

1. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008
2. Quantum computation and quantum information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010
3. Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995
4. Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Basics of complex vector spaces
CO2	Quantum mechanics as applied in Quantum computing
CO3	Architecture and algorithms
CO4	Fundamentals of Quantum computations
CO5	Understand noise and error correction techniques

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	2	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	2	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	2	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1723	SOFTWARE ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To use architecture to address accelerating growth in requirements and system size.
- For utilizing architecture to optimize key quality attributes.
- Scale systems by discovering architecturally significant influences, using DevOps.
- To understand architecture's role in the organization, so you can deliver more value.

UNIT I	**INTRODUCTION, SOFTWARE ARCHITECTURE, ITS IMPORTANCE**	**9**
Software Architecture, Architectural Structures and Views, Software Architecture Importance: Enabling a System's Quality Attributes, Managing Change, Predicting System Qualities, Communication among Stakeholders, Early Design Decisions, Constraints on Implementation, Organizational Structure, Enabling Incremental Development, Cost and Schedule Estimates, Reusable Model, Architecture Allows Incorporation of Independently Developed Elements.		**CO1**
UNIT II	**QUALITY ATTRIBUTES, QUALITY ATTRIBUTE REQUIREMENTS, INTEGRABILITY**	**9**
Understanding Quality Attributes: Functionality, Quality Attribute Considerations, Specifying Quality Attribute Requirements: Quality Attribute Scenarios, Achieving Quality Attributes through Architectural Patterns and Tactics, Designing with Tactics, Analysing Quality Attribute Design, Integrability: Evaluating the Integrability of an Architecture, Its General Scenario, Integrability Tactics, Its Tactics-Based Questionnaire, Patterns.		**CO2**
UNIT III	**VIRTUALIZATION, ARCHITECTURALLY SIGNIFICANT REQUIREMENTS, DESIGNING** AN **ARCHITECTURE**	**9**
Virtualization: Shared Resources, Virtual Machines, VM Images, Containers and VMs, Container Portability, Pods, Serverless Architecture, Architecturally Significant Requirements: Gathering ASRs from Requirements Documents, Gathering ASRs by Interviewing Stakeholders and understanding the Business Goals, Capturing ASRs in a Utility Tree, Designing an Architecture: Attribute-Driven Design, The Seven Steps of ADD.		**CO3**
UNIT IV	**EVALUATING AN ARCHITECTURE, DOCUMENTING AN ARCHITECTURE**	**9**
Evaluating an Architecture: Evaluation as a Risk Reduction Activity, Key Evaluation Activities, Contextual Factors, The Architecture Trade-off Analysis Method, Lightweight Architecture Evaluation Documenting an Architecture: Uses and Audiences for Architecture Documentation, Notations, Views, Combining View, Documenting Behaviour, Beyond Views, Documenting the Rationale, Architecture Stakeholders.		**CO4**
UNIT V	**ROLE OF ARCHITECTS IN PROJECTS, ARCHITECTURE COMPETENCE**	**9**
The Role of Architects in Projects: The Architect and the Project Manager, Incremental Architecture and Stakeholders, Architecture and Agile Development, Architecture and Distributed Development Architecture Competence: Competence of Individuals: Duties, Skills, and Knowledge of Architects, Competence of a Software Architecture Organization, Become a Better Architect.		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Addison-Wesley Professional, 4th Edition, 2021.

REFERENCE BOOKS

1. Richard H. Thayer, Mark J. Christensen, "Software Engineering, The Development", Volume 1, Third Edition, 2016.
2. Arthur M Langer, "Analysis and Design of Next-generation Software Architectures" , Springer Nature Switcher land, 2020.
3. Mark Richards and Neal Ford, "Software Architecture Fundamentals Workshop Part 1: From Developer to Architect", 2020.
4. Taylor et al., "Software Architecture: Foundations, Theory, and Practice" , John Wiley, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Introduction to Software Architecture and its importance
CO2	Understanding of Quality Attributes, Quality Attribute Requirements and Integrability
CO3	The concept of Virtualization, Architecture Significant Requirements, Designing an Architecture
CO4	Evaluating an Architecture and Documenting an Architecture
CO5	The role of Architects in Projects and architecture Competence

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1724	MULTIMEDIA AND GRAPHICS PACKAGES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about multimedia system properties and data stream characteristics of continuous media
- To explore the features of different types of media like image, audio and video
- To provide knowledge about Multimedia Communication Systems
- To know about R Graphics
- To explore the concepts of Grid graphics

UNIT I	**MEDIA AND DATA STREAMS**	**9**
Multimedia: Media and Data Streams: Medium –Main properties of Multimedia System –Multimedia –Traditional Data Streams Characteristics –Data Stream characteristics of continuous Media		**CO1**
UNIT II	**MULTIMEDIA**	**9**
Sound / Audio: Basic Sound Concepts –Music –Speech –Images and Graphics: Basic Concepts –Computer I mage Processing –Video and Animation: Basic Concepts –Television –Computer-Based Animation		**CO2**
UNIT III	**MULTIMEDIA COMMUNICATION SYSTEMS**	**9**
Multimedia Communication Systems: Application Subsystem –Collaborative Computing –Session Management - Transport Subsystem –Transport Layer –Network Layer –Quality of Service and Resource Ma nagement – Ba sic Concepts – Establishment and Closing of the Multimedia Call – Managing Resources during Multimedia Transmission		**CO3**
UNIT IV	**INTRODUCTION TO R GRAPHICS**	**9**
R Graphics Examples: Standard Plots –Trellis Plots –The Grammar of Graphics –Specialized plots –Organization of R Graphics: Types of Graphics functions –Traditional Graphics Vs Grid Graphics		**CO4**
UNIT V	**GRID GRAPHICS**	**9**
Trellis Graphics: The Lattice graphics model –lattice plot types –the formula argument and multipanel conditioning – the group argument and legends –layout argument and arranging plots –scale argument a nd labeling a xes – panel argument and annotating plots		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ralf Steinmetz, Klara Nahrstedt, "Multimedia: Computing, Communications & Applications", Pearson Education Inc., 2011
2. Paul Murrell, "R Graphics", CRC Press, Second Edition, 2012

REFERENCE BOOKS

1. Ze-Nian Li , Mark S. Drew and Jiangchuan Liu, Fundamentals of Multimedia , Springer International Publishing, 2014
2. Winston Chang R., Graphics Cookbook, O'Reilly, 2013

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand multimedia system properties and data stream characteristics of continuous media
CO2	Analyze the features of different media
CO3	Understand the Multimedia Communication Systems
CO4	Understand the concepts of R graphics
CO5	Analyze the Grid graphics concepts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	-	-	-	2	2	2	3	3	2
CO2	2	2	1	1	2	-	-	-	-	2	2	2	3	3	2
CO3	2	2	1	1	2	-	-	-	-	2	2	2	3	3	2
CO4	2	2	1	1	2	-	-	-	-	2	2	2	3	3	2
CO5	2	2	1	1	2	-	-	-	-	2	2	2	3	3	2

CS1725	HUMAN COMPUTER INTERACTION	L	T	P	C

(Common to CSE & AI-ML)		3	0	0	3

OBJECTIVES

- To know how to analyze and consider user's need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human – machine interaction

UNIT I	**INTRODUCTION**	**9**
Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output		**CO1**
UNIT II	**DESIGN PROCESS**	**9**
Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centered Design - Methods for User-Centered Design		**CO2**
UNIT III	**IMPLEMENTATION AND EVALUATION PROCESS**	**9**
Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support		**CO3**
UNIT IV	**MODELS**	**9**
Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction		**CO4**
UNIT V	**APPLICATIONS**	**9**
Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. “Human – Computer Interaction”, Second edition, Prentice Hall,1998

REFERENCE BOOKS

1. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. “Human – Computer Interaction”, Addison Wesley, 1994.
2. John M.Carrol, “Human Computer Interaction in the New Millenium”, Pearson Education, 2002.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To develop good design for human machine interaction syste
CO2	Analyze the user's need in interaction system
CO3	To design new interaction model to satisfy all types of customers
CO4	Evaluate the usability and effectiveness of various products
CO5	To know how to apply interaction techniques for systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	3	3	2	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2

PROFESSIONAL ELECTIVE – V

CS1811	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of natural language processing
- To understand word level and syntactic analysis.
- To understand the syntax analysis and parsing
- To understand the role of semantics of sentences and pragmatics
- To get knowledge about the machine translation

UNIT I	**INTRODUCTION**	**9**
Overview: Origins and challenges of NLP-Language and Grammar-Processing Indian Languages - NLP Applications-Information Retrieval. Language Modeling: Various Grammar-based Language Models-Statistical Language Model.		**CO1**
UNIT II	**WORD LEVEL ANALYSIS**	**9**
Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance - Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff -Words and Word classes-Part-of Speech Tagging - Issues in PoS tagging – Hidden Markov and Maximum Entropy models.		**CO2**
UNIT III	**SYNTACTIC ANALYSIS**	**9**
Context-Free Grammars, Grammar rules for English, Treebank, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.		**CO3**
UNIT IV	**SEMANTICS AND PRAGMATICS**	**9**
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selection restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.		**CO4**
UNIT V	**NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION**	**9**
Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation-Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Second Edition, Pearson Publication, 2014
2. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009
3. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman & Hall/CRC Press, 2010.

REFERENCE BOOKS

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, OReilly Media, 2009
2. Breck Baldwin, "Natural Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
3. Richard M Reese, "Natural Language Processing with Java", First Edition, Packt Publishing,2015.
4. YoavGoldberg, GraemeHirst, "Neural Network Methods for Natural Language Processing - Synthesis Lectures on Human Language Technologies", Morgan and Claypool Life Sciences, 2017.
5. Deepti Chopra, Nisheeth JoshiIti Mathur, "Mastering Natural Language Processing with Python", First Edition, Packt Publishing Limited, 2016
6. Mohamed ZakariaKurdi "Natural Language Processing and Computational Linguistics 1: Speech, Morphology and Syntax", First Edition, ISTE Ltd. Wiley, 2016
7. Atefeh Farzindar, DianaInkpen, "Natural Language Processing for Social Media, Second Edition, Morgan and Claypool Life Sciences, 2015

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To tag a given text with basic Language features
CO2	To design an innovative application using NLP components
CO3	To implement a rule-based system to tackle morphology/syntax of a language
CO4	To design a tag set to be used for statistical processing for real-time applications
CO5	To perform machine translation by preserving the meaning of the input text, and producing fluent text in the output language

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)										PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1	1	2	3	2	1	1	2	3	3	2	3
CO2	2	2	2	1	2	2	2	1	2	2	2	3	3
CO3	2	3	2	2	3	2	1	1	2	3	3	2	3
CO4	2	3	2	1	2	1	1	1	2	2	3	3	3
CO5	2	3	2	2	2	2	2	2	2	2	3	3	3

CS1812	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the Architecture of PIC microcontroller
- To learn about Interrupts and timers
- To recognize the Peripheral devices for data communication and transfer
- To know the Functional blocks of ARM processor
- To learn about Architecture of ARM processors

UNIT I	**INTRODUCTION TO PIC MICROCONTROLLER**	**9**
Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations		**CO1**
UNIT II	**INTERRUPTS AND TIMER**	**9**
PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variability strings		**CO2**
UNIT III	**PERIPHERALS AND INTERFACING**	**9**
I^2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing		**CO3**
UNIT IV	**INTRODUCTION TO ARM PROCESSOR**	**9**
Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems		**CO4**
UNIT V	**ARM ORGANIZATION**	**9**
3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000

REFERENCE BOOKS
1. Mazidi, M.A.,“PIC Microcontroller” Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and apply computing platform and software for engineering problems
CO2	Understand the concepts of Architecture of PIC microcontroller
CO3	Acquire knowledge on Interrupts and timers
CO4	Understand the importance of Peripheral devices for data communication
CO5	Acquire knowledge in Architecture of ARM processors

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	-	1	-	1	-	1	3	3	2
CO2	2	2	1	1	2	-	-	1	-	1	-	1	3	3	2
CO3	2	2	1	1	2	-	-	1	-	1	-	1	3	3	2
CO4	2	2	1	1	2	-	-	1	-	1	-	1	3	3	2
CO5	2	2	1	1	2	-	-	1	-	1	-	1	3	3	2

CS1813	FORENSICS AND CYBER LAW	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of Forensics and Cyber Crime.
- To know about the types and categories of Cyber Crime.
- To learn about penetration, auditing and testing in Cyber Crime.
- To understand the importance of Cyber Security.
- To recognize the significance of Cyber Act.

UNIT I	**INTRODUCTION TO FORENSICS AND CYBER CRIME**		**9**
Fundamentals of computer, Internet Technology, E-Governance & E-Business ,Crime, criminology, origin, source, recent trends. Emergence of information based society, economic, administration, social, dependence of use of information, accession, threats, civil society and global society, Overview of computer forensics and Investigative Techniques, Computer forensic tools, activities of forensic investigations and testing methodology		**CO1**	
UNIT II	**TYPES AND CATEGORIES OF CYBER CRIME**		**9**
Personal, Business, Financial, Office Security, Cyber Crime – Complete transparency, hacking/cracking, denial of service, IP piracy, phrasing, hetaerism etc. Cyber Attack – cyber attackers		**CO2**	
UNIT III	**ROLE OF COMPUTERS AND INTERNET IN CYBER CRIME, PENETRATION TESTING AND AUDITING**		**9**
Computer as witness, evidence, act, defining evidence, computer forensics, computer storage, media of electric record for use of course of law. Customers and legal agreements, Router penetration testing, Firewalls penetration testing, Intrusion detection system penetration testing, Wireless networks penetration testing, Password cracking penetration testing, Social engineering penetration testing, Application penetration testing, Policies and controls testing. Penetration testing report and documentation writing , Policies and procedures Security Policies-checklist		**CO3**	
UNIT IV	**CYBER SECURITY**		**9**
The concept of cyber security , meaning, scope and the frame work, basic structure development and management, Rules, Regulations, Act, Legislation - Meaning, Scope, Difference between Rules		**CO4**	
UNIT V	**NEED FOR A CYBER ACT**		**9**
The Indian Context , Need for a Cyber Act , Information Technology Act , Scope and further Development , Information Technology Act (Amendment) , coverage of Cyber Security and Cyber Crime Indian cyber Laws vs. cyber laws of U.S.A , similarities , scope and coverage , Effectiveness. Laboratory work: consists of gathering information, evidence with tools like WinHex, Metasploit and Social Engineering toolkit		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOKS

1. Cyber Forensics: from Data to Digital Evidence , Albert J. Marcella Jr., Wiley,1 st Edition,2012
2. Hack I.T. - Security Through Penetration Testing, T. J. Klevinsky, Scott Laliberte and Ajay Gupta, Addison-Wesley, 1st Edition,2002

REFERENCE BOOKS
1. Computer Forensics: Cybercriminals, Laws, And Evidence , Marie-Helen Maras, Jones & Bartlett Learn ,1st Edition ,2011 2. Computer Forensics: Investigating Network Intrusions and Cyber Crime, EC Council Press Series, Cengage Learning , 2010

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals of Forensics and Cyber Crime.
CO2	Know about the types and categories of Cyber Crime.
CO3	Identify about penetration, auditing and testing in Cyber Crime.
CO4	Know the importance of Cyber Security.
CO5	Recognize the significance of Cyber Act.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1814	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Be familiar with mathematical foundations of data mining tools
- Understand and implement classical models and algorithms in data warehouses and data mining
- Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering
- Master data mining techniques in various applications like social, scientific and environmental context
- Develop skill in selecting the appropriate data mining algorithm for solving practical problems

UNIT I	**DATA WAREHOUSE**	**9**
Introduction to Data Ware House, Differences between operational data base systems and data Ware House, Data Ware House characteristics, Data Ware House Architecture and its components, Extraction-Transformation-Loading, Logical (MulitDimensional), Data Modeling, Schema Design, star and snow-Flake Schema, Fact Constellation, Fact Table, Fully Addictive, Semi-Addictive, Non-Addictive Measures; FactLess-Facts, Dimension Table characteristics; Fact-Less-Facts, Dimension Table characteristics; OLAP cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP		**CO1**
UNIT II	**INTRODUCTION TO DATA MINING**	**9**
Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing- Data Cleaning, Missing Data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binaryzation , Data Transformation; Measures of similarity and dissimilarity-Basics		**CO2**
UNIT III	**ASSOCIATION RULES**	**9**
Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation, APRIORI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set-Maximal Frequent Item Set, Closed Frequent Item Set		**CO3**
UNIT IV	**CLASSIFICATION**	**9**
Problem definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision trees-Decision Tree Construction, Methods for expressing attribute test conditions, Measures for Selecting the Best split, Algorithm for Decision tree Induction, Naïve-Bayes Classifier, Bayesian Belief Networks; K-nearest neighbor classification-Algorithm and characteristics		**CO4**
UNIT V	**CLUSTERING**	**9**
Problem Definition, Clustering overview, Evaluation of clustering algorithms, Partitioning clustering K-Means Algorithm, K-Means Additional Issues, PAM Algorithm, Hierarchical Clustering-Algorithm- Agglomerative Methods and Divisive Methods, Basic Agglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and weakness, Outlier Detection		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han, Micheline Kamber, Data Mining-Concepts and Techniques, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006
2. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Introduction to Data Mining, Pearson Education

REFERENCE BOOKS

1. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press
2. Pualraj Ponnaiah, Data Ware Housing Fundamentals, Wiley Student Edition
3. Ralph Kimball, The Data Ware House Life Cycle Toolkit, Wiley Student Edition
4. Vikaram Pudi, P Radha Krishna, Data Mining, Oxford University

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functionality of the various data mining and data warehousing component
CO2	Appreciate the strengths and limitations of various data mining and data warehousing models
CO3	Explain the analyzing techniques of various data
CO4	Describe different methodologies used in data mining and data ware housing
CO5	Compare different approaches of data ware housing and data mining with various technologies

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	-	-	1	-	2	2	2	3	3	2
CO2	2	2	2	1	2	-	-	1	-	2	2	2	3	3	2
CO3	2	2	2	1	2	-	-	1	-	2	2	2	3	3	2
CO4	2	2	2	1	2	-	-	1	-	2	2	2	3	3	2
CO5	2	2	2	1	2	-	-	1	-	2	2	2	3	3	2

CS1815	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the basic tenets of software quality and quality factors.
- Be exposed to the Software Quality Assurance (SQA) architecture and the details of SQA components.
- Understand of how the SQA components can be integrated into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality

UNIT I	**INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE**	**9**
Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall"s quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans		**CO1**
UNIT II	**SQA COMPONENTS AND PROJECT LIFE CYCLE**	**9**
Software Development methodologies – Quality assurance activities in the development process - Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management		**CO2**
UNIT III	**SOFTWARE QUALITY INFRASTRUCTURE**	**9**
Procedures and work instructions - Templates - Checklists – 3S development team - Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval		**CO3**
UNIT IV	**SOFTWARE QUALITY MANAGEMENT & METRICS**	**9**
Project process control – Computerized tools - Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of software quality – Classical quality cost model – Extended model – Application of Cost model		**CO4**
UNIT V	**STANDARDS, CERTIFICATIONS & ASSESSMENTS**	**9**
Quality management standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – IEEE st 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities – SQA units and other actors in SQA systems		**CO5**

TOTAL : 45 PERIODS

TEXT BOOK

1. Daniel Galin, “Software Quality Assurance”, Pearson Publication, 2009

REFERENCE BOOKS

1. G.James, D.Witten,T.Hastie,R.Tibshirani-An introduction to statistical learning with applications in R,Springer,2013.
2. E.Alpaydin, Introduction to Machine Learning, Prentice Hall Of India,2010.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009.
4. C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Utilize the concepts in software development life cycle
CO2	Demonstrate their capability to adopt quality standards.
CO3	Assess the quality of software product.
CO4	Apply the concepts in preparing the quality plan & documents
CO5	Understand certification and assessments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	3	2	3	2	2	2	2	3	3	3
CO2	1	1	1	2	1	3	2	3	2	2	2	2	3	3	3
CO3	1	1	1	2	1	3	2	3	2	2	2	2	3	3	3
CO4	1	1	1	2	1	3	2	3	2	2	2	2	3	3	3
CO5	1	1	1	2	1	3	2	3	2	2	2	2	3	3	3

PROFESSIONAL ELECTIVE – VI

CS1821	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of software defined networks.
- To understand the separation of the data plane and the control plane.
- To study about the SDN Programming.
- To study about the various applications of SDN

UNIT I	**INTRODUCTION**	**9**
History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes		**CO1**
UNIT II	**OPEN FLOW & SDN CONTROLLERS**	**9**
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts		**CO2**
UNIT III	**DATA CENTERS**	**9**
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE		**CO3**
UNIT IV	**SDN PROGRAMMING**	**9**
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications		**CO4**
UNIT V	**SDN**	**9**
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.

REFERENCE BOOKS

1. Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Analyze the evolution of software defined networks
CO2	Express the various components of SDN and their uses
CO3	Explain the use of SDN in the current networking scenario
CO4	Design and develop various applications of SDN
CO5	Understand about SDN frameworks

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2

CS1822	iOS APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles of iOS app development
- To provide hands-on experience and networking with use of Swift programming language
- To understand the conceptual overview, design issues, and practical development via iOS a pp development projects
- To use iOS development tools such as Xcode, design interfaces and interactions and evaluate their usability, and integrate camera, photo, and location -information to enhance iOS apps

UNIT I	INTRODUCTION TO SWIFT PROGRAMMING	9
Swift language essentials: Arrays, Dictionaries, functions, Optionals, Control Flow, Structs Enums and Classes, Playgrounds. Elements of The Swift Foundation classes, Cocoa Touch Foundation Framework, Simple connections to the User Interface		**CO1**
UNIT II	**IOS APP DESIGN AND DEVELOPMENT PRINCIPLES**	**9**
Overview of iOS History, iOS Devices, iOS App Markets, iOS Design Principles, i OS Software Arc hitecture, iOS Development Tools, Xcode, iOS Programming Languages of Swift and Objective-C, Objective-C Compatibility, Foundation Frameworks, Model-View-Controller(MVC), Multiple MVCs		**CO2**
UNIT III	**BEST PRACTICES FOR IOS USER INTERFACE AND FUNCTIONALITY DESIGN**	**9**
UI Overview, Views, Gestures, View Controller Lifecycle, Storyboard, Autolayout, Scroll View, Multithreading, Table View, Unwind Segues, Alerts, Timers, View Animation, Dynamic Animation, Application Lifecycle, Core Motion, Core Location, Map Kit, Modal Segues, Camera, Persistence, Embed Segues, Internationalization and Settings		**CO3**
UNIT IV	**IOS NETWORKING AND SECURITY**	**9**
iOS Networking with MVC, Social Networking in iOS, Web API Security and Data Transport, i OS Secure Network Setting, Basic OAuth2 Functionality, Secure JSON Web APIs, Cryptographically Secured Push Notifications, Core Data, Secure Data Storage		**CO4**
UNIT V	**IOS APP SOFTWARE ENGINEERING**	**9**
Software Development Cycles, Requirements Capture, Automated Testing, Test-Driven Development, Debugging, Deployment to Market, Distribution of iOS App through the App Store, Monetization		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Matt Neuburg, iOS 9 Programming Fundamentals with Swift, O'Reilly, 2015
2. The Swift Programming Language, Swift Programming Series, Apple Inc., 2019

REFERENCE BOOKS

1. Jesse Feiler, "iOS App Development For Dummies," Wiley, 2014
2. Craig Grummitt, "iOS Development with Swift," Manning Publications, 2017
3. Christian Keur, Aaron Hillegass, "iOS Programming: The Big Nerd Ranch Guide," 7th Edition, O'Reilly, 2020
4. Matt Neuburg, "iOS 13 Programming Fundamentals with Swift: Swift, Xcode, and Cocoa Basics," O'Reilly, 2020

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand iOS development tools and Swift programming language to develop iOS Apps from scratch
CO2	Describe the principles of software requirements for the iOS app development and networking
CO3	Apply the principles of software engineering to the iOS app software development and networking
CO4	Describe the skills required to produce and maintain a high-quality iOS app
CO5	Evaluate and apply software process and software best practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	-	-	1	-	1	1	1	3	3	2
CO2	2	2	1	1	1	-	-	1	-	1	1	1	3	3	2
CO3	2	2	1	1	1	-	-	1	-	1	1	1	3	3	2
CO4	2	2	1	1	1	-	-	1	-	1	1	1	3	3	2
CO5	2	2	1	1	1	-	-	1	-	1	1	1	3	3	2

CS1823	NETWORK SIMULATION USING NS3	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the ns3 fundamentals and installation
- To become familiar with events and simulation
- To understand logging and tracing, during network simulation
- To learn the intricacies of building various network topologies
- To run network simulations in ns3 using C++ and Python scripts

UNIT I	**NS3 ARCHITECTURE AND INSTALLATION**	**9**
Introduction – Network Simulation – Network Emulation – Evolution of Network Simulators and Emulators – Testbed – ns3 Installation –Software Organization –ns2 vs ns3 –running ns3 scripts		**CO1**
UNIT II	**RANDOM VARIABLES**	**9**
Pseudo-Random number generation –creating random variables –Class Random Variable Stream –Base Class Public API – Types of Random Variables		**CO2**
UNIT III	**EVENTS AND SIMULATION**	**9**
Simulator object –Scheduler –Simulation time –Events –ns3 source code –key abstractions – Node – Packet – Channel –Net Device –Topology Helpers –ns3 Namespace –Containers – Applications –Building ns3 script		**CO3**
UNIT IV	**LOGGING AND TRACING**	**9**
Logging module –enabling logging –Command Line Arguments –Tracing System –ASCII tracing –parsing traces – PCAP tracing –tcpdump –Wireshark –callbacks –connect with config –dynamic trace sources – Trace sinks – gnuplot –NetAnim		**CO4**
UNIT V	**BUILDINGTOPOLOGIES AND DATA COLLECTION**	**9**
Bus Network topology –Wireless Network topology –Queues –Queuing models –Data collection –GNUPlotHelper –Supported Trace types - FileHelper		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jack L. Burbank, “An Introduction to Network Simulator 3”, Wiley-Blackwell, First Edition, 2016

REFERENCE BOOKS

1. Klaus Wehrle, Mesut Gunes, James Gross, “Modeling and Tools for Network Simulation”, Springer, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand ns3 software organization and installation
CO2	Generate simple events in simulation
CO3	Implement logging, tracing and Animation
CO4	Build various network topologies
CO5	Analyze wired & wireless network simulations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)	PROGRAM SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	-	-	1	-	-	1	1	3	3	2
CO2	2	3	1	1	1	-	-	1	-	-	1	1	3	3	2
CO3	2	3	1	1	1	-	-	1	-	-	1	1	3	3	2
CO4	2	3	1	1	1	-	-	1	-	-	1	1	3	3	2
CO5	2	3	1	1	1	-	-	1	-	-	1	1	3	3	2

CS1824	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
	(Common to CSE & IT)	3	0	0	3

OBJECTIVES

- Understand how blockchain systems (mainly Bitcoin and Ethereum) work
- To securely interact with them,
- Design, build, and deploy smart contracts and distributed applications,
- Integrate ideas from blockchain technology into their own projects.

UNIT I	**BASICS**	**9**
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.		**CO1**
UNIT II	**BLOCKCHAIN**	**9**
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.		**CO2**
UNIT III	**DISTRIBUTED CONSENSUS**	**9**
Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		**CO3**
UNIT IV	**CRYPTOCURRENCY**	**9**
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin		**CO4**
UNIT V	**CRYPTOCURRENCY REGULATION**	**9**
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

REFERENCE BOOKS

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger, ”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design principles of Bitcoin and Ethereum and Nakamoto consensus
CO2	Learn the simplified Payment Verification protocol and describe differences between proof-of-work and proof-of-stake consensus.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO5	Evaluate security, privacy, and efficiency of a given blockchain system.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	2	3	3	1	2	2	1	1	2	3	3	2
CO2	1	1	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	1	3	2	3	3	1	1	2	1	1	2	3	3	2
CO4	1	1	2	2	3	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	3	2	1	2	2	1	1	2	3	3	2

CS1825	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide the knowledge on information retrieval system capabilities.
- To introduce different computational search problems and evaluate search engines.
- To introduce different applications of informational retrieval techniques in the internet or web environment.
- To discuss about information visualization and system evaluation.

UNIT I	**INTRODUCTION**		**9**
Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.		**CO1**	
UNIT II	**CATALOGING AND INDEXING**		**9**
Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.		**CO2**	
UNIT III	**AUTOMATIC INDEXING**		**9**
IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.		**CO3**	
UNIT IV	**USER SEARCH TECHNIQUES**		**9**
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.		**CO4**	
UNIT V	**INFORMATION VISUALIZATION**		**9**
Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its technologies, Network Infrastructure.		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOK

1. Kowalski, Gerald, Mark T May bury: INFORMATION RETRIEVAL SYSTEMS: Theory and Implementation, Kluwer Academic Press, 1997

REFERENCE BOOKS

1. Gerald Kowalski: INFORMATION RETRIEVAL Architecture and Algorithms.
2. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval data Structures and Algorithms, Prentice Hall, 1992.
3. Modern Information Retrieval by Yates Pearson Education.
4. Information Storage & Retrieval by Robert Korfhage –John Wiley & Sons.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand various functionalities and capabilities of Information Retrieval System.
CO2	Gain knowledge on cataloguing and data structure methodology for IRS.
CO3	Differentiate various clustering algorithms and indexing.
CO4	Differentiate various user search techniques and system search techniques.
CO5	Understand the concepts of information visualization and text search

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO2	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO3	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO4	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO5	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2

OPEN ELECTIVES – I & II

OBT101	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

UNIT I	**OVERVIEW OF THE CELL**	**9**
Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.		**CO1**
UNIT II	**MICROBIAL GROWTH: PURE CULTURE TECHNIQUES**	**9**
Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures. Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.		**CO2**
UNIT III	**MANAGEMENT OF WASTE**	**9**
Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting		**CO3**
UNIT IV	**BIOREMEDIATION**	**9**
Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex-situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.		**CO4**
UNIT V	**BIOENERGY AND BIOMINING**	**9**
Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,

REFERENCE BOOKS

1. Environmental Biotechnology - Allan Stagg.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	2	2	4	2	1	1	1	2	1	1
CO2	2	1	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	3	3	2	1	1	2	4	3	1	2	4	5	1	2	2
CO4	3	3	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	4	5	2	4	3	2	1	2	3	1	1	2	2

OBT104	BIOSENSORS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	**PROTEIN BASED BIOSENSORS**	**9**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		**CO1**
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		**CO2**
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		**CO3**
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		**CO4**
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT I	BASICS OF NANOTECHNOLOGY	9
Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.		CO1
UNIT II	**DIFFERENT CLASSES OF NANOMATERIALS**	**9**
Classification based on dimensionality-Quantum Dots,Wells and Wires - Carbon based nano materials (buckyballs, nanotubes, grapheme) - Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		CO2
UNIT III	**SYNTHESIS OF NANOMATERIALS**	**9**
Chemical Methods: Metal Nanocrystals by Reduction -Sol - gel processing - Solvothermal Synthesis - Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		CO3
UNIT IV	**CHARACTERIZATION OF NANOSTRUCTURES**	**9**
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)- Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		CO4
UNIT V	**APPLICATIONS**	**9**
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices -Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	Develop an ability to critically evaluate the promise of a nanotechnology device.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	1

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data models.
- To know the details of data input and topology
- To know the knowledge on data management and output processes
- To know the data quality and standards

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open-source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		CO1
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector ModelsTIN and GRID data models - OGC standards - Data Quality.		CO2
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.		CO3
UNIT IV	**DATA ANALYSIS**	**9**
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.		CO4
UNIT V	**APPLICATIONS**	**9**
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition,2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver,Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2ndEdition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers,2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO2	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2
CO3	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO4	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO5	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration and management.
- To know the market related research process and its HRM
- To understand the recruitment and training processes in hospitals
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I	OVERVIEW OF HOSPITAL ADMINISTRATION	9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		CO1
UNIT II	HUMAN RESOURCE MANAGEMENT IN HOSPITAL	9
Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.		CO2
UNIT III	RECRUITMENT AND TRAINING	9
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		CO3
UNIT IV	SUPPORTIVE SERVICES	9
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		CO4
UNIT V	COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL	9
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and issues in supporting departments of hospitals
CO5	Understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1

OEC103	BASICS OF EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IoT

UNIT I	**INTRODUCTION TO EMBEDDED SYSTEM**	**9**
Complex systems and microprocessors– Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques–Design example: Model train controller.		**CO1**
UNIT II	**BASICS OF ARM ARCHITECTURE AND PERIPHERAL INTERFACING**	**9**
ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU		**CO2**
UNIT III	**EMBEDDED PROGRAMMING CONCEPTS**	**9**
Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing		**CO3**
UNIT IV	**INTRODUCTION TO IoT**	**9**
Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT - Passive and active sensors - Different applications of sensors - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.		**CO4**
UNIT V	**COMMUNICATION PROTOCOLS FOR EMBEDDED AND IoT**	**9**
Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - Wi-Fi, Bluetooth, ZigBee.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons", Inc, USA, 2013

REFERENCE BOOKS

a. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons Ltd, UK, 2014
b. Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd, UK, 2015.
c. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi" , 1st Edition, Apress Publishers, USA, 2013.
d. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	2	1	2	-	1	2	2	3	3	2
CO2	3	3	2	3	-	3	1	2	-	1	2	2	3	3	2
CO3	3	3	2	3	3	3	1	2	1	1	2	2	3	3	2
CO4	3	3	3	3	-	2	1	2	-	1	2	2	3	3	2
CO5	3	3	3	3	2	3	1	2	1	1	2	2	3	3	2

OEE101	BASIC CIRCUIT THEORY	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I	**BASIC CIRCUITS ANALYSIS**	**9**
Resistive elements - Resistors in series and parallel circuits; Ohm's Law; Kirchoffs laws – methods of analysis-Mesh current and node voltage.		**CO1**
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS**	**9**
Network reduction- voltage and current division, source transformation, star delta conversion; Network theorems- Thevenins and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO2**
UNIT III	**ANALYSIS OF AC CIRCUITS**	**9**
Introduction to AC circuits- Inductive reactance, Capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor; RL, RC , RLC networks; Network reductions- voltage and current division, source transformation; Mesh and node analysis; Network theorems- Thevenins and Norton Theorems, Superposition Theorem , Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO3**
UNIT IV	**THREE PHASE CIRCUITS**	**9**
A.C. circuits – Average and RMS value, Phasor Diagram, Power, Power Factor and Energy; Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced; phasor diagram of voltages and currents; power measurement in three phase circuits.		**CO4**
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance – frequency response, Quality factor and Bandwidth; Self and mutual inductance; Coefficient of coupling; Tuned circuits – Single tuned circuits.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd.,New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",McGraw Hill, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to introduce electric circuits and its analysis
CO2	Ability to impart knowledge on solving circuit equations using network theorems
CO3	Ability to introduce the phenomenon of resonance in coupled circuits.
CO4	Ability to introduce Phasor diagrams and analysis of three phase circuits
CO5	Ability to impart knowledge on resonance and coupled circuits

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEE103	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	P	T	C
		3	0	0	3

OBJECTIVES

- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

UNIT I	**INTRODUCTION**	**9**
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.		**CO1**
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Reference theory fundamentals-principle of operation and analysis: IG and PMSG		**CO2**
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers		**CO3**
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Standalone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system		**CO4**
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan, “Non-conventional Energy Sources”, Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCE BOOKS

1. Muhammad H. Rashid, “Power Electronics Hand Book”, Third Edition, Butterworth- Heinemann, 2015.
2. Ion Boldea, “Variability Speed Generators”, Second Edition, CRC Press, 2015.
3. Rai. G.D, “Non- conventional Energy Sources”, Khanna Publishers, 2004.
4. Gray, L. Johnson, “Wind Energy Systems”, Prentice Hall, 2006.
5. Andrzej M. Trzynnadlowski, “Introduction to Modern Power Electronics”, Third Edition, Wiley India Pvt. Ltd, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Ability to understand and analyze power system operation, stability, control and protection.
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization.
CO3	Ability to understand the stand alone and grid connected renewable energy systems.
CO4	Ability to design of power converters for renewable energy applications.
CO5	Ability to acquire knowledge on wind electrical generators and solar energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	FUNDAMENTALSOF ROBOT	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.		CO1
UNIT II	**ROBOT DRIVE SYSTEMS ANDEND EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		CO2
UNIT III	**SENSORS AND MACHINEVISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications-Inspection, Identification, Visual Serving and Navigation.		CO3
UNIT IV	**ROBOT KINEMATICS AND ROBOTPROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		CO4
UNIT V	**IMPLEMENTATION ANDROBOTECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill,2001.

REFERENCE BOOKS

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education,2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co.,1994.
3. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co.,1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill,1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company,2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd.,1991.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functions of the basic components of a Robot.
CO2	Study the use of various types of End of Effectors and Sensors
CO3	Understand Sensors and Machine Vision of Robot
CO4	Understand Robot Kinematics and Robot Programming
CO5	Understand the Implementation of Robots in Industries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	2	3	2	1	2
CO2	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO3	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO4	3	2	1	2	2	-	-	-	-	2	2	3	3	2	2
CO5	2	2	1	2	2	-	-	-	-	2	2	3	2	2	2

OMB101	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3
OBJECTIVES ❖ To learn the quality philosophies and tools in the managerial perspective.					
UNIT I	**INTRODUCTION**				**9**
Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.					**CO1**
UNIT II	**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**				**9**
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology					**CO2**
UNIT III	**STATISTICAL PROCESS CONTROL**				**9**
Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations.					**CO3**
UNIT IV	**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**				**9**
Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.					**CO4**
UNIT V	**QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**				**9**
Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.					**CO5**
					TOTAL : 45 PERIODS
TEXT BOOKS					
1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011 2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.					

REFERENCE BOOKS

1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.
2. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005.
3. Poornima M.Charantimath, Total Quality Management, Pearson Education, First Indian Reprint 2003.
4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able:

CO1	To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.
CO2	To understand the principles of business process improvement
CO3	To understand and apply the concepts of statistical process control
CO4	To apply the tools and techniques used for quality management
CO5	To understand the methods in organizing and implementation of quality systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C

	3	0	0	3

OBJECTIVES

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948
- To familiarize students with powers of inspectorate of factories
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.
- To prepare onsite and offsite emergency plan.

UNIT I	**FACTORIES ACT – 1948**	**9**
Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948		**CO1**
UNIT II	**ENVIRONMENT ACT – 1986**	**9**
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.		**CO2**
UNIT III	**MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**	**9**
Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.		**CO3**
UNIT IV	**OTHER ACTS AND RULES**	**9**
Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983- Pesticides Act		**CO4**
UNIT V	**INTERNATIONAL ACTS AND STANDARDS**	**9**
Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO2	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO3	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO4	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO5	2	2	-	-	1	2	2	2	2	2	2	2	1	1	1

OTHER COURSES OFFERED BY CSE

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (LAB INTEGRATED)	L	T	P	C
Common to EEE and EIE		3	0	2	4

OBJECTIVES

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table.

UNIT I	C PROGRAMMING BASICS	9 + 6
Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays. **Lab Component** • Implementation of basic c programs a. Find greatest of three numbers b. Create a simple Calculator • Implementation of array a. Computing Mean, Median and Mode b. Matrix Addition		**CO1**
UNIT II	**FUNCTIONS, POINTERS AND STRUCTURES**	**9 + 6**
Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation. **Lab Component** • Implementation of user defined data types a. Computation of Sine series. b. Swapping of two numbers and changing the value of a variable using pass by reference		**CO2**
UNIT III	**LINEAR DATA STRUCTURES**	**9 + 6**
List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue. **Lab Component** • Implementation of linear data structure a. List implementation of List, Stack, Queue. b. Implement polynomial addition using list. c. Evaluate arithmetic expression.		**CO3**
UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9 + 6**
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs. **Lab Component** • Implementation of tree		**CO4**

a. Construct binary search tree. b. Traverse the binary tree recursively in pre-order, post-order and in-order. • Graph traversal a. Depth first search b. Breadth first search.	

UNIT V	SEARCHING, SORTING AND HASH TABLE	9 + 6
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling. **Lab Component** • Sorting & Searching a. Insertion sort b. Merge sort c. Linear Search d. Binary Search		**CO5**

THEORY : 45 PERIODS

PRACTICAL : 30 PERIODS

TOTAL : 75 PERIODS

TEXT BOOKS

1. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

CS1516	VISUAL PROGRAMMING	L	T	P	C
Common to EEE and EIE		3	0	0	3

OBJECTIVES

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variability's, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB

UNIT I	FUNDAMENTALS OF WINDOWS AND MFC	9
Messages : Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.		CO1
UNIT II	**RESOURCES AND CONTROLS**	**9**
Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.		CO2
UNIT III	**DOCUMENT / VIEW ARCHITECTURE**	**9**
The in existence function revisited – Document object – View object – Frame window object Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in app wizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializability classes.		CO3
UNIT IV	**FUNDAMENTALS OF VISUAL BASIC**	**9**
Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming. Variabilitys: Declaration – Types – Converting variability types – User defined data types - Lifetime of a variability. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.		CO4

UNIT V	DATABASE PROGRAMMING WITH VB	9
Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Tability def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements–Cursortypes and locking mechanism–Manipulating the record set object – Simple record editing and updating.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted,2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications,2002.

REFERENCE BOOKS

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, McGraw Hill, reprinted,2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', McGraw Hill, Reprinted,2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Tech media Pub,1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand study about the concepts of windows programming models.
CO2	Understand the concepts of Menu basics, menu magic and classic controls.
CO3	Understand the concept of Document/View Architecture with single & multiple document interface.
CO4	Understand the integrated development programming event driven document interface.
CO5	Understand the database and the database management system programming.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2
CO5	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2

OPEN ELECTIVE COURSES OFFERED BY CSE

OCS101	INTRODUCTION TO C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts in C Programming Language.
- To understand Input and Output Statements.
- To enhance analyzing and problem solving skills and use the same for writing programs in C.
- To familiarize the basic syntax in arrays and pointers
- To provide exposure to problem-solving through programming

UNIT I	**INTRODUCTORY CONCEPTS & C FUNDAMENTALS**	**9**
Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants.		**CO1**
UNIT II	**OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS**	**9**
Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement		**CO2**
UNIT III	**FUNCTIONS & PROGRAM STRUCTURE**	**9**
Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions		**CO3**
UNIT IV	**ARRAYS & POINTERS**	**9**
Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions		**CO4**
UNIT V	**STRUCTURES, UNIONS & DATA FILES**	**9**
Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.

REFERENCE BOOKS

1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition.
2. Let Us C Yashavant kanetkar, BPB

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify situations where computational methods and computers would be useful.
CO2	Demonstrate the use of operators, input and output statements and control statements
CO3	Identify solution to a problem and apply control structures and user defined functions for solving the problem
CO4	Demonstrate the use of numeric arrays and pointers
CO5	Demonstrate the ability to design creative solutions to real life problems faced by the industry.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS102	PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT I	C PROGRAMMING BASICS	9
Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays.		**CO1**
UNIT II	**FUNCTIONS, POINTERS AND STRUCTURES**	**9**
Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation.		**CO2**
UNIT III	**LINEAR DATA STRUCTURES**	**9**
List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue..		**CO3**
UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9**
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASH TABLE**	**9**
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges
- To have knowledge on the various virtualization techniques that serve in computation and storage services on the cloud
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT I	**INTRODUCTION**	**9**
Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing		**CO1**
UNIT II	**VIRTUALIZATION**	**9**
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization		**CO2**
UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**9**
NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage.		**CO3**
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**9**
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.		**CO4**
UNIT V	**CASE STUDIES**	**9**
Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	1	-	-	-	-	-	2	1	-	-	-	2	-	-	1
CO5	2	1	1	-	2	2	-	-	2	-	-	3	2	2	2

OCS104	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of Transaction Processing and concurrency
- To have an basic knowledge about the Storage implementation and query processing
- To understand database security concepts and database programming

UNIT I	INTRODUCTION	9
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL		CO1
UNIT II	**DATABASE DESIGN**	**9**
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form		CO2
UNIT III	**TRANSACTION CONCEPTS AND CONCURRENCY CONTROL**	**9**
Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery		CO3
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation		CO4
UNIT V	**ADVANCED TOPICS AND DATABASE PROGRAMMING**	**9**
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand relational data model, evolve conceptual model of a given problem and SQL

CO2	To understand Relational model and normalization to perform database design effectively
CO3	Apply and relate the concept of transaction, concurrency control and recovery in database
CO4	To understand the implementation technique and query processing
CO5	To understand the concepts of database security and database programming

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	1	2	-	1	1	-	1	-	1	1	-	1
CO2	2	-	1	1	1	-	1	1	-	-	-	1	1	-	1
CO3	1	-	1	1	1	1	-	1	-	-	-	1	1	-	1
CO4	2	-	2	1	1	1	-	1	-	-	-	1	1	-	1
CO5	1	-	2	1	2	1	-	1	1	-	-	1	1	-	1

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT I	**INTRODUCTION TO DATA ANALYSIS**	**9**
Overview of Data Analytics, Need of Data Analytics, Nature of Data**,** Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		**CO1**
UNIT II	**R PROGRAMMING BASICS**	**9**
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		**CO2**
UNIT III	**DATA VISUALIZATION USING R**	**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. **Working with R Charts and Graphs:** Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		**CO3**
UNIT IV	**STATISTICS WITH R**	**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		**CO4**
UNIT V	**PRESCRIPTIVE ANALYTICS**	**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
7. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
8. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2

OCS106	DATA COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols

UNIT I	**INTRODUCTION AND PHYSICAL LAYER**	**9**
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		**CO1**
UNIT II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		**CO2**
UNIT III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		**CO3**
UNIT IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		**CO4**
UNIT V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

OCS107	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

UNIT - I	**INTRODUCTION TO MACHINE LEARNING**	**9**
Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics.		CO1
UNIT - II	**CLUSTERING AND SEGMENTATION METHODS**	**9**
Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance.		CO2
UNIT - III	**FUZZY LOGIC**	**9**
Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application		CO3
UNIT - IV	**NEURAL NETWORKS**	**9**
Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics		CO4
UNIT - V	**RNN AND REINFORCEMENT LEARNING**	**9**
Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics		CO5
	TOTAL PERIODS:	**45**

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand basic machine learning techniques such as regression, classification
CO2	Understand about clustering and segmentation
CO3	Model a fuzzy logic system with fuzzification and defuzzification
CO4	Understand the concepts of neural networks and neuro fuzzy networks.
CO5	Gain knowledge on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCE BOOKS:

1. Bruno Siciliano, Oussama Khatib, “Handbook of Robotics”, 2016 2nd Edition, Springer
2. Simon Haykin, “Neural Networks and Learning Machines: A Comprehensive Foundation”, Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, “Fuzzy Logic with Engineering Applications”, 4th Edition, Chichester, 2011, Sussex Wiley.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	1	0	0	0	0	0	1	3	3	2	3
CO2	3	2	3	2	1	0	0	0	0	0	1	3	3	2	3
CO3	3	2	3	2	1	0	0	0	0	0	1	3	3	2	3
CO4	3	2	3	2	1	0	0	0	0	0	1	3	3	2	3
CO5	3	2	3	2	1	0	0	0	0	0	1	3	3	2	3

OCS109	Fundamentals of Database MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT - I	DBMS AND CONCEPTUALDATAMODELING	9
Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.		**CO1**

UNIT - II	DATABASE QUERYING	9
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries –joins aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.		**CO2**

UNIT – III	DATABASE PROGRAMMING	9
Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle		**CO3**

UNIT – IV	DATABASE DESIGN	9
Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system/ university database system.		**CO4**

UNIT – V	ADVANCED TOPICS	9
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.		**CO5**
	Total Periods:	**45**

Text Books:

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson,2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill,2011

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education,2006.
2. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications,2015.

Course Outcomes (CO)

CO1	Ability to understand relational data model, evolve conceptual model of a given problem.
CO2	Understand query the relational database and write programs with database connectivity
CO3	Ability to understand the DBMS programming
CO4	Ability to understand the DBMS Design
CO5	Ability to understand the database security and information retrieval concepts

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	1	3	3	1	1	3	2	2
CO2	3	3	3	1	1	1	1	1	3	3	1	1	3	3	2
CO3	3	3	3	1	1	1	1	2	3	3	1	1	3	3	2
CO4	3	3	3	1	1	2	1	2	3	3	1	1	3	3	2
CO5	3	3	3	1	1	1	1	2	3	3	1	1	3	2	2

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	**INTRODUCTION**	**6**
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		**CO1**
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**6**
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Emergency Provisions - National Emergency, President Rule, Financial Emergency		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**6**
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		**CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**6**
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		**CO1**
UNIT II	**IMPORTANCE OF VALUES**	**6**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		**CO2**
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**6**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		**CO4**
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**6**
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		**CO5**
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	INTRODUCTION AND METHODOLOGY	6
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions — Overview of methodology and Searching.		CO1
UNIT II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		CO2
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers‘ attitudes and beliefs and Pedagogic strategies.		CO3
UNIT IV	**PROFESSIONAL DEVELOPMENT**	**6**
Professional development: alignment with classroom practices and follow up support — Peer support - Support from the head teacher and the community - Curriculum and assessment — Barriers to learning: limited resources and large class sizes		CO4
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		CO5
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop healthy mind in a healthy body thus improving social health also improve efficiency
- ❖ Invent Do‘s and Don‘t‘s in life through Yam
- ❖ Categorize Do‘s and Don‘t‘s in life through Niyam
- ❖ Develop a healthy mind and body through Yog Asans
- ❖ Invent breathing techniques through Pranayam

UNIT I	**INTRODUCTION TO YOGA**	**6**
Definitions of Eight parts of yog.(Ashtanga)		**CO1**
UNIT II	**YAM**	**6**
Do`s and Don‘t‘s in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		**CO2**
UNIT III	**NIYAM**	**6**
Do`s and Don‘t‘s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		**CO3**
UNIT IV	**ASAN**	**6**
Various yog poses and their benefits for mind & body		**CO4**
UNIT V	**PRANAYAM**	**6**
Regularization of breathing techniques and its effects-Types of pranayam		**CO5**
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do‘s and Don‘t‘s in life through Yam
CO3	Learn Do‘s and Don‘t‘s in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**6**
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) — Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**6**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**6**
Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63		**CO5**

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	6
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of “Soul of India lies in villages” — (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.		**CO1**
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	**6**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **Assignment:** Describe your analysis of rural household economy, it‘s challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		**CO2**
UNIT III	**RURAL INSTITUTIONS**	**6**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj — Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit — 4.		**CO3**
UNIT IV	**RURAL DEVELOPMENT PROGRAMMES**	**6**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		**CO4**

UNIT V	FIELD WORK	6
Each student selects one programme for field visit Field based practical activities: ❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities ❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site ❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures ❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) ❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization ❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps ❖ Participate in Gram Sabha meetings, and study community participation ❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries ❖ Attend Parent Teacher Association meetings, and interview school drop outs ❖ Visit local Anganwadi Centre and observe the services being provided ❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. ❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys ❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness ❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants ❖ Formation of committees for common property resource management, village pond maintenance and fishing.		**CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	**INTRODUCTION TO CULTURE**	**6**
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		**CO1**
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**6**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		**CO2**
UNIT III	**RELIGION AND PHILOSOPHY**	**6**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		**CO3**
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**6**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		**CO4**
UNIT V	**EDUCATION SYSTEM IN INDIA**	**6**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Understand education systems in India

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Introduction to Sanga Tamil Literature.
- ❖ 'Agathinai' and'Purathinai' in SangaTamil Literature.
- ❖ 'Attruppadai' in SangaTamil Literature.
- ❖ 'Puranaanuru' in SangaTamil Literature.
- ❖ 'Pathitrupaththu' in SangaTamil Literature.

UNIT I	**SANGA TAMIL LITERATURE – AN INTRODUCTION**	**6**
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's GrammarTamil Sangam Literature's parables.		**CO1**
UNIT II	**'AGATHINAI'AND'PURATHINAI'**	**6**
Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		**CO2**
UNIT III	**'ATTRUPPADAI'**	**6**
Attruppadai Literature – Attruppadaiin 'Puranaanuru' – Attruppadaiin 'Pathitrupaththu'- Attruppadaiin 'Paththupaattu'.		**CO3**
UNIT IV	**'PURANAANURU'**	**6**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**
UNIT V	**'PATHITRUPATHTHU'**	**6**
Pathitrupaththuin 'Ettuthogai' — Pathitrupaththu's Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		**CO5**
		TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai‘ and ‘Purathinai‘in their personal and societal life.
CO3	Appreciate and apply the messages in’ Attruppadai‘ in their personal and societal life.
CO4	Appreciate and apply the messages in’ Puranaanuru‘ in their personal and societal life.
CO5	Appreciate and apply the messages in’ Pathitrupaththu‘ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

Value Added Courses

VAC001	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		1	0	2	2

OBJECTIVES

- The main learning objective of this course is to make the students an appreciation for:
- To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.
- Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students

UNIT I	**INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS**	**9**
The Various Industrial Revolutions – Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry – Industry 4.0 revolutions – Support System for Industry 4.0 – Smart Factories.		**CO1**
UNIT II	**IMPLEMENTATION SYSTEMS FOR IIOT**	**9**
Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.		**CO2**
UNIT III	**IIOT DATA MONITORING & CONTROL**	**9**
IoT Gate way – IoT Edge Systems and It's Programming – Cloud computing – Real Time Dashboard for Data Monitoring – Data Analytics and Predictive Maintenance with IIoT technology		**CO3**
UNIT IV	**IIOT Sensors & Networks**	**9**
Next Generation Sensors – Collaborative Platform and Product Lifecycle Management – Industrial IoT- Layers – Software Defined Networks: IIoT Analytics – Security and Fog Computing – Fog Computing in IIoT – Emerging descriptive data standards for IIoT – Cloud data base.		**CO4**
UNIT V	**INDUSTRIAL IOT- APPLICATIONS**	**9**
Healthcare Power Plants – Inventory Management & Quality Control – Plant Safety and Security Oil – Chemical and Pharmaceutical industry – Applications of UAVs in Industries.		**CO5**
	TOTAL : 45 PERIODS	

REFERENCE:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Students can develop a comprehensive understanding of Internet of Things (IoT) technologies, including sensors, communication protocols, cloud computing, and data analytics.
CO2	The program can provide students with hands-on experience in designing, implementing, and managing IoT-based solutions for industrial applications.
CO3	The program can provide students with an understanding of IoT security and privacy issues, including data encryption, access control, and device authentication.
CO4	The program can help students develop effective communication and teamwork skills through group projects and case studies, which are essential for working in cross-functional teams in industrial IoT settings.
CO5	Graduates of the program can be better equipped to take on roles in IoT-based industrial applications and other areas of technology, due to their in-depth knowledge of IoT technologies and their practical experience in designing and implementing industrial IoT solutions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PS O2	PSO 3
CO1	2	2	1	1	2	2	-	-	-	2	2	2	2	2	3
CO2	1	1	1	1	2	2	-	-	1	2	2	2	1	2	2
CO3	3	2	2	2	2	2	-	-	1	1	1	1	2	2	2
CO4	1	1	2	1	2	2	-	-	3	2	2	1	1	2	2
CO5	1	1	1	2	1	2	1	1	2	2	2	2	2	2	2

VAC002	AUGMENTED REALITY & VIRTUAL REALITY	L	T	P	C
		1	0	2	2

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

1. To provide students with good depth of knowledge of Augmented Reality and Virtual Reality
2. Knowledge on Tools and Applications of Augmented Reality and Virtual Reality

UNIT I	**Introduction to Augmented Reality and Virtual Reality (VR)**	**9**
History of AR - Augmented reality characteristics– Difference between Augmented Reality and Virtual Reality– AR technological components– Technologies used in AR– Feature Extraction – Hardware components – AR devices – Importance of AR - Real world uses of AR – AR types – Software tools available for AR.		**CO1**
UNIT II	**Computer Graphics and Geometric Modeling**	**9**
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference.		**CO2**
UNIT III	**Need of technologies for Augmented Reality & Virtual Reality**	**9**
Hardware technology– virtual scenes – 3D objects– AR & VR components Display – HMD – Eyeglasses– Contact Lenses – significance of AR – AR powered devices – Motion tracking –Virtual environment - VR technology, AR & VR application development drawbacks – Compatibility Performance.		**CO3**
UNIT IV	**Tools and Applications of Augmented Reality & Virtual Reality**	**9**
Tools available for Augmented Reality and Recognition - Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems - Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.		**CO4**
UNIT V	**Augmented Realities and Virtual Reality for Micro Learning**	**9**
Micro learning techniques – Utilizing VR for learning – VR for Practical online assessment – VR info graphics – Virtual case considerations - Utilizing AR for learning – Accessible learning – sensible data – elevated learner engagement - Engineering, Entertainment, Science, Training, Game Development		**CO5**
		TOTAL : 45 PERIODS

REFERENCE:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand the importance of augmented reality in Industry 4.0 with real-time examples
CO2	To describe the history and recent developments of AR
CO3	To provide the need on emerging technologies AR and VR
CO4	To discuss the revolution and impact of AR
CO5	To understand the applications of AR and VR

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PS O3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC003	ETHICAL HACKING - CYBER SECURITY	L	P	C
		1	2	2

OBJECTIVES:

- To learn the fundamentals of Cyber Security and Ethical Hacking
- To learn the Foot printing & Reconnaissance and Scanning Networks
- To understand Enumeration and Vulnerability Analysis
- To understand Exploitation on Network
- To learn the Web Attacks and Report Writing

UNIT I	FUNDAMENTALS OF CYBER SECURITY AND ETHICAL HACKING	9
Introduction to Cyber Security - Cyber Security & Ethical Hacking - Domains of Cyber Security - Principles of Cybersecurity (CIA Triad, Security Models, Principles of Privileges) - Offensive & Defensive Security - Cyber Kill Chain - Types of Security Teams (Red Team, Blue Team, Purple Team) - Cyber Security Frameworks (NIST, MITRE, ISO/IEC) Phases & Methodologies in Ethical Hacking - Introduction to Malware - Types of Malware		CO1

UNIT II	FOOTPRINTING RECONNAISSANCE AND SCANNING NETWORKS	9
Introduction to Foot printing Reconnaissance - Types of Reconnaissance (Passive & Active) - Active Reconnaissance (Ping, Traceroute, Telnet, Whatweb, Wappalyzer, Netcraft) - Passive Reconnaissance (nslookup, whois, dig, DNSDumpster, Shodan) - Introduction to OSINT (OSINT Framework, OSRFRAMEWORK, Social Searcher,) - Introduction to Scanning Networks - Types of Network Scanning (Port Scan, Service Scan, Vulnerability Scan) - Scanning Techniques - Port Scanning (TCP, UDP) - Host Discovery (ICMP, ARP) - Introduction to Wireshark - Capturing Data Packets - Packet Analysis.		CO2

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.		CO3

UNIT IV	EXPLOITATION ON NETWORK	9
Introduction to Exploitation - What is Shell - Types of Linux Shells (Bash, Csh/Tcsh, Ksh, Zsh, Fish) - What is Gaining Access & Maintaining Access - Reverse Shell & Bind Shell - Introduction to Metasploit Framework - Metasploit Modules - Staged Payload & Non-Staged Payload - Using Metasploit Framework Gaining the User Shell Acess - Gaining Root Shell Acess in Metasploit Framework - Introduction to Manual Exploitation - Gaining User Shell in Manual Exploitation - What is Privilege Escalation - Linux & Windows Privilege Escalation - Using Linpeass Script Finding Non-Privilege Path on Linux System - Using Winpeass Script Finding Non-Privilege Path on Windows System - Hands-on Windows & Linux Privilege Escalation - Introduction to Post Exploitation.		CO 4

UNIT V	WEB ATTACKS AND REPORT DOCUMENTATION	9
Introduction to OWAP TOP 10 and SANS TOP 25 - Web Server & Web Application Attack Methodology - Indirect Object Reference (IDOR) - SQL Injection - Cross Site Scripting - XML Injection or XML External Internal - Account Hijacking - Sensitive Data Exposure - Server Side Forgery - Race Condition - Generate Proper Vulnerability Assessment Penetration Testing Report Document.		CO5
		TOTAL : 45 PERIODS

REFERENCE:

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the importance of fundamentals of cyber security and ethical hacking
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods.
CO3	To demonstrate the enumeration and vulnerability analysis methods
CO4	To acquire knowledge on the options for network protection.
CO5	To gain knowledge on hacking options available in Web applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC004	BLOCKCHAIN AND CRYPTO CURRENCIES		L	T	P	C
			1	0	2	2

OBJECTIVES

1. To understand Blockchain's fundamental components, and examine decentralization using blockchain.
2. To understand Cryptocurrency and its background concepts.
3. To learn smart contract programing language solidity.
4. To understand public blockchain application development platform and develop distributed applications.
5. To understand enterprise blockchain application development platform and develop distributed enterprise applications

UNIT I	**Introduction**	**9**
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash function, consensus, byzantine fault-tolerant, distributed computing, 51% attack, digital cash etc.		**CO1**
UNIT II	**Cryptocurrency Basics**	**9**
Bitcoin blockchain, Challenges and solutions, Crypto mining, mining types, mining hardware, proof of work, Proof of stake, alternatives to Bitcoin consensus, other crypto currencies like Ethereum, Tether, BNB etc		**CO2**
UNIT III	**Solidity Walkthrough**	**9**
Introduction to Ethereum blockchain – Ethereum Virtual Machine – remix IDE - MetaMask wallet – running simple smart contract – voting application – Lottery application – File sharing application		**CO3**
UNIT IV	**Public Blockchain Application Development**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		**CO4**
UNIT V	**Enterprise Blockchain Application Development**	**9**
Introduction to Hyperledger – Hyperledger Fabric architecture– language supports for hyperledger fabric – setting up hyprledger fabric - Building application in hyperledger fabric.		**CO5**
	TOTAL : 45 PERIODS	

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.
4. https://hyperledger-fabric.readthedocs.io/en/latest/tutorials.html

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand Blockchain's fundamental components, and examine decentralization using blockchain.
CO2	Understand Cryptocurrency and its background concepts
CO3	Write smart contract using programing language solidity.
CO4	Develop distributed applications using public blockchain application development platform Ethereum.
CO5	Develop distributed applications using enterprise blockchain application development platform Hyperledger

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO2	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO4	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO5	-	-	-	-	1	-	-	-	-	1	-	1	-	1	1

VAC005	INDUSTRIAL PRACTICES WITH DEVOPS	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To introduce DevOps terminology, definition & concepts
2. To understand the Maven, Profiles and Plugins
3. To understand the concepts of Continuous Integration/ Continuous Testing/ ContinuousDeployment using Jenkins
4. To understand to leverage Cloud-based DevOps tools using Azure DevOps
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

UNIT I	**INTRODUCTION TO DEVOPS**	**9**
Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github		**CO1**
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**9**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artifacts, Dependency management, Installation of Gradle, understand build using Gradle		**CO2**
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	**9**
Install & Configure Jenkins, Jenkins Architecture Overview, creating a Jenkins Job, configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace		**CO3**
UNIT IV	**BUILDING DEVOPS PIPELINES USING AZURE**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		**CO4**
UNIT V	**DEVOPS PRACTICALS**	**9**
Create Maven Build pipeline in Azure - Run regression tests using Maven Build pipeline in Azure - Install Jenkins in Cloud - Create CI pipeline using Jenkins - Create a CD pipeline in Jenkins and deploy in Cloud		**CO5**
		TOTAL : 45 PERIODS

REFERENCES:

1. Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2. Mitesh Soni, Hands-On Azure Devops: CICD Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for .DevOps and Microsoft Azure (English Edition) , 2020
3. Mariot Tsitoara, " Beginning Git and GitHub: A Comprehensive Guide to Version Control Management, and Teamwork for the New Developer", Second Edition, 2019.
4. https://www.jenkins.io/user-handbook.pdf
5. https://maven.apache.org/guides/getting-started

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand different actions performed through Version control tools like Git.
CO2	Compile and Build using Maven & Gradle applications
CO3	Ability to Perform Continuous Integration using Jenkins.
CO4	Understand to leverage Cloud-based DevOps tools using Azure DevOps
CO5	Develop various Devops applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

VAC006	APPLIED MACHINE LEARNING WITH PYTHON	L	T	P	C
		1	0	2	2

OBJECTIVES

- To provide a basic understanding of data manipulation.
- To understand scikit learn for model evaluation.
- To provide a comprehensive understanding of neural networks and computer vision.

UNIT I	DATA MANIPULATION WITH PYTHON LIBRARIES	9
Overview of Data Manipulation with Python-Introduction to Pandas and NumPy-Data Cleaning and Preprocessing-Handling Missing Data-Data Exploration and Analysis		CO1
UNIT II	**MACHINE LEARNING BASICS WITH SCIKIT-LEARN**	**9**
Introduction to Machine Learning-Types of Machine Learning Algorithms-Overview of Decision Trees and Random Forests-Hands-on Implementation with Scikit-Learn-Model Evaluation and Validation.		CO2
UNIT III	**LINEAR REGRESSION AND BEYOND**	**9**
Linear Regression Fundamentals-Implementing Linear Regression from Scratch-Logistic Regression for Classification-Introduction to Support Vector Machines (SVM)-Hands-on Exercises with Scikit-Learn.		CO3
UNIT IV	**ADVANCED MACHINE LEARNING TECHNIQUES**	**9**
Introduction to Gradient Boosting-Implementation of Gradient Boosting with XGBoost-Neural Networks Basics with PyTorch-Deep Learning Fundamentals-Applications of Neural Networks.		CO4
UNIT V	**COMPUTER VISION AND TRANSFER LEARNING**	**9**
Image Classification with Convolutional Neural Networks (CNN)-Transfer Learning Concepts and Applications-Hands-on Image Classification with PyTorch-Fine-tuning Pre-trained Models-Building Custom Models for Specific Tasks.		CO5
		TOTAL : 45 PERIODS

REFERENCE:

1. " Data Wrangling with Pandas" by Kevin Markham - A practical guide that delves into data cleaning, preprocessing, handling missing data, and exploratory data analysis using Pandas.

2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron - A comprehensive guide that covers a wide range of machine learning topics, including decision trees, random forests, and model evaluation with scikit-learn.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand a predictive models that can classify or regress on data by recursively partitioning.
CO2	To develop a foundational understanding of the underlying algorithms, optimizing model parameters
CO3	To build a robust and high-performance ensemble model for regression or classification tasks.
CO4	To understand the automatic learning of hierarchical representations from data for tasks such as classification, regression, and feature extraction.
CO5	To incorporating transfer learning are to leverage pre-trained models to efficiently learn and classify features in images, facilitating accurate predictions.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**P O3**	**P O4**	**P O5**	**P O6**	**P O7**	**P O8**	**P O9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PS O3**
CO1	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO2	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO4	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO5	-	-	-	-	1	-	-	-	-	1	-	1	-	1	1

M.E. COMPUTER SCIENCE AND ENGINEERING

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - IV SEMESTERS CURRICULA AND SYLLABI

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

Profession: Graduates excel in computer technology in order to pursue higher education and research, or have a successful career in industries or as entrepreneurs.

Technophile: Graduates will have the ability and attitude to adapt emerging technological changes in the field of Computer Science and Engineering.

Team Player: Possess an ability to collaborate as a team member and team leader to affect technical solutions for computing systems, providing improved function and outcomes.

PROGRAM OUTCOMES POs:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs):

Efficacy: Ability to apply mathematical methodologies and foundational concepts of Computer Science and Engineering to solve computational tasks, model the real world problem using appropriate data structure and algorithm with suitable programming languages.

Potentiality to design: Analyze, design and evaluate a computer based system by applying software engineering principles and practices for developing quality software for scientific and business applications.

Technical expertise: Adapt to modern engineering technologies and thereby build robust, reliable, maintainable, scalable, innovative and efficient computing systems by considering social, environmental, economic, and security constraints

MAPPING OF PROGRAM OUTCOMES (POs) WITH
PROGRAM EDUCATIONAL OBJECTIVES (PEOs) and PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Outcomes (POs)	Program Educational Objectives (PEOs)			Program Specific Outcomes (PSOs)		
	Profession	Technophile	Team Player	Efficacy	Potentiality to design	Technical expertise
Engineering knowledge	3	3	1	3	3	3
Problem analysis	3	3	2	3	3	2
Design/development of solutions	3	3	2	3	3	3
Conduct investigations of complex problems	3	3	3	3	3	2
Modern tool usage	2	3	1	3	3	3
The engineer and society	2	2	2	2	2	3
Environment and sustainability	2	2	2	2	2	3
Ethics	3	2	3	2	2	2
Individual and team work	3	2	3	2	2	2
Communication	3	2	3	2	2	3
Project management and finance	2	2	2	3	3	2
Life-long learning	3	3	2	3	2	3

Correlation Level 1, 2 or 3 as defined below:

1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)

MAPPING OF COURSE OUTCOMES (Cos)

WITH PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs)

A broad relation between the Course Outcomes and Program Outcomes is given in the following table

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Advanced Mathematics for Scientific Computing	√	√	√					√	√	√		√	√	√	√
	Algorithm Design and Implementation (Lab Integrated)	√	√	√						√				√	√	√
	Advanced Computer Architecture	√	√	√										√	√	√
	Advanced Network Principles and Protocols	√	√	√										√	√	√
	Machine Learning Techniques	√	√	√										√	√	√
	Research Methodology and IPR					√	√	√	√	√	√		√	√	√	√
	Machine Learning Lab	√	√	√		√	√		√	√	√		√	√	√	√
II	Information Storage Management	√	√	√					√	√	√		√	√	√	√
	Compiler Optimization Techniques	√	√	√						√				√	√	√
	Soft Computing Techniques	√	√	√										√	√	√
	Big Data Analytics	√	√	√				√	√	√	√		√	√	√	√
	Data Analytics Lab	√	√	√	√	√	√		√	√	√		√	√	√	√
II	Design and Analysis of Parallel Algorithms	√	√	√		√			√				√	√	√	√
	Open Source Programming	√	√	√		√			√				√	√	√	√
	Principles of Cryptography	√	√	√		√			√					√	√	√
	Computer Graphics and Image Processing	√	√	√		√				√				√	√	√
	Internet of Things	√	√	√		√			√				√	√	√	√

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
III	Human Computer Interaction	√	√	√						√	√		√	√	√	√
	Imaging and Multimedia Systems	√	√	√					√					√	√	√
	Agent Based Intelligent Systems	√	√	√		√							√	√	√	√
	Deep Learning	√	√	√		√							√	√	√	√
	Information Retrieval Techniques	√	√	√						√			√	√	√	√
	Blockchain Technologies	√	√	√										√	√	√
	Speech Processing and Synthesis	√	√	√										√	√	√
	Advanced Software Engineering	√	√	√										√	√	√
	Mobile Network Systems	√	√	√										√	√	√
	Cyber Security	√	√	√										√	√	√
	Cloud Computing	√	√	√										√	√	√
	Software Design Patterns				√				√	√	√			√	√	√
	Big Data Mining and Analytics	√	√	√		√								√	√	√
	Social Network Analysis	√	√	√		√			√					√	√	√
	Cognitive Science	√	√	√		√			√		√	√		√	√	√

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1151	Advanced Mathematics for Scientific Computing	FC	4	4	0	0	4
2	CP1101	Algorithm Design and Implementation (Lab Integrated)	PCC	5	3	0	2	4
3	CP1102	Advanced Computer Architecture	PCC	3	3	0	0	3
4	CP1103	Advanced Network Principles and Protocols	PCC	3	3	0	0	3
5	CP1104	Machine Learning Techniques	PCC	3	3	0	0	3
6	RM1101	Research Methodology and IPR	RMC	2	2	0	0	2
PRACTICAL								
7	CP1107	Machine Learning Laboratory	PCC	4	0	0	4	2
Total				**24**	**18**	**0**	**6**	**21**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CP1201	Information Storage Management	PCC	3	3	0	0	3
2	CP1202	Compiler Optimization Techniques	PCC	4	4	0	0	4
3	CP1203	Soft Computing Techniques	PCC	4	4	0	0	4
4	CP1204	Big Data Analytics	PCC	3	3	0	0	3
5		Open Elective - I	OEC	3	3	0	0	3
6		Professional Elective - I	PEC	3	3	0	0	3
PRACTICAL								
7	CP1207	Data Analytics Laboratory	PCC	4	0	0	4	2
Total				**24**	**20**	**0**	**4**	**22**
8		Audit Course (Optional)	AC					

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective - II	PEC	3	3	0	0	3
2		Professional Elective - III	PEC	3	3	0	0	3
3		Professional Elective - IV	PEC	3	3	0	0	3
PRACTICAL								
4	CP1307	Project Work - Phase I	EEC	12	0	0	12	6
Total				**21**	**9**	**0**	**12**	**15**
5		Value Added Course / Internship	Audit Course	Two Weeks				1

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1	CP1407	Project Work - Phase II	EEC	24	0	0	24	12
Total				**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	MA1151	Advanced Mathematics for Scientific Computing	4	4	0	0	4

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1101	Algorithm Design and Implementation (Lab Integrated)	4	3	0	2	4
2	CP1102	Advanced Computer Architecture	3	3	0	0	3
3	CP1103	Advanced Network Principles and Protocols	3	3	0	0	3
4	CP1104	Machine Learning Techniques	3	3	0	0	3
5	CP1107	Machine Learning Lab	4	0	0	4	2
6	CP1201	Information Storage Management	3	3	0	0	3
7	CP1202	Compiler Optimization Techniques	4	4	0	0	4
8	CP1203	Soft Computing Techniques	4	4	0	0	4
9	CP1204	Big Data Analytics	3	3	0	0	3
10	CP1207	Data Analytics Lab	4	0	0	4	2

RESEARCH METHODOLOGY COURSE (RMC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	RM1101	Research Methodology and IPR	2	2	0	0	2

PROFESSIONAL ELECTIVE COURSES (PEC)
SEMESTER II
PROFESSIONAL ELECTIVE – I

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1211	Design and Analysis of Parallel Algorithms	3	3	0	0	3
2	CP1212	Open Source Programming	3	3	0	0	3
3	CP1213	Principles of Cryptography	3	3	0	0	3
4	CP1214	Computer Graphics and Image Processing	3	3	0	0	3
5	CP1215	Internet of Things	3	3	0	0	3

SEMESTER III
PROFESSIONAL ELECTIVE – II

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1311	Human Computer Interaction	3	3	0	0	3
2	CP1312	Imaging and Multimedia Systems	3	3	0	0	3
3	CP1313	Agent Based Intelligent Systems	3	3	0	0	3
4	CP1314	Deep Learning	3	3	0	0	3
5	CP1315	Information Retrieval Techniques	3	3	0	0	3

SEMESTER III
PROFESSIONAL ELECTIVE – III

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1321	Block chain Technologies	3	3	0	0	3
2	CP1322	Speech Processing and Synthesis	3	3	0	0	3
3	CP1323	Advanced Software Engineering	3	3	0	0	3
4	CP1324	Mobile Network Systems	3	3	0	0	3
5	CP1325	Cyber Security	3	3	0	0	3

SEMESTER III
PROFESSIONAL ELECTIVE – IV

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1331	Cloud Computing	3	3	0	0	3
2	CP1332	Software Architecture and Design Patterns	3	3	0	0	3
3	CP1333	Big Data Mining and Analytics	3	3	0	0	3
4	CP1334	Social Network Analysis	3	3	0	0	3
5	CP1335	Cognitive Science	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OBY101	Essentials Of Hazardous Waste Management	3	3	0	0	3
2	OCP101	Business Data Analytics	3	3	0	0	3
3	OEC101	Next Generation Wireless Networks	3	3	0	0	3
4	OMF103	Optimization Techniques	3	3	0	0	3
5	OPE101	Renewable sources of Electrical Energy	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CP1307	Project Work - Phase I	12	0	0	12	6
2	CP1407	Project Work - Phase II	24	0	0	24	12

AUDIT COURSE (AC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	2	2	0	0	0
2	AD1002	Value Education	2	2	0	0	0
3	AD1003	Pedagogy Studies	2	2	0	0	0
4	AD1004	Stress Management by Yoga	2	2	0	0	0
5	AD1005	Personality Development Through Life EnlightenmentSkills	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	2	2	0	0	0

CREDIT SUMMARY

S. No.	SUBJECT AREA	I	II	III	IV	CREDITS TOTAL	PERCENTAGE
1	**FC**	4				**4**	**5.71**
2	**PCC**	15	16			**31**	**44.29**
3	**PEC**		3	9		**12**	**17.14**
4	**RMC**	2				**2**	**2.86**
4	**OEC**		3			**3**	**4.29**
5	**EEC**			6	12	**18**	**25.71**
Total		**21**	**22**	**15**	**12**	**70**	**100**

MA1151	ADVANCED MATHEMATICS FOR SCIENTIFIC COMPUTING	L	T	P	C
		4	0	0	4

OBJECTIVES

- To understand the basics of random variables and standard distributions
- To understand the arrival process and various queuing and server models
- To appreciate the use of simulation techniques
- To apply testing of hypothesis to infer outcome of experiments
- To apply mathematical linear programming techniques to solve constrained problems.

UNIT I	RANDOM VARIABLES	12
Random variables – Bernoulli, Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions – Function of a Random variable - Moments, Moment generating function.		CO1
UNIT II	**QUEUING MODELS**	**12**
Poisson Process – Markovian Queues – Single and Multi-server Models – Model 1: (M/M/1): FIFO/∞/∞)-Model 2: (M/M/1): FIFO/N/∞)- Model 3: (M/M/C): FIFO/∞/∞)- Model 4: (M/M/C): FIFO/N/∞)- Little‟s formula –Machine Interference Model – Steady State analysis – Self Service Queue		CO2
UNIT III	**SIMULATION**	**12**
Discrete Event Simulation – Monte – Carlo Simulation – Stochastic Simulation – Applications to Queuing systems.		CO3
UNIT IV	**TESTING OF HYPOTHESIS**	**12**
Sampling distributions – Estimation of parameters - Statistical hypothesis – Tests based on Normal, t, Chi-square and F distributions for mean, variance and proportion.		CO4
UNIT V	**LINEAR PROGRAMMING**	**12**
Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Problems.		CO5
		TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Johnson, R.A. Miller and Freund‟s,” Probability and Statistical for Engineers, Prentice Hall of India Pvt., Ltd., New Delhi, Seventh Edition, 2005.
2. Hamdy A. Taha, “Operations Research: An Introduction”, Prentice Hall of India Pvt, Ltd. New Delhi, Eighth Edition, 2007.
3. Jay L. Devore,” Probability and Statistics for Engineering and the Sciences”, Cengage Learning, Seventh Edition, 2009.
4. J.Medhi,” Stochastic models of Queuing Theory”, Academic Press, Elsevier, Amsterdam, 2003
5. Winston, W.L., “Operations Research”, Thomson – Brooks/Cole, Fourth Edition, 2003.
6. Gross D. and Harris C.M., “Fundamentals of Queuing Theory”, John Wiley and Sons, New York, 1998.
7. Ross. S.M., “Probability Models for Computer Science”, Academic Press, 2002.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the type of random variable and distribution for a given operational conditions /scene
CO2	The course gives ideas on Queuing models modelling through Monrovian Queues through which students will be able to Design appropriate queuing model for a given problem / system situation.
CO3	Handle the real-life situation through discrete event simulation and do the analysis.
CO4	Gain the knowledge on testing of hypotheses on data from biological, economic and social experiments and all kinds of generalizations based on information from samples.
CO5	Learn an optimization technique by learning the solution procedures of linear programming, the same can be applied to Formulate and find optimal solution in the real life optimizing /allocation /assignment problems involving conditions and resource constraints

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	2	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	2	2	1
CO3	3	3	2	3	3	2	1	-	-	-	2	2	2	2	1
CO4	3	3	2	3	2	2	1	-	-	-	1	2	2	2	1
CO5	3	3	3	3	2	2	1	-	-	-	2	1	2	2	1

CP1101	ALGORITHM DESIGN AND IMPLEMENTATION (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

UNIT I	ALGORITHM DESIGN INTRODUCTION	9+6

Review off Data Structures-Program Performance- Time and space complexity, average and worst-case analysis, asymptotic notation, recurrence equations- Search techniques (backtracking and bounding), Sorting algorithms - lower bound, sorting in linear time, Greedy algorithms (Huffman coding, knapsack), Divide and conquer - Master theorem, Dynamic programming (0/1 knapsack, Traveling salesman problem, matrix multiplication, all-pairs shortest paths)

Lab Component

- Implement nth Fibonacci using recursive and non-recursive function. Compare the time complexities of both.
- Sort a given set of n integer elements using Merge Sort method and compute its time complexity. Run the program for varied values of n> 5000, and record the time taken to sort. Plot a graph of the time taken versus non graph sheet. The elements can be read from a file or can be generated using the random number generator. Demonstrate using Java how the divide-and-conquer method works along with its time complexity analysis: worst case, average case and best case.

CO1

UNIT II	ADVANCED STRUCTURES	9+6

Binary search trees, B trees, AVL trees, Red black trees, splay trees. Van Emde Boas trees. Randomly built binary search trees. Heaps, Binomial heaps, Fibonacci heaps. Minimum spanning trees, BFS, DFS, strongly connected components, Biconnected components.

Lab Component

- Implement B trees and Red black trees
- Implement Binomial Heaps and Fibonacci heaps

CO2

UNIT III	NETWORK FLOW AND STRING MATCHING	9+6

Flow networks, The Ford-Fulkerson method, Maximum bipartite matching. String Matching: Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm.

Lab Component

- Analyse the flow of network using Ford-Fulkerson method
- Implement Knuth-Morris-Pratt algorithm

CO3

UNIT IV	APPROXIMATION ALGORITHMS	9+6

NP completeness, Reductions, coping with NP completeness, Approximation algorithms: The vertex cover problem, - the travelling salesman problem, The set covering problem, The Subset-sum problem. Graph colouring.

Lab Component

- Use approximation algorithms and implement the technique in the travelling salesman problem.
- Design and implement in Java to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution. 12. Design and implement in Java to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

CO4

UNIT V	RANDOMIZED ALGORITHMS	9+6
Las Vegas and Monte Carlo algorithm, Random variables and their expectations. Probabilistic analysis and uses of indicator random variables: Birthday paradox, coupon collector's problem, The online hiring problem. Randomized version of quick sort, Miller Rabin randomized primality Test. **Lab Component** • Implement Las Vegas using randomized algorithm • Simulate the Miller Rabin randomized primality Test.		CO5

PRACTICAL :30 PERIODS	THEORY:45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein. "Introduction to Algorithms," Third edition ,Prentice Hall India, 2011

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++," Third edition, Pearson 2007.
2. Michael Sipser, "Introduction to theory of computation", Thomson Course technology, 2006
3. R. Motwani and P. Raghavan, "Randomized Algorithms," Cambridge University Press, 1995

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the following capabilities: to evaluate algorithms, to select from a range of possible options, to provide justification for that selection, and to implement the algorithm in programming context.
CO2	Choose the appropriate data structure for modelling a given problem and Compare and contrast the costs and benefits of different data structure implementations.
CO3	Choose the appropriate string matching and network flow algorithms
CO4	Explain the significance of NP-completeness and importance of approximation algorithms.
CO5	Explain the use of randomization in the design of an algorithm for a problem where a deterministic algorithm is unknown or much more difficult

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	3	3
CO2	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2

CP1102	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I	**FUNDAMENTALS OF COMPUTER DESIGN AND ILP**	**9**
Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading		**CO1**
UNIT II	**MEMORY HIERARCHY DESIGN**	**9**
Introduction – Optimizations of Cache - Performance– Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.		**CO2**
UNIT III	**MULTIPROCESSOR ISSUES**	**9**
Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks		**CO3**
UNIT IV	**MULTICORE ARCHITECTURES**	**9**
Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers-Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer		**CO4**
UNIT V	**VECTOR, SIMD AND GPU ARCHITECTURES**	**9**
Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Darryl Gove, ―Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, ―Programming Massively Parallel Processors‖, Morgan Kauffman, 2010

REFERENCE BOOKS

1. David E. Culler, Jaswinder Pal Singh, ―Parallel computing architecture : A hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999
2. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the limitations of ILP.
CO2	Discuss the issues related to multiprocessing and suggest solutions
CO3	Discuss the various techniques used for optimising the cache performance
CO4	Point out the salient features of different multicore architectures and how they exploit parallelism.
CO5	Point out how data level parallelism is exploited in architectures

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	3	3
CO2	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2

CP1103	ADVANCED NETWORK PRINCIPLES AND PROTOCOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks
- To understand the paradigm of Software defined networks

UNIT I	NETWORK PRINCIPLES	9
Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.		CO1
UNIT II	**WIRELESS NETWORKS**	**9**
IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles		CO2
UNIT III	**CELLULAR NETWORKS**	**9**
GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security		CO3
UNIT IV	**4G NETWORKS**	**9**
LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G		CO4
UNIT V	**SOFTWARE DEFINED NETWORKS**	**9**
Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Erik Dahlman, Stefan Parkvall, Johan Skold, ―4G: LTE/LTE-Advanced for Mobile Broadband‖, Academic Press, 2013.
2. Jonathan Rodriguez, ―Fundamentals of 5G Mobile Networks‖, Wiley, 2015.

REFERENCE BOOKS
1. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014. 2. Martin Sauter, ―Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0‖, Wiley, 2009. 3. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, ―Next-Generation Wireless Technologies‖, Springer, 2013. 4. Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Morgan Kauffman, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the components required for designing a network
CO2	Design a network at a high-level using different networking technologies
CO3	Analyze the various protocols of wireless and cellular networks
CO4	Discuss the features of 4G and 5G networks
CO5	Experiment with software defined networks

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	3	3
CO2	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2

CP1104	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques
- To understand graphical models of machine learning algorithms

UNIT I	INTRODUCTION	9
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.		CO1
UNIT II	**LINEAR MODELS**	**9**
Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.		CO2
UNIT III	**TREE AND PROBABILISTIC MODELS**	**9**
Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map		CO3
UNIT IV	**DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS**	**9**
Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process		CO4
UNIT V	**GRAPHICAL MODELS**	**9**
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen Marsland ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014

REFERENCE BOOKS

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
2. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014
3. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Distinguish between, supervised, unsupervised and semi-supervised learning
CO2	Apply the appropriate machine learning strategy for any given problem
CO3	Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
CO4	Design systems that use the appropriate graph models of machine learning
CO5	Modify existing machine learning algorithms to improve classification efficiency

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1	1	1	1	1	1	1	3	3	3
CO2	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	1	1	1	1	1	1	1	1	1	3	3	2

RM1101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

OBJECTIVES

- ❖ Problem formulation, analysis and solutions.
- ❖ Technical paper writing / presentation without violating professional ethics
- ❖ Patent drafting and filing patents.

UNIT I	**RESEARCH PROBLEM FORMULATION**	**6**
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations		**CO1**
UNIT II	**LITERATURE REVIEW**	**6**
Effective literature studies approaches, analysis, plagiarism, and research ethics.		**CO2**
UNIT III	**TECHNICALWRITING /PRESENTATION**	**6**
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.		**CO3**
UNIT IV	**INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)**	**6**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.		**CO4**
UNIT V	**INTELLECTUAL PROPERTY RIGHTS (IPR)**	**6**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.		**CO5**
		TOTAL: 30 PERIODS

REFERENCE BOOKS

1. Asimov, “Introduction to Design”, Prentice Hall, 1962.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step-by-Step Guide for beginners” 2010

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand the concept of research methods and apply in problem solving.
CO2	To analyse the data using statistical tools to solve practical problems.
CO3	To understand the guidelines for effective report writing
CO4	To understand and acquire the knowledge on Intellectual Property Rights
CO5	To acquire knowledge on patent and copyright, trademark, and industrial design

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	3	1	2	2	1	1	2	2	2	1
CO2	1	1	1	1	1	2	2	2	2	1	1	2	2	1	1
CO3	1	1	1	1	1	3	1	1	2	1	1	2	2	2	1
CO4	1	1	1	1	1	2	2	2	2	1	1	3	2	1	1
CO5	1	1	1	1	1	2	1	2	2	1	1	2	2	1	1

CP1107	MACHINE LEARNING LAB	L	T	P	C
		0	0	4	2

OBJECTIVES

- The course serves as a comprehensive introduction to various topics in machine learning.
- Students should be able to design and implement machine learning solutions to classification, regression, and clustering problems
- Students should able to evaluate and interpret the results of the algorithms.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.	**CO1**
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.	
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**CO2**
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.	**CO3**
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.	
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems,O'reily,Second edition,2019

WEB REFERENCES

1. https://github.com/profthyagu/Python--Candidate-Elimination-Algorithm
2. https://machinelearningmastery.com/tutorial-to-implement-k-nearest-neighbors-in-python-from-scratch/
3. https://www.geeksforgeeks.org/ml-locally-weighted-linear-regression/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the implementation procedures for the machine learning algorithms. Design Java/Python programs for various Learning algorithms.
CO2	Apply appropriate data sets to the Machine Learning algorithms.
CO3	Identify and apply Machine Learning algorithms to solve real world problems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2

CP1201	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic components of Storage System Environment.
- To understand the Storage Area Network Characteristics and Components
- To examine emerging technologies including IP-SAN.
- To understand the concepts in Business continuity and backup technologies
- To learn replication and modes off replication

UNIT I	STORAGE SYSTEMS	9
Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Centre Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.		**CO1**
UNIT II	**STORAGE NETWORKING TECHNOLOGIES**	**9**
Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.		**CO2**
UNIT III	**ADVANCED STORAGE NETWORKING AND VIRTUALIZATION**	**9**
IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.		**CO3**
UNIT IV	**BUSINESS CONTINUITY**	**9**
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.		**CO4**
UNIT V	**REPLICATION**	**9**
Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its technologies, Network Infrastructure		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Somasundaram Gnana Sundaram, Alok Shrivastava, Information Storage Management, John Wiley & sons,2nd Edition 2014.

REFERENCE BOOKS
1. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, —Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001
3. http://download.101com.com/GIG/Custom/2010PDFS/StorageMgt/Storage_Management2010.pdf

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Select from various storage technologies to suit for required application.
CO2	Apply security measures to safeguard storage & farm.
CO3	Analyse QoS on Storage.
CO4	Usage of Business continuity and planning in real time
CO5	Understanding local replication technologies.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	1	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	2	1	2	2	1	1	2	3	3	2

CP1202	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		4	0	0	4

OBJECTIVES

- To be aware of different forms of intermediate languages and analysing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn inter procedural analysis and optimizations.
- To explore the knowledge about resource utilization.

UNIT I	**INTERMEDIATE REPRESENTATIONS AND ANALYSIS**	**9**
Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis.		**CO1**
UNIT II	**EARLY AND LOOP OPTIMIZATIONS**	**9**
Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial- Redundancy Elimination - Redundancy Elimination and Re-association - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination		**CO2**
UNIT III	**PROCEDURE OPTIMIZATION AND SCHEDULING**	**9**
Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.		**CO3**
UNIT IV	**INTER PROCEDURAL OPTIMIZATION**	**9**
Symbol table – Runtime Support – Inter procedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph – Inter procedural Data-Flow Analysis Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References.		**CO4**
UNIT V	**REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY**	**9**
Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.

REFERENCE BOOKS

1. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, ―Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.
2. Robert Morgan ,Building an Optimizing Compiler, Digital Press, 1998
3. Steven Muchnick, ―Advanced Compiler Design and Implementation‖, Morgan Kaufman Publishers, 1997.
4. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, ―Optimizing Compilers for Modern Architectures: A Dependence based Approach‖, Morgan Kaufman, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the different optimization techniques for simple program blocks.
CO2	Design performance enhancing optimization techniques
CO3	Perform the optimization on procedures
CO4	Ensure better utilization of resources
CO5	Ensure resource allocation and memory optimization

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	1	2	2	1	1	2	3	3	2
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CO3	3	3	3	2	3	1	1	1	2	1	1	2	3	3	2
CO4	3	3	3	2	3	1	2	2	2	1	1	3	3	3	2
CO5	3	3	3	3	3	1	1	2	2	1	1	2	3	3	2

<table>
<tr><td>CP1203</td><td colspan="2">SOFT COMPUTING TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ Understand Soft Computing concepts, technologies, and applications
❖ Understand the underlying principle of soft computing with its usage in various applications.
❖ Understand neural networks and its functionalities.
❖ Understand different fuzzy tools to solve real life problems.
Understand Genetic algorithms and implement in case studies.</td></tr>
<tr><td>UNIT I</td><td colspan="5">SOFT COMPUTING INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="2">Overview of Soft Computing, Difference between Soft and Hard computing, Brief descriptions of different components of soft computing including Artificial intelligence systems Neural networks, fuzzy logic, genetic algorithms. Artificial neural networks Vs Biological neural networks, ANN architecture, Basic building block of an artificial neuron, Activation functions, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, ADALINE, MADALINE</td><td colspan="5">CO1</td></tr>
<tr><td>UNIT II</td><td colspan="5">LEARNING TECHNIQUES</td><td>9</td></tr>
<tr><td colspan="2">Artificial Neural Networks: Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.</td><td colspan="5">CO2</td></tr>
<tr><td>UNIT III</td><td colspan="5">NEURAL NETWORKS</td><td>9</td></tr>
<tr><td colspan="2">Neural Networks as Associative Memories - Hopfield Networks, Bidirectional Associative Memory. Topologically Organized Neural Networks – Competitive Learning, Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: Kohonen Network.</td><td colspan="5">CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="5">FUZZY LOGIC</td><td>9</td></tr>
<tr><td colspan="2">Fuzzy Logic: Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference System Fuzzy Logic Crisp & fuzzy sets fuzzy relations fuzzy conditional statements fuzzy rules fuzzy algorithm. Fuzzy logic controller.</td><td colspan="5">CO4</td></tr>
<tr><td>UNIT V</td><td colspan="5">GENETIC ALGORITHMS</td><td>9</td></tr>
<tr><td colspan="2">Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA case studies. Introduction to genetic programming- basic concepts.</td><td colspan="5">CO5</td></tr>
<tr><td colspan="7" align="right">TOTAL : 45 PERIODS</td></tr>
<tr><td colspan="7">TEXT BOOKS</td></tr>
<tr><td colspan="7">1. Eiben A. E. and Smith J. E., “Introduction to Evolutionary Computing”, Second Edition, Springer, Natural Computing Series, 2007.
2. Engelbrecht A. P., “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006.
3. Konar. A, “Computational Intelligence: Principles, Techniques and Applications”, Springer Verlag, 2005.</td></tr>
</table>

REFERENCE BOOKS

1. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2004.
2. Ross T. J., "Fuzzy Logic with Engineering Applications", McGraw Hill, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop application on different soft computing techniques.
CO2	Develop application on different soft computing techniques in Neural network
CO3	Develop application techniques based on classification algorithms.
CO4	Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert system
CO5	Develop application on different soft computing techniques in GA.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO4	3	3	3	2	2	1	2	2	2	1	1	3	3	3	2
CO5	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2

CP1204	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT I	INTRODUCTION TO BIG DATA	9
Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.		CO1
UNIT II	**HADOOP FRAMEWORK**	**9**
Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN		CO2
UNIT III	**DATA ANALYSIS**	**9**
Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.		CO3
UNIT IV	**MINING DATA STREAMS**	**9**
Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.		CO4
UNIT V	**BIG DATA FRAMEWORKS**	**9**
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.

REFERENCE BOOKS

1. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
4. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O‘Reilly Media, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand how to leverage the insights from big data analytics
CO2	Understand the Hadoop framework
CO3	Analyse data by utilizing various statistical and data mining approaches
CO4	Perform analytics on real-time streaming data
CO5	Understand the various No Sql alternative database models

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
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CO3	1	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	1	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	2	1	2	2	1	1	2	3	3	2

CP1207	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- The course serves as a comprehensive introduction to various topics in machine learning.
- Students should be able to design and implement machine learning solutions to classification, regression, and clustering problems
- Students should able to evaluate and interpret the results of the algorithms.

LIST OF EXPERIMENTS

1.	Install, configure and run Hadoop and HDFS	CO1
2.	Implement word count / frequency programs using MapReduce	
3.	Implement an MR program that processes a weather dataset	CO2
4.	Implement Linear and logistic Regression	
5.	Implement SVM / Decision tree classification techniques	
6.	Implement clustering techniques	
7.	Visualize data using any plotting framework	CO3
8.	Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing, and Presenting Data, John Wiley & Sons

WEB REFERENCES

1. https://www.thedatalab.com/skills-talent/online-learning/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Process big data using Hadoop framework
CO2	Build and apply linear and logistic regression models
CO3	Perform data analysis with machine learning methods and graphical data analysis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2

CP1211	DESIGN AND ANALYSIS OF PARALLEL ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand different parallel structures and models of computation.
- To introduce the various classes of PRAM algorithms.
- To study MIMD algorithms for basic problems.
- Design and analyse parallel algorithms for matrix operations
- To learn about parallel computing models, design and analyze parallel algorithms Interconnection networks.

UNIT I	STRUCTURES AND ALGORITHMS FOR ARRAY PROCESSORS	9
Structures and algorithms for array processors: SIMD Array Processors, Interconnection networks, Parallel algorithms for Array processors. Multiprocessor architecture- Interconnection networks-multiprocessor control and algorithms- parallel algorithms for multiprocessors.		CO1
UNIT II	PRAM ALGORITHMS	9
Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting – Merging Two Sorted Lists – Matrix Multiplication- Selection - broadcast-all sums- parallel selection. Searching a random sequence, sorted sequence on PRAM models		CO2
UNIT III	MIMD	9
Merging - A network for merging - merging on PRAM models. Sorting on a linear array, EREW, CREW and CRCW SIMD models, MIMD Enumeration sort.		CO3
UNIT IV	MATRIX OPERATIONS	9
Matrix operations- Transposition, Matrix by matrix multiplication, matrix by vector multiplication. Numerical problems- solving systems of linear equations, finding roots of non-linear equations on PRAM models.		CO4
UNIT V	GRAPHS	9
Graphs - Connected components- dense graphs- sparse graphs. Minimum spanning tree-Solli's algorithm, Disconnected components, Ear decomposition, Directed graphs.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", University press, Second edition , 2011
3. V Rajaraman, C Siva Ram Murthy," Parallel computers- Architecture and Programming ", PHI learning, 2016.

REFERENCE BOOKS
1. Kai Wang and Briggs, "Computer Architecture and Parallel Processing", McGraw Hill, 1985. 2. S. G. Akl, "Designa and Analysis of Parallel Algorithms", Prentice Hall Inc., 1992. 3. Joseph Jaja, " An Introduction to parallel Algorithms", Addison Wesley, 1992.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop structures and algorithms for standard problems and applications.
CO2	Analyse efficiency of different parallel algorithms
CO3	Develop parallel algorithms for standard problems and applications.
CO4	Understand matrix operations in parallel algorithms
CO5	To enable the student to design and analyse parallel algorithms

MAPPING OF COs WITH POs AND PSOs

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CO4	3	3	3	2	2	1	1	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	1	1	2	2	1	1	2	3	3	2

CP1212	OPEN SOURCE PROGRAMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Understand the difference between open-source programming and familiarity with Linux operating system.
- ❖ To build applications based on Open-Source web technology like PHP
- ❖ To understand web database applications
- ❖ Understanding and development of web applications using open source web technologies like MySql, PERL, TCL, Python.

UNIT I	INTRODUCTION	9
Introduction to open source programming languages, advantages and drawbacks of open source programming, threats and vulnerabilities in open source languages, Operating System – Ubuntu Linux – Introduction to shell programming.		**CO1**
UNIT II	**PHP**	**9**
PHP Language Basics, Functions - calling a function, variable function, and anonymous function, Strings - cleaning, encoding and escaping, and comparing strings, Arrays – storing data in arrays, extracting multiple values, traversing, and sorting arrays, Objects – creation, introspection, and serialization, Web Techniques – processing forms and maintaining state.		**CO2**
UNIT III	**WEB DATABASE APPLICATIONS**	**9**
Three-tier architecture, Introduction to Object oriented programming with PHP 5, Database basics, MYSQL - querying web databases, writing to web databases, validation with Javascript, Form based authentication, protecting data on the web.		**CO3**
UNIT IV	**MSQL,PERL, TCL, AND PYTHON**	**9**
MySQL - MySQL Functions - Inserting Records Selecting Records - Deleting Records - Update Records –PERL: Numbers and Strings, Control Statements, Lists and Arrays, Files, Pattern matching, Hashes, Functions. TCL: Introduction to TCL/TK, Python: Introduction to Python.		**CO4**
UNIT V	**SECURITY IN WEB APPLICATIONS**	**9**
Recognizing web application security threats, Code Grinder, Building functional and secure web applications, Security problems with Javascript, vulnerable GCI scripts, Code Auditing and Reverse Engineering, types of security used in applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kevin Tatroe, Peter MacIntyre, Rasmus Lerdorf, “Programming PHP”, O’Reilly Media, 2012.
2. Michael Cross, “Developer’s Guide to Web Application Security”, Syngress Publishers, 2007
3. Hugh E. Williams, David Lane, “Web Database applications with PHP and MYSQL”, Second Edition, O’Reilly Media, 2004.

REFERENCE BOOKS

1. Tom Christiansen, Brian D Foy, Larry Wall, Jon Orwant, “Programming Perl”, Fourth Edition, O’Reilly Media, 2012.
2. Mark Lutz, “Programming Python”, Fourth Edition, O’Reilly Media, 2010.
3. Online Tutorials and Recent IEEE/ACM Journal Papers

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and use the concepts of open-source programming
CO2	Usage of PHP in web applications
CO3	Develop codes in open-source web applications
CO4	Usage of open-source languages like MYSQL, PERL, TCL and Python
CO5	Understand the risks associated with the open-source codes and write secure CGI scripts.

MAPPING OF COs WITH POs AND PSOs

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CO4	1	2	2	2	2	1	1	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	1	1	2	2	1	1	2	3	3	2

CP1213	PRINCIPLES OF CRYPTOGRAPHY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide deeper understanding into cryptography, its application to network security, threats / vulnerabilities to networks and countermeasures.
- To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
- To familiarize Digital Signature Standard and provide solutions for their issues.
- To familiarize with cryptographic techniques for secure (confidential) communication of two parties over an insecure (public) channel; verification of the authenticity of the source of a message.

UNIT I	**INTRODUCTION**	**9**
Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.		**CO1**
UNIT II	**BLOCK CIPHER AND DATA ENCRYPTION STANDARDS**	**9**
Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles. ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4.		**CO2**
UNIT III	**PUBLIC KEY CRYPTOGRAPHY AND RSA**	**9**
Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, , Elliptic Curve Arithmetic, Elliptic Curve Cryptography. MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC.DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard.		**CO3**
UNIT IV	**AUTHENTICATION APPLICATION**	**9**
Kerberos, X.509 Authentication Service, Public Key Infrastructure. EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME.IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.		**CO4**
UNIT V	**WEB SECURITY**	**9**
Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats. FIREWALL: Firewall Design principles, Trusted Systems.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. William Stallings (2006), Cryptography and Network Security: Principles and Practice, 4th edition, Pearson Education, India. 2. William Stallings (2000), Network Security Essentials (Applications and Standards), Pearson Education, India.
REFERENCE BOOKS
1. Charlie Kaufman (2002), Network Security: Private Communication in a Public World, 2nd edition, Prentice Hall of India, New Delhi. 2. Atul Kahate (2008), Cryptography and Network Security, 2nd edition, Tata McGraw-Hill, India 3. Robert Bragg, Mark Rhodes (2004), Network Security: The complete reference, Tata McGraw-Hill, India

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand security trends and classical cryptography methods.
CO2	Understand Block cipher and encryption standards
CO3	Simulate with RSA and public key cryptography
CO4	Usage of Authentication methods
CO5	Develop web security principles as security measures,

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	1	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	1	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	1	1	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	1	2	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	1	1	2	2	1	1	2	3	3	2

CP1214	COMPUTER GRAPHICS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand basic algorithms for computer graphics and image processing.
- To understand various filters, Point processing, and Arithmetic operations in image processing.
- To understand different applications of graphics and image processing.

UNIT I	**GRAPHICS SYSTEMS AND GRAPHICAL USER INTERFACE**	**9**
Pixel, Resolution, Video display devices - Types – Graphical devices – Direct screen interaction – Logical input function –GKS. User dialogue – Interactive picture construction techniques.		**CO1**
UNIT II	**GEOMETRIC DISPLAY PRIMITIVES AND ATTRIBUTES**	**9**
Geometric display primitives: Points, Lines and Polygons. Point display method – Line drawing: DDA 2D Transformations and Viewing: Transformations - types – matrix representation – Concatenation - Scaling, Rotation, Translation, Shearing, Mirroring. Homogeneous coordinates – Window to view port transformations. Windowing and Clipping: Point, Lines, Polygons - boundary intersection methods.		**CO2**
UNIT III	**DIGITAL IMAGE FUNDAMENTALS**	**9**
Image Formation and types – Basic geometric transformations – Fourier Transforms – Walsh – Hadamard – Discrete Cosine – Hotelling Transforms.		**CO3**
UNIT IV	**IMAGE ENHANCEMENT AND RESTORATION**	**9**
Histogram Modification Techniques – Image Smoothening – Image Sharpening – Image Restoration – Degradation Model – Noise Models – Spatial Filtering – Frequency Domain Filtering.		**CO4**
UNIT V	**IMAGE SEGMENTATION AND RECOGNITION**	**9**
Detection of Discontinuities – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Morphology operations. Pattern classification - Clustering and Matching - Knowledge representation and use for scene analysis and image understanding (2D and 3D) - Object recognition and identification – Case study of various applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Donald Hearn & M. Pauline Baker , and warren R. Carithers, “Computer Graphics”, Prentice-Hall of India, Fourth edition 2011. (UNIT I & II)
2. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson Education, Third edition, 2011. (UNIT III, IV &V)

REFERENCE BOOKS

1. Newmann W.M. and Sproull R.F., "Principles of Interactive Computer Graphics", Tata McGraw-Hill, Second edition, 2008
2. Foley J.D., Van Dam A, Fiener S.K. and Hughes J.F., “Computer Graphics", Second edition, Pearson education, 2008.
3. Anil Jain K, “Fundamentals of Digital Image Processing”, Prentice-Hall of India, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Usage of Graphical systems and GUI
CO2	Develop simpler games using geometric display primitives
CO3	Usage of Digital Image fundamentals.
CO4	Usage off image enhancement and restoration in creation of Animation
CO5	Use image segmentation in pattern recognition applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	2	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	2	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	2	1	3	3	2	2	1	2	2	1	1	2	3	3	2

CP1215	INTERNET OF THINGS		L	T	P	C
			3	0	0	3

OBJECTIVES

- ❖ To understand the fundamentals of Internet of Things
- ❖ To learn about the basics of IOT protocols
- ❖ To build a small low-cost embedded system using Raspberry Pi.
- ❖ To apply the concept of Internet of Things in the real-world scenario

UNIT I	INTRODUCTION TO IoT	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology		CO1
UNIT II	**IoT ARCHITECTURE**	**9**
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture		CO2
UNIT III	**IoT PROTOCOLS**	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security		CO3
UNIT IV	**BUILDING IoT WITH RASPBERRY PI & ARDUINO**	**9**
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		CO4
UNIT V	**CASE STUDIES AND REAL-WORLD APPLICATIONS**	**9**
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, -Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), -Architecting the Internet of Things‖, Springer, 2011.

REFERENCE BOOKS

1. Honbo Zhou, -The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
2. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , -The Internet of Things – Key applications and Protocols‖, Wiley, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze various protocols for IoT
CO2	Develop web services to access/control IoT devices.
CO3	Design a portable IoT using Rasperry Pi
CO4	Deploy an IoT application and connect to the cloud.
CO5	Analyze applications of IoT in real time scenario

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	2	1	2	2	2	1	1	2	3	3	2
CO3	2	2	2	1	2	1	1	1	2	1	1	2	3	3	2
CO4	2	2	2	1	2	1	2	2	2	1	1	3	3	3	2
CO5	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2

CP1311	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know how to analyze and consider user's need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human – machine interaction

UNIT I	**INTRODUCTION**	**9**
Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output		**CO1**
UNIT II	**DESIGN PROCESS**	**9**
Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centered Design - Methods for User-Centered Design		**CO2**
UNIT III	**IMPLEMENTATION AND EVALUATION PROCESS**	**9**
Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support		**CO3**
UNIT IV	**MODELS**	**9**
Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction.		**CO4**
UNIT V	**APPLICATIONS**	**9**
Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. "Human – Computer Interaction", Second edition, Prentice Hall,1998.

REFERENCE BOOKS

1. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. "Human – Computer Interaction", Addison Wesley, 1994.
2. John M.Carrol, "Human Computer Interaction in the New Millenium", Pearson Education, 2002.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To develop good design for human machine interaction syste
CO2	Analyze the user's need in interaction system
CO3	To design new interaction model to satisfy all types of customers
CO4	Evaluate the usability and effectiveness of various products
CO5	To know how to apply interaction techniques for systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	1	2	2	2	1	1	2	3	3	2
CO3	2	2	2	1	1	1	1	1	2	1	1	2	3	3	2
CO4	2	2	2	1	2	1	2	2	2	1	1	3	3	3	2
CO5	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2

CP1312	IMAGING AND MULTIMEDIA SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of image processing and image security techniques
- To study various compression and file formats used in imaging and multimedia systems
- To analyse different media and design issues related to multimedia systems

UNIT I	INTRODUCTION	9
Introduction to Image Processing: Steps in Image Processing Systems –Image Acquisition – Sampling and Quantization – Pixel Relationships – Colour Fundamentals and Models. Introduction to Multimedia: Multimedia Elements – Multimedia applications – Multimedia System Architecture – Evolving technologies for Multimedia – Defining objects for Multimedia systems – Multimedia Data interface standards – Multimedia Databases		CO1
UNIT II	**COMPRESSION AND FILE FORMATS**	**9**
Compression and Decompression: Need for Data Compression – Types of Compression – Binary Image Compression Schemes – Image Compression – Video Compression – Audio Compression. Data and File Format Standards: Rich Text Format – TIFF File Format – Resource Interface File Format – MIDI File Format - JPEG DIB File Format – AVI Indeo File Format – MPEG Standards –TWAIN.		CO2
UNIT III	**IMAGE COMPUTING AND SECURITY**	**9**
Image computing: The basics of processing 2D images- Thresholding -Convolution-Edge Detection-Mathematical Morphology and Shape Descriptors-Noise Reduction- Image Fusion. Image Security: Image Forensics - Steganography -Image Cryptography Techniques-Chaos based and Non-Chaos based methods.		CO3
UNIT IV	**I/O TECHNOLOGIES**	**9**
Input and Output Technologies: Multimedia I/O Technologies: Image Scanners – Digital Voice and Audio – Digital Camera – Video Images and Animation – Full Motion Video -Video Motion Analysis.		CO4
UNIT V	**APPLICATION DESIGN**	**9**
Multimedia Application Classes – Types of Multimedia Systems – Virtual Reality – Components of Multimedia Systems -Multimedia Authoring Systems – Multimedia Authoring Tools - User Interface Design- Mobile Messaging – Hypermedia Message Components -Hypermedia Linking and embedding.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rafael C Gonzalez, Richard E Woods 2nd Edition, Digital Image Processing - Pearson Education, 2011.
2. Ralf Steinmetz, Klara Steinmetz, “Multimedia Computing, Communications & Applications”, Pearson education, 2009.

REFERENCE BOOKS
1. A.K. Jain, Fundamentals of Digital Image Processing ,PHI, New Delhi, 2001. 2. William K Pratt, Digital Image Processing, John Willey , 2012. 3. Prabat K Andleigh and Kiran Thakrar, “Multimedia Systems and Design”, Prentice Hall India, 2007,New Delhi. 4. Tay Vaughan, “Multimedia Making It Work”, McGraw Hill, 2011. 5. Parekh R “Principles of Multimedia” Tata McGraw-Hill, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know to basics of image processing Systems
CO2	Technics to develop new compression standard
CO3	Understand image computing and secuity
CO4	Acquire skill set to handle all multimedia components efficient
CO5	Develop Integrated and Collaborative multimedia system

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	2	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	1	2	2	2	2	1	1	2	3	3	2
CO3	2	2	2	1	1	2	1	1	2	1	1	2	3	3	2
CO4	2	2	2	2	1	2	2	2	2	1	1	3	3	3	2
CO5	2	2	2	2	1	2	1	2	2	1	1	2	3	3	2

CP1313	AGENT BASED INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basics of Problem-Solving Agents.
- To study the concepts of Knowledge representation.
- To learn the planning techniques.
- To enable the students to know uncertainty techniques to support real-time applications
- To understand the knowledge of higher-level agents

UNIT I	**INTRODUCTION**	**9**
Definitions - Foundations - History - Intelligent Agents-Problem Solving-Searching - Heuristics - Constraint Satisfaction Problems - Game playing.		**CO1**
UNIT II	**KNOWLEDGE REPRESENTATION AND REASONING**	**9**
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events		**CO2**
UNIT III	**PLANNING AGENTS**	**9**
Logical Agents-First order logic-First Order Inference-Unification-Chaining- Resolution Strategies-Knowledge Representation-Objects-Actions-Events		**CO3**
UNIT IV	**AGENTS AND UNCERTAINITY**	**9**
Acting under uncertainty – Probability Notation-Bayes Rule and use - Bayesian Networks-Other Approaches-Time and Uncertainty-Temporal Models- Utility Theory - Decision Network – Complex Decisions.		**CO4**
UNIT V	**HIGHER LEVEL AGENTS**	**9**
Knowledge in Learning-Relevance Information-Statistical Learning Methods-Reinforcement Learning-Communication-Formal Grammar-Augmented Grammars-Future of AI.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach",2nd Edition, Prentice Hall, 2002

REFERENCE BOOKS

1. Michael Wooldridge, "An Introduction to Multi Agent System", John Wiley, 2002.
2. Patrick Henry Winston, Artificial Intelligence, 3rd Edition, AW, 1999.
3. Nils.J.Nilsson, Principles of Artificial Intelligence, Narosa Publishing House, 1992.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand basics of intelligent agents.
CO2	Represent knowledge and implement reasoning techniques.
CO3	Understand various categories of multi agents.
CO4	Explore the deep learning applications
CO5	Analyze optimization and generalization in Higher Level Agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	2	2	2	2	2	1	1	2	3	3	2
CO3	2	2	2	1	2	3	1	1	2	1	1	2	3	3	2
CO4	2	2	2	1	2	2	2	2	2	1	1	3	3	3	2
CO5	2	2	2	1	2	2	1	2	2	1	1	2	3	3	2

CP1314	DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT I	INTRODUCTION	9
Introduction to machine learning- Linear models (SVMs and Perceptron, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates		**CO1**
UNIT II	**DEEP NETWORKS**	**9**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning		**CO2**
UNIT III	**DIMENTIONALITY REDUCTION**	**9**
Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.		**CO3**
UNIT IV	**OPTIMIZATION AND GENERALIZATION**	**9**
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience		**CO4**
UNIT V	**CASE STUDY AND APPLICATIONS**	**9**
Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCE BOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand basics of deep learning
CO2	Implement various deep learning models
CO3	Realign high dimensional data using reduction techniques
CO4	Analyze optimization and generalization in deep learning
CO5	Explore the deep learning applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	3	1	3	2	2	2	2	1	1	2	3	3	2
CO3	3	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	3	3	3	2	2	2	2	2	2	1	1	3	3	3	2
CO5	3	3	3	3	2	2	1	2	2	1	1	2	3	3	2

CP1315	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of information retrieval with pertinence to modelling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- To understand the concepts of digital libraries

UNIT I	**INTRODUCTION: MOTIVATION**	**9**
Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR —IR Versus Web Search–Components of a Search engine		**CO1**
UNIT II	**MODELING**	**9**
Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.		**CO2**
UNIT III	**INDEXING**	**9**
Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency		**CO3**
UNIT IV	**CLASSIFICATION AND CLUSTERING**	**9**
Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning		**CO4**
UNIT V	**SEARCHING THE WEB**	**9**
Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition, 2008.
2. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The concepts and Technology behind Search” (ACM Press Books), Second Edition, 2011.

REFERENCE BOOKS

1. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Build an Information Retrieval system using the available tool
CO2	Identify and design the various components of an Information Retrieval system
CO3	Apply various indexing techniques in information retrieval.
CO4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO5	Design an efficient search engine and analyze the Web content structure

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	1	3	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	2	2	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	2	1	2	2	1	1	2	3	3	2

CP1321	BLOCKCHAIN TECHNOLOGIES		L	T	P	C
			3	0	0	3

OBJECTIVES

- ❖ Understand how blockchain systems (mainly Bitcoin and Ethereum) work
- ❖ To securely interact with them,
- ❖ Design, build, and deploy smart contracts and distributed applications,
- ❖ Integrate ideas from blockchain technology into their own projects

UNIT I	BASICS	9
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.		**CO1**
UNIT II	**BLOCKCHAIN**	**9**
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.		**CO2**
UNIT III	**DISTRIBUTED CONSENSUS**	**9**
Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		**CO3**
UNIT IV	**CRYPTOCURRENCY**	**9**
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin		**CO4**
UNIT V	**CRYPTOCURRENCY REGULATION**	**9**
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

REFERENCE BOOKS

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Design principles of Bitcoin and Ethereum. and Nakamoto consensus
CO2	Learn the simplified Payment Verification protocol and describe differences between proof-of-work and proof-of-stake consensus.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO4	Evaluate security, privacy, and efficiency of a given blockchain system.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	2	3	3	1	2	2	1	1	2	3	3	2
CO2	1	1	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	1	3	2	3	3	1	1	2	1	1	2	3	3	2
CO4	1	1	2	2	3	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	3	2	1	2	2	1	1	2	3	3	2

CP1322	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I	**SPEECH PROCESSING AND SYNTHESIS**	**9**
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		**CO1**
UNIT II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	**9**
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.		**CO2**
UNIT III	**SPEECH RECOGNITION**	**9**
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		**CO3**
UNIT IV	**TEXT ANALYSIS**	**9**
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		**CO4**
UNIT V	**SPEECH SYNTHESIS**	**9**
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.

REFERENCE BOOKS

1. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
2. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
2. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
CO2	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
CO3	Justify the use of formant and concatenative approaches to speech synthesis
CO4	Identify the apt approach of speech synthesis depending on the language to be processed
CO5	Determine the various encoding techniques for representing speech.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	2	3	3	1	1	3	1	1	2	1	1	2	3	3	2
CO4	2	2	2	1	2	2	2	2	2	1	1	3	3	3	2
CO5	2	2	3	1	2	2	1	2	2	1	1	2	3	3	2

CP1323	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To comprehend software development process and formal specifications
- To know advanced software development techniques and its application in real world context
- To understand how to manage complex projects
- To use advanced software testing techniques
- To understand process improvement and re -engineering

UNIT I	**SOFTWARE ENGINEERING PROCESS AND FORMAL METHODS**	**9**
Software Process models – Software Life Cycle – Development Activities – Managing Software Development – Unified Modeling Language – Requirement elicitation and specification – Understanding formal methods – motivation for formal methods – informal requirements to formal specifications – validating formal specifications – Overview of Z specification		**CO1**
UNIT II	**AGILE AND ASPECT ORIENTED SOFTWARE ENGINEERING**	**9**
Agile Development: Agility – agile principles- Extreme Programming -— Agile process models – Agile modeling – Agile unified Process – tools set for agile process – Complex Projects: SCRUM — basics, SCRUM Process, Development using SCRUM — Aspect Oriented Software Development: Aspect-Orientation in the Software Lifecycle – Generic Aspect-Oriented Design with UML – Modeling for Aspect-Oriented Software Development- Developing Secure Applications Through Aspect-Oriented Programming.		**CO2**
UNIT III	**COMPONENT-BASED SOFTWARE ENGINEERING**	**9**
Engineering of component-based systems, the CBSE process – Designing class based components – component design for Web Apps – Component-based development – Component-level design patterns – Classifying and retrieving components, and economics of CBSE.		**CO3**
UNIT IV	**ADVANCED SOFTWARE TESTING TECHNIQUES**	**9**
Software Review – Testing Strategies - Testing Conventional Applications – Testing Object- Oriented Applications – Testing Web Applications – Formal Modeling and verification – Metrics : Product, process, project, testing and quality metrics – Software Test Automation		**CO4**
UNIT V	**SOFTWARE PROCESS IMPROVEMENT AND REENGINEERING**	**9**
SPI process – CMMI – SPI frameworks – SPI Trends – Emerging trends ion Software Engineering – identifying soft trends – Technology directions – Tool-related trends – Software Maintenance and Reengineering: software reengineering, reverse reengineering, restructuring, forward reengineering.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Roger S. Pressman, "Software Engineering — A Practioner‟s Approach", MCGraw Hill, 7thedition, 2009.
2. Ian Sommerville, "Software Engineering", Addison-Wesley 9th Edition, 2010.
3. Bernd Bruegge, Allen H. Dutoit, "Object-Oriented Software Engineering", Prentice Hall, Third Edition, 2009.

REFERENCE BOOKS

1. Robert E. Filman, Tzilla Elrad, Siobhán Clarke, Mehmet Aksit, "Aspect-Oriented Software Development", Addison-Wesley Professional, 2004.
2. Renu Rajni, Pradeep Oak, "Software Testing: Effective Methods, Tools and Techniques", TataMcGraw Hill, 2004.
3. Jonathan Bowen, "Formal Specification and Documentation using Z - A Case Study Approach",Intl Thomson Computer Press, 1996.
4. Antoni Diller, "Z: An Introduction to Formal Methods", Wiley, 1994.
5. James Shore, Shane Warden "The Art of Agile Development - Pragmatic guide to agile software development", O'Reilly Media, October 2007.
6. Ken Schwaber, "Agile Project Management with SCRUM", Microsoft Press, 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analytically apply general principles of software development in the development of complex software and software- intensive systems
CO2	Usage of Agile technology in SCRUM Development
CO3	Discuss methods and techniques for advanced software development and also to be able to use these in various development situations
CO4	Apply testing techniques for object-oriented software and web-based systems
CO5	Apply re-engineering concepts in software development process

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	1	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	2	1	2	2	1	1	2	3	3	2

CP1324	MOBILE NETWORK SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of Mobile communication systems.
- To understand the different multiplexing scheme.
- To understand the significance of different layers in mobile system.

UNIT I	INTRODUCTION	9
Introduction to wireless, mobile and cellular mobile systems- cellular mobile telephone systems, analog and digital cellular systems- frequency reuse, co-channel interference.		CO1
UNIT II	**MAC**	**9**
Medium access control - MAC, SDMA, FDMA, TDMA, CDMA, Hand offs and dropped calls- initiation of handoff, power difference, mobile assisted cell-site and Intersystem handoff.		CO2
UNIT III	**COMMUNICATION SYSTEMS**	**9**
Mobile Telecommunication standards, GSM, DECT, TETRA, IMT-2000, CTEO, satellite systems – GEO, LEO and MEO, and broadcast systems –Digital audio and video broadcasting, IEEE 802.11, HIPERLAN, Bluetooth, Wireless ATM, WATM services.		CO3
UNIT IV	**MOBILE NETWORK LAYER**	**9**
Network support for mobile systems – Mobile IP- IP packet delivery- Agent discovery-tunnelling and encapsulation, reverse tunnelling, IPV6, DHCP.		CO4
UNIT V	**MOBILE TRANSPORT LAYER**	**9**
Mobile transport and application layer protocol - Review of traditional TCP, fast retransmit/fast recovery, transmission/timeout freezing, file systems, WWW, WAP.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jochen Sciiiller, "Mobile Communications ", Pearson Education India, 2009.

REFERENCE BOOKS

1. Theodore S. Rappaport, “Wireless Communications: Principles and Practice”, 2/e, Pearson Education, 2010.
2. William C.Y Lee, "Mobile Cellular Telecommunications ", McGraw Hill International Editions, 1995

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the concepts of mobile and wireless communications.
CO2	Understand the concepts of MAC in mobile and wireless communication
CO3	Understand the concepts of Communication systems in mobile and wireless communications
CO4	Understand the concepts of packet delivery in mobile and wireless communications
CO5	Apply the knowledge gained in exploring, application and protocol development

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	2	2	2	2	1	3	1	1	2	1	1	2	3	3	2
CO4	2	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	2	2	2	3	2	2	1	2	2	1	1	2	3	3	2

CP1325	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To understand fundamentals of Hacking and Hackers process
- ❖ To learn finger printing services and system hacking.
- ❖ To understand malware threats and denial of service.
- ❖ To know webserver hacking and mobile device operation.
- ❖ To know about IDS, Honey bots and botnets.

UNIT I	**INTRODUCTION TO ETHICAL HACKING**	**9**
Security Fundamental, Security testing, Hacker and Cracker, Descriptions, Test Plans-keeping It legal, Ethical and Legality- The Attacker's Process, The Ethical Hacker's Process, Security and the Stack		**CO1**
UNIT II	**FOOTPRINTING AND SCANNING**	**9**
Information Gathering, Determining the Network Range, Identifying Active Machines, Finding Open Ports and Access Points, OS Fingerprinting Services, Mapping the Network Attack Surface -Enumeration, System Hacking		**CO2**
UNIT III	**MALWARE THREATS**	**9**
Viruses and Worms, Trojans, Covert Communication, Keystroke Logging and Spyware, Malware Counter measures- Sniffers, Session Hijacking, Denial of Service and Distributed Denial of Service		**CO3**
UNIT IV	**WEB SERVER HACKING**	**9**
Web Server Hacking, Web Application Hacking, Database Hacking- Wireless Technologies, Mobile Device Operation and Security, Wireless LANs.		**CO4**
UNIT V	**PHYSICAL SECURITY**	**9**
Physical Security, Social Engineering- Intrusion Detection Systems, Firewalls, Honeypots-Cloud Computing, Botnets		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nancy R Mead,Carol C Woody,Cyber security Engineering,A practical approach for systems and software assurance,CRC press,2016.

REFERENCE BOOKS

1. Certified Ethical Hacker, Version 9, Second Edition, Michael Gregg, Pearson IT Certification
2. Hacking the Hacker, Roger Grimes, Wiley, Online ISBN:9781119396260, © 2017 by John Wiley & Sons, Inc.
3. The Unofficial Guide to Ethical Hacking, Ankit Fadia, Premier Press,2002

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe and understand the basics of the ethical hacking
CO2	Perform the foot printing and scanning - Demonstrate the techniques for system hacking
CO3	Characterize the malware and their attacks and detect and prevent them
CO4	Determine the signature of different attacks and prevent them
CO5	Detect and prevent the security attacks in different environments

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	2	1	2	2	1	1	2	3	3	2
CO3	3	3	3	1	3	3	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	2	1	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	2	1	2	2	1	1	2	3	3	2

CP1331	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization. To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of Cloud architecture and virtualization support that is fundamental to cloud computing
- To understand the security issues in the grid and the cloud environment.
- To be able to know the insight on the programming model and set up a private cloud

UNIT I	VIRTUALIZATION	9
Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization –– Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization.		CO1
UNIT II	**VIRTUALIZATION INFRASTRUCTURE**	**9**
Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.		CO2
UNIT III	**CLOUD PLATFORM ARCHITECTURE**	**9**
Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms: GAE,AWS – Inter-cloud Resource Management		CO3
UNIT IV	**CLOUD SECURITY**	**9**
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management		CO4
UNIT V	**PROGRAMMING MODEL**	**9**
Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O'Reilly Media, Inc.,2009.

REFERENCE BOOKS

1. Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner's Guide", McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
4. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Employ the concepts of storage virtualization, network virtualization and its management
CO2	Apply the concept of virtualization in the cloud computing
CO3	Identify the architecture, infrastructure and delivery models of cloud computing
CO4	Develop services using Cloud computing
CO5	Apply the security models in the cloud environment

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	1	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	1	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	2	1	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	1	2	2	2	1	1	3	3	3	2
CO5	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2

CP1332	SOFTWARE ARCHITECTURE AND DESIGN PATTERNS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the creational and structural patterns.
- Be able to explain the role of analyzing architectures.
- Be capable of applying his knowledge to create an architecture for given application.
- Be able to identify different structural and behavioral patterns.
- To know the usage of design patterns by solving a case study

UNIT I	**ENVISIONING ARCHITECTURE**	**9**
.The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views. Creating an Architecture- Quality Attributes, Achieving qualities, Architectural styles and patterns, designing the Architecture, Documenting software architectures, Reconstructing Software Architecture.		**CO1**
UNIT II	**ANALYZING ARCHITECTURES**	**9**
Architecture Evaluation, Architecture design decision making, ATAM, CBAM. Moving from one system to many: Software Product Lines, Building systems from off the shelf components, Software architecture in future.		**CO2**
UNIT III	**CREATIONAL AND STRUCTURAL PATTERNS**	**9**
Patterns: Pattern Description, Organizing catalogs, role in solving design problems ,Selection and usage. Creational and Structural patterns: Abstract factory, builder, factory method, prototype, singleton, adapter, bridge, composite, façade, flyweight, Proxy.		**CO3**
UNIT IV	**BEHAVIORAL PATTERNS**	**9**
Chain of responsibility, command, Interpreter, iterator, mediator, memento, observer, state, strategy, template method, visitor.		**CO4**
UNIT V	**CASE STUDIES**	**9**
A-7E – A case study in utilizing architectural structures, The World Wide Web - a case study in interoperability, Air Traffic Control – a case study in designing for high availability, Celsius Tech – a case study in product line development		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Len Bass,Paul Clements&Rick Kazman, Software Architecture in Practice, 2nd Edition, Pearson Education, 2003.
2. Erich Gamma, Design Patterns, 1st Edition, Pearson Education,1995
3. http://en.wikibooks.org/wiki/Introduction_to_Software_Engineering/Architecture/Design_Patterns.

REFERENCE BOOKS

1. Luke Hohmann , Beyond Software architecture, Addison wesley, 2003.
2. David M. Dikel, David Kane and James R. Wilson, Software architecture, 1st Edition, Prentice Hall,2001
4. F.Buschmann , Pattern Oriented Software Architecture, Wiley&Sons,1st Edition,2001

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the architecture, creating it and moving from one to any, different structural patterns.
CO2	Analyze the architecture and build the system from the components.
CO3	Design creational and structural patterns.
CO4	Learn about behavioural patterns.
CO5	Do a case study in utilizing architectural structures.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	3	1	3	2	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO4	3	3	3	1	2	2	2	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	2	1	2	2	1	1	2	3	3	2

CP1333	BIG DATA MINING AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand big data and data analytics lifecycle
- To learn Basic Data analytic methods using R
- To understand concepts in clustering and regression
- To learn classification techniques in text documents
- To Get a knowledge on advanced analytical methods, technology and tools

UNIT I	BIG DATA OVERVIEW	9
State of the practice in Analytics-Key roles for new big data ecosystem Data Analytics Lifecycle-Data analytics lifecycle overview- Discovery- Data Preparation-Model Planning-Model Building-Communicate Results operationalize		CO1
UNIT II	**INTRODUCTION TO R**	**9**
Exploratory Data Analytics-Statistical methods for evaluation Hadoop & Map Reduce framework for R, R with Relational Database Management Systems, R with Non-Relational (NoSQL) DBs		CO2
UNIT III	**CLUSTERING**	**9**
Overview of Clustering-K-means, Association Rules-Overview-Apriori Algorithm-Evaluation of candidate rules-An Example: Transactions in grocery Store-Validation and Testing-Diagnostics, Regression-Linear Regression-Logistic Regression-Reason to choose and Cautions-Additional Regression Models		CO3
UNIT IV	**CLASSIFICATION**	**9**
Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional classification methods, Time series Analysis Overview of Time series analysis-ARIMA Model-Additional methods, Text Analysis-Text analysis steps-A text analysis Example-Collecting raw Text-Representing Text-Term Frequency—Inverse document frequency(TFIDF)-Categorizing documents by Topics-Determining Sentiments-Gaining insights		CO4
UNIT V	**ANALYTICS FOR UNSTRUCTURED DATA**	**9**
The Hadoop Ecosystem-NoSQL, In-Database Analytics-SQL Essentials-In-Database Text Analysis-Advanced SQL		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015. .
2. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016

REFERENCE BOOKS

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.
3. Kim H. Pries and Robert Dunnigan, “Big Data Analytics: A Practical Guide for Managers” CRC Press, 2015

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the big data concepts
CO2	Utilize and apply the Analytical methods, Technology and tools in the industry.
CO3	Apply the techniques of clustering in real time applications
CO4	Apply the concepts off classification to classify text documents.
CO5	Understand Hadoop ecosystem and apply to solve real-life problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	2	1	2	2	2	1	1	2	3	3	2
CO3	2	2	2	1	2	1	1	1	2	1	1	2	3	3	2
CO4	2	2	2	1	2	1	2	2	2	1	1	3	3	3	2
CO5	2	2	2	1	2	1	1	2	2	1	1	2	3	3	2

CP1334	SOCIAL NETWORK ANALYSIS		L	T	P	C
			3	0	0	3

OBJECTIVES

- To understand the components of the social Network
- To model and visualize the social network
- To mine the users in the w4
- To understand the evolution of the social Network
- To know the applications in Real Time Systems

UNIT I	**INTRODUCTION**	**9**
Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks		**CO1**
UNIT II	**MODELING AND VISUALIZATION MODELING AND VISUALIZATION**	**9**
Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.		**CO2**
UNIT III	**MINING COMMUNITIES**	**9**
Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.		**CO3**
UNIT IV	**EVOLUTION**	**9**
Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models		**CO4**
UNIT V	**APPLICATIONS**	**9**
A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2012
2. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 2014
3. Peter Mika, "Social networks and the Semantic Web", Springer, 2007.
4. Guandong Xu,Yanchun Zhang, and Lin Li, "Web Mining and Social Networking Techniques and Applications", Springer.

REFERENCE BOOKS

1. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011
2. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
3. Przemyslaw Kazienko, Nitesh Chawla,”Applications of Social Media and Social Network Analysis”, Springer,2015

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Work on the internals components of the social network
CO2	Model and visualize the social network
CO3	Mine the behavior of the users in the social network
CO4	Predict the possible next outcome of the social network
CO5	Apply social network in real time application.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	1	2	2	1	1	2	3	3	2
CO2	3	3	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	3	3	3	1	1	3	1	1	2	1	1	2	3	3	2
CO4	3	3	2	1	2	2	2	2	2	1	1	3	3	3	2
CO5	3	3	3	1	2	2	1	2	2	1	1	2	3	3	2

CP1335	COGNITIVE SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the basic concepts, approaches and issues in the field of cognitive science
- To increase the awareness of the students to the questions raised in the disciplines of computer science, linguistics, philosophy and psychology;
- To focus on the interaction of these disciplines in approaching the study of the mind – brain language.
- Specialization on topics central to cognitive development such as the nature of mental representation, reasoning, perception, language use, learning as well as other cognitive processes of humans and other intelligent systems.
- To focus on memory and social cognition

UNIT I	INTRODUCTION TO COGNITIVE SCIENCE	9
Introduction to the study of cognitive sciences. A brief history of cognitive science. Methodological concerns in philosophy, artificial intelligence and psychology. Structure and constituents of the brain; Brief history of neuroscience; Mathematical models; Looking at brain signals		CO1
UNIT II	**REPRESENTATION OF SENSORY INFORMATION**	**9**
Processing of sensory information in the brain- Neural Network Models; Processing of sensory information in the brain; motor and sensory areas; Brain Imaging, fMRI, MEG, PET, EEG-Multisensory integration in cortex; information fusion; from sensation to cognition, cybernetics		CO2
UNIT III	**LANGUAGE AND LATERALIZATION**	**9**
Linguistic knowledge: Syntax, semantics, (and pragmatics); Generative linguistics; Brain and language; Language disorders; Lateralization; Cognitivist and emergent standpoints ; A robotic perspective		CO3
UNIT IV	**COGNITIVE DEVELOPMENT**	**9**
Introduction to Psychology- Attention and related concepts; Human visual attention; Computational models of attention; Applications of computational models-Learning: Categories and concepts; Concept learning; Logic ; Machine learning		CO4
UNIT V	**MEMORY AND SOCIAL COGNITION**	**9**
Constructing memories; Explicit vs. implicit memory; Information processing (three-boxes) model of memory; Sensory memory; Short term memory; Long term memory- Rationality; Bounded rationality; Prospect theory ; Heuristics and biases; Reasoning in computers- social cognition; Context and social judgment; Schemas; Social signals		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gardner, The Mind's New Science, chapters 2,3,4. Gardner, Howard E. The mind's new science: A history of the cognitive revolution. Basic books, 2008.
2. Wallace, Mark T., and Barry E. Stein. "Sensory organization of the superior colliculus in cat and monkey." Progress in brain research 112 (1996): 301-311.
3. Fromkin, Rodman, and Hyams. An Introduction to Language, Boston, MA: Thomson Wadsworth, 9th edition, 2011.

REFERENCE BOOKS

1. "Language and the Brain", https://web.stanford.edu/~zwicky/language-and-the-brain-ch4-8.pdf
2. Simon, Bounded Rationality in Social Science: Today and Tomorrow, Mind & Society, 1, 2000, 25-39

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the basics of Cognitive science.
CO2	Use the sensory information and neural network models in real time.
CO3	Apply Linguistic knowledge in terms of robots perspective
CO4	Learn the computational models
CO5	Apply the knowledge of Memory and Social cognition.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3	1	2	2	1	1	2	3	3	2
CO2	2	2	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	3	3	2	1	3	1	1	2	1	1	2	3	3	2
CO4	1	2	2	2	2	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	2	2	1	2	2	1	1	2	3	3	2

OPEN ELECTIVE COURSES – I

OBY101	ESSENTIALS OF HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the type, nature and treatment of hazardous wastes.

UNIT I	**INTRODUCTION**	**9**
Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances.		
UNIT II	**HAZARDOUS WASTES MANAGEMENT**	**9**
Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification-Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.		
UNIT III	**BIOMEDICAL WASTE MANAGEMENT**	**9**
Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection - ,disposal. Infection control Practices.		
UNIT IV	**RADIOACTIVE WASTE MANAGEMENT**	**9**
Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.		
UNIT V	**E-WASTE MANAGEMENT**	**9**
Regulatory aspects of E-I Waste management, Waste characteristics- Generation–- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management		

TOTAL : 45 PERIODS

TEXT BOOKS

1. Hazardous waste management Charles A.Wentz. Second edition 1995.McGraw Hill International.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.
3. Criteria for hazardous waste landfills–CPCBguidelines2000

REFERENCE BOOKS

1. Basic Hazardous waste management, "William C.Blackman.Jr", Third Edition, 2001, Lewis Publishers
2. Integrated solidwaste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.
3. Criteria for hazardous waste landfills–CPCB guidelines 2000..
4. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997.
5. Management of Solid waste in developing countries by Frank Flint off, WH Original publication.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand Hazardous Solid Waste
CO2	To introduce students to basic concepts of planning and management of hazardous waste management.
CO3	The content involves importance of necessity of hazardous waste management
CO4	To understand Physico-Chemical Treatment: Incineration
CO5	To understand the Hazard analysis.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	1	2	-	-	1	1	-	-	1	-	2
CO2	-	-	-	2	2	1	-	-	2	-	-	-	1	-	2
CO3	-	-	-	1	1	2	-	-	1	2	-	-	1	-	2
CO4	-	-	-	-	2	1	-	-	2	1	-	-	1	-	2
CO5	-	-	-	1	2	-	-	-	1	2	-	-	1	-	2

OCP101	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I **OVERVIEW OF BUSINESS ANALYTICS** **9**

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real–time decision–making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.Quiz on case studies.

CO1

UNIT II **ESSENTIALS OF BUSINESS ANALYTICS** **9**

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, Z–Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data. Quiz on data visualization for univariate, bivariate data.

UNIT III **MODELING UNCERTAINTY AND STATISTICAL INFERENCE** **9**

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and
- Hypothesis testing.
- Converting real–time decision–making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing. Quizzes on topics like sampling and probability.

UNIT IV	ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK	9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map–Reduce: Matrix–Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web–based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.

Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V	OTHER DATA ANALYTICAL FRAMEWORKS	9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map–Reduce Tasks and Result Projection

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Vignesh Prajapati, 'Big Data Analytics with R and Hadoop', Packt Publishing, 2013
2. Umesh R Hodeghatta, Umesha Nayak, 'Business Analytics Using R – A Practical Approach', A press, 2017
3. Anand Rajaraman, Jeffrey David Ullman, 'Mining of Massive Datasets', Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, 'Essentials of Business Analytics', Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, 'Business Analytics: The Science of Data–Driven Decision Making', Wiley, 2017.
6. A. Ohri, 'R for Business Analytics', Springer, 2012.
7. Rui Miguel Forte, 'Mastering Predictive Analytics with R', Packt Publication, 2015.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the real–world business problems and model with analytical solutions.
CO2	Solve analytical problem with relevant mathematics background knowledge.
CO3	Convert any real–world decision–making problem to hypothesis and apply suitable statistical testing.
CO4	Write and demonstrate simple applications involving analytics using Hadoop and MapReduce
CO5	Use open–source frameworks for modeling and storing data and apply suitable visualization technique using R for visualizing voluminous data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2
CO2	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2
CO3	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2
CO4	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2
CO5	3	3	3	3	3	2	1	1	2	1	2	1	2	2	2

OEC101	NEXT GENERATION WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know how Convergence of video/voice/data, high-performance wireless networks, mobile networking has been implemented for broad band applications
- To know about the broad landscape of emerging networking and inter-networking technologies

UNIT I	HETEROGENEOUS RADIO TECHNOLOGIES	9
Evolution of Wireless Networks - Wireless Local Area Networks - Public Wide-Area Wireless networks. Introduction to 1G/2G/3G/4G Terminology -Evolution of Public Mobile Services – First Wave of Mobile Data Services: Text-Based Instant Messaging - Second Wave of Mobile Data Services: Low Speed Mobile Internet Services - Current Wave of Mobile Data Services: High-Speed and Multimedia Mobile Internet Services - IP-Based Wireless Networks - 3GPP, 3GPP2.		
UNIT II	**WIRELESS IP NETWORK ARCHITECTURES**	**9**
3GPP Packet Data Networks - Network Architecture-3GPP2 Packet Data - MWIF All-IP Mobile Networks – Network Architectures - Access to MWIF Networks - Session Management.		
UNIT III	**IP MULTIMEDIA SUBSYSTEMS AND APPLICATION-LEVEL SIGNALING**	**9**
Signaling in IP Networks -Session Initiation Protocol (SIP) -Session Description Protocol (SDP)3GPP IP Multimedia Subsystem (IMS) - IMS Architecture - Mobile Station Addressing for Accessing the IMS - Reference Interfaces –Service Architecture - Registration with the IMS - Deregistration with the IMS -End-to-End Signalling Flows for Session Control- 3GPP2 IP Multimedia Subsystem (IMS).		
UNIT IV	**MOBILITY MANAGEMENT**	**9**
Basic Issues in Mobility Management - Mobility Management in IP Networks - Mobility Management in 3GPP Packet Networks -Mobility Management in 3GPP2 - Packet Data Networks – mobility Management in MWIF Networks - Comparison of Mobility Management in IP, 3GPP and 3GPP2 Networks.		
UNIT V	**QUALITY OF SERVICE**	**9**
Internet QoS - QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS in 3GPP2 - 3GPP2 QoS Architecture - 3GPP2 QoS Management -3GPP2 QoS Classes - QoS Attributes (QoS Profile) -Management of End-to-End IP QoS.		
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols," John Wiley & Sons, Inc. Publication, First Edition, 2008.
2. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks," Wiley Publication, 2005.
3. Minoru Etoh, "Next Generation Mobile Systems3G and Beyond", Wiley Publications, First Edition, 2005.
4. SavoGlisic, "Advanced Wireless Communications 4G Technologies," Wiley Publications, First Edition,2009

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Analyze Packet Switching Services of the Next Generation wireless services
CO2	Explain the architectures of wireless IP network.
CO3	Evaluate the performance of Voice and data over Internet Protocol
CO4	Explain the Mobility management schemes of the Next Generation wireless services.
CO5	Evaluate integrated broadband access using telecommunications systems in terms of QoS.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	3	2	3	1	2	3	1	1	1
CO2	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO3	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO4	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO5	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3

<table>
<tr><td>OMF103</td><td colspan="2">OPTIMIZATION TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ To introduce the various optimization techniques and their advancements.
❖ To make use of the above techniques while modeling and solving the engineering problems of different fields</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="5">Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems</td><td colspan="2"></td></tr>
<tr><td>UNIT II</td><td colspan="5">CLASSIC OPTIMIZATION TECHNIQUES</td><td>9</td></tr>
<tr><td colspan="5">Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.</td><td colspan="2"></td></tr>
<tr><td>UNIT III</td><td colspan="5">NON-LINEAR PROGRAMMING</td><td>9</td></tr>
<tr><td colspan="5">Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming</td><td colspan="2"></td></tr>
<tr><td>UNIT IV</td><td colspan="5">INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES</td><td>9</td></tr>
<tr><td colspan="5">Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem</td><td colspan="2"></td></tr>
<tr><td>UNIT V</td><td colspan="5">ADVANCES IN SIMULATION</td><td>9</td></tr>
<tr><td colspan="5">Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems</td><td colspan="2">CO5</td></tr>
<tr><td colspan="7">TOTAL : 45 PERIODS</td></tr>
<tr><td colspan="7">TEXT BOOKS</td></tr>
<tr><td colspan="7">1. Singiresu S. Rao , “Engineering Optimization: Theory and Practice”, Fourth Edition ,John Wiley & Sons, Inc., 2009.
2. R. Panneerselvam, “Operations Research”, Prentice Hall of India Private Limited, New Delhi 1 – 2005</td></tr>
<tr><td colspan="7">REFERENCE BOOKS</td></tr>
<tr><td colspan="7">1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994 Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992</td></tr>
</table>

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	The student has the basic knowledge about historical development of optimization problems, formulation of the problem, classification and application to various engineering domain.
CO2	Ability to approach and solve the linear equations of operational research problems which relates to the real engineering business problem.
CO3	Ability to approach and solve the Non-linear equations of operational research problems which relates to the real engineering business problem.
CO4	Ability to use the various optimization techniques for solving the various experimental studies to obtain the optimum objective function value.
CO5	The student has the knowledge about various simulation techniques and knows to relate these techniques to various experimental studies to obtain the optimum objective function value.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	1	1	3	3	2	3	1	2	3	1	1	1
CO2	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO3	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO4	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO5	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3

OPE101	RENEWABLE SOURCES OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the energy scenario and various energy sources.
- To learn the solar photovoltaic and solar thermal systems.
- To impart knowledge on wind energy and bio-mass energy conversion systems.
- To provide knowledge about the Geothermal and Ocean energy conversion system.
- To design and implement hybrid energy conversion system.

UNIT I	**INTRODUCTION**	**9**
Renewable energy sources and its energy scenario - global and Indian; Environmental aspects and impacts of renewable energy generation on environment; Types of Renewable energy sources: solar - wind - Biomass - Ocean - Tidal - Geothermal and Fuel cell.		
UNIT II	**SOLAR ENERGY SYSTEMS**	**9**
Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - Introduction to Solar photo-voltaic (PV) system and Solar - thermal system; Equivalent circuit of a solar cell, solar array and its sizing. Solar thermal collectors: flat plate collectors - concentrating collectors; solar thermal applications - heating, cooling, desalination, drying, cooking - solar thermal electric power plant.		
UNIT III	**WIND ENERGY AND BIO-MASS ENERGY**	**9**
Wind Sources: horizontal and vertical axis wind turbine - performance characteristics - types of wind turbine generators - Betz criteria; Bio-mass: Principles of Bio-Conversion - Anaerobic/aerobic digestion - types of Bio-gas digesters - gas yield - combustion characteristics of bio-gas - utilization for cooking.		
UNIT IV	**GEOTHERMAL AND OCEAN ENERGY**	**9**
Geothermal: Resources - types of wells - methods of harnessing the energy. Ocean Energy: OTEC- Principles, utilization - setting of OTEC plants - thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques - mini-hydro power plants and their economics.		
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems - Types of Hybrid systems - Case studies of solar and Wind.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage", Tata McGraw Hill, 1990.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 2011.

REFERENCE BOOKS

1. G. L. Johnson, Wind energy systems, Prentice Hall Inc. New Jersey.
2. J. M. Kriender, Principles of Solar Engineering", McGraw Hill, 1987.
3. Twidell&Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011
4. V. S. Mangal, Solar Engineering", Tata McGraw Hill, 1992.
5. N. K. Bansal, Renewable Energy Source and Conversion Technology", Tata McGraw Hill, 1989.
6. P. J. Lunde, Solar Thermal Engineering", John Willey & Sons, New York, 1988.

3. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes", Wiley & Sons, 1990.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the energy scenario and the various sources of non-conventional energy sources.
CO2	Learn the physics of solar energy and to understand the solar photovoltaic, solar-thermal energy conversion system.
CO3	Acquire knowledge in wind and bio-mass energy conversion system.
CO4	Acquire knowledge in Geothermal and Ocean energy conversion system.
CO5	Design and implement hybrid energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	1	1	3	3	2	3	1	2	3	1	1	1
CO2	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO3	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO4	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3
CO5	3	1	3	1	1	3	3	2	3	1	2	3	2	3	3

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	INTRODUCTION	9
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		CO1
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**9**
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		CO2
UNIT III	**ORGANS OF GOVERNANCE**	**9**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		CO3
UNIT IV	**EMERGENCY PROVISIONS**	**9**
Emergency Provisions - National Emergency, President Rule, Financial Emergency		CO4
UNIT V	**LOCAL ADMINISTRATION**	**9**
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI-Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop knowledge of self-development
- ❖ Explain the importance of Human values
- ❖ Develop the overall personality through value education
- ❖ Overcome the self-destructive habits with value education
- ❖ Interpret social empowerment with value education

UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**9**
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		**CO1**
UNIT II	**IMPORTANCE OF VALUES**	**9**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		**CO2**
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**9**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**9**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		**CO4**
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**9**
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	INTRODUCTION AND METHODOLOGY	9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		CO1
UNIT II	**THEMATIC OVERVIEW**	**9**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		CO2
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**9**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		CO3
UNIT IV	**PROFESSIONAL DEVELOPMENT**	**9**
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes		CO4
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**9**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop healthy mind in a healthy body thus improving social health also improve efficiency
- ❖ Invent Do's and Don't's in life through Yam
- ❖ Categorize Do's and Don't's in life through Niyam
- ❖ Develop a healthy mind and body through Yog Asans
- ❖ Invent breathing techniques through Pranayam

UNIT I	**INTRODUCTION TO YOGA**	**9**
Definitions of Eight parts of yog.(Ashtanga)		**CO1**
UNIT II	**YAM**	**9**
Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		**CO2**
UNIT III	**NIYAM**	**9**
Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		**CO3**
UNIT IV	**ASAN**	**9**
Various yog poses and their benefits for mind & body		**CO4**
UNIT V	**PRANAYAM**	**9**
Regularization of breathing techniques and its effects-Types of pranayam		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do's and Don't's in life through Yam
CO3	Learn Do's and Don't's in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**9**
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**9**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**9**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**9**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**9**
Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	9
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.		CO1
UNIT II	RURAL ECONOMY AND LIVELIHOOD	9
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **Assignment:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		CO2
UNIT III	RURAL INSTITUTIONS	9
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		CO3
UNIT IV	RURAL DEVELOPMENT PROGRAMMES	9
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		CO4

UNIT V	FIELD WORK	9

Each student selects one programme for field visit Field based practical activities:

- ❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- ❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- ❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- ❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- ❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- ❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps
- ❖ Participate in Gram Sabha meetings, and study community participation
- ❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- ❖ Attend Parent Teacher Association meetings, and interview school drop outs
- ❖ Visit local Anganwadi Centre and observe the services being provided
- ❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- ❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- ❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- ❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- ❖ Formation of committees for common property resource management, village pond maintenance and fishing.

CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS
1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers 2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	**INTRODUCTION TO CULTURE**	**9**
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		**CO1**
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**9**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		**CO2**
UNIT III	**RELIGION AND PHILOSOPHY**	**9**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		**CO3**
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		**CO4**
UNIT V	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Understand education systems in India

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Introduction to Sanga Tamil Literature.
- ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
- ‘Attruppadai’ in SangaTamil Literature.
- ‘Puranaanuru’ in SangaTamil Literature.
- ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT I	SANGA TAMIL LITERATURE – AN INTRODUCTION	9
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s GrammarTamil Sangam Literature’s parables.		**CO1**
UNIT II	**‘AGATHINAI’AND‘PURATHINAI’**	**9**
Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		**CO2**
UNIT III	**‘ATTRUPPADAI’**	**9**
Attruppadai Literature – Attruppadaiin ‘Puranaanuru’ – Attruppadaiin ‘Pathitrupaththu’- Attruppadaiin ‘Paththupaattu’.		**CO3**
UNIT IV	**‘PURANAANURU’**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**
UNIT V	**‘PATHITRUPATHTHU’**	**9**
Pathitrupaththuin ‘Ettuthogai’ – Pathitrupaththu’s Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To enable graduates to develop solutions to real world problems in the frontier areas of Applied Electronics.
2. To enable the graduates to adapt to the latest trends in technology through self-learning and to pursue research to meet out the demands in industries and Academia.
3. To enable the graduates to exhibit leadership skills and enhance their abilities through lifelong learning.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: To critically evaluate the design and provide optimal solutions to problem areas in advanced signal processing, digital system design, embedded systems and VLSI design.

PSO2: **To e**nhance and develop electronic systems using modern engineering hardware and software tools.

PSO3: To work professionally and ethically in applied electronics and related areas.

Mapping of Programme Educational Objectives (PEOs) and the Program Outcomes (Pos):

PEOs	PROGRAM OUTCOMES (POS)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	2	2	1	1	-	2	3	2	2
PEO2	3	2	2	2	2	-	-	2	3	3	3	3
PEO3	3	2	2	2	2	1	1	3	2	3	2	3

Mapping of Programme Specific Outcomes (PSOs) and the Program Outcomes (Pos):

PSOs	PROGRAM OUTCOMES (POS)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO1	3	3	3	2	2	1	1	1	2	3	2	2
PSO2	3	2	3	2	3	-	-	2	3	3	2	2
PSO3	3	2	2	2	-	3	1	3	2	3	2	3

M.E. APPLIED ELECTRONICS
SEMESTER COURSE WISE PO MAPPING

		SUBJECTS	PROGRAMME OUTCOMES											
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I YEAR	SEMESTER I	Applied Mathematics for Electronics Engineers	3	3	2	1				3	2	3		2
		Advanced Digital System Design	3	2	2	2	1			3	2	3		2
		Advanced Digital Signal Processing	3	2	2	2	1			3	2	3		2
		Embedded System Design	3	2	2	2	2			3	2	3		2
		Sensors, Actuators and Interface Electronics	3	2	2	1				3	2	3		2
		Professional Elective I												
		Digital Control Engineering	3	2	2	1				3	2	3		2
		Computer Architecture and Parallel Processing	3	2	2	1				3	2	3		2
		CAD for VLSI	3	2	2	2	1			3	2	3		2
		Electromagnetic Interference and Compatibility	3	2	2	1				3	2	3		2
		Electronic System Design Lab I	3	2	2	2	2			3	3	3		2
	SEMESTER II	Soft Computing and Optimization Techniques	3	2	2	2	1			3	2	3		2
		ASIC and FPGA Design	3	2	2	2				3	2	3		2
		Hardware – Software Co-design	3	2	2	2				3	2	3		2
		Digital Image Processing	3	2	2	2	1			3	2	3		2
		Professional Elective - II												
		VLSI Design Techniques	3	2	2	2	1			3	2	3		2

		Nano Electronics	3	2	1					3	2	3		2
		Wireless Adhoc and Sensor Networks	3	2	1					3	2	3		2
		High Performance Networks	3	2	1					3	2	3		2
		Professional Elective - III												
		DSP Architectures and Programming	3	2	2	2	2			3	2	3		2
		RF System Design	3	2	2	1				3	2	3		2
		Speech and Audio Signal Processing	3	2	2	1	1			3	2	3		2
		Solid State Device Modeling and Simulation	3	2	2	1				3	2	3		2
		Electronic System Design Lab II	3	2	2	2	2			3	3	3		2
		Term Paper Writing and Seminar	3	2	2	1				3	3	3		3
II YEAR	**SEMESTER III**	Advanced Microprocessors and Microcontrollers Architectures	3	2	2	2				3	2	3		2
		Professional Elective –IV												
		Internet of Things	3	2	2	2	1			3	2	3		2
		System on Chip Design	3	2	2	1	1			3	2	3		2
		Robotics	3	2	2	2	1			3	2	3		2
		Physical Design of VLSI Circuits	3	2	2	1				3	2	3		2
		Professional Elective V												
		Signal Integrity for High Speed Design	3	2	1					3	2	3		2
		MEMS and NEMS	3	2	1					3	2	3		2
		Secure Computing Systems	3	2	2	1				3	2	3		2
		Pattern Recognition	3	2	2					3	2	3		2
		Project Work Phase I	3	3	3	3	3	2	2	3	3	3	3	3
	SEM IV	Project Work Phase – II	3	3	3	3	3	2	2	3	3	3	3	3

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SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5152	Applied Mathematics for Electronics Engineers	FC	4	4	0	0	4
2.	AP5151	Advanced Digital System Design	PC	3	3	0	0	3
3.	AP5152	Advanced Digital Signal Processing	PC	5	3	2	0	4
4.	AP5191	Embedded System Design	PC	3	3	0	0	3
5.	AP5101	Sensors, Actuators and Interface Electronics	PC	3	3	0	0	3
6.		Professional Elective I	PC	3	3	0	0	3
PRACTICALS								
7.	AP5111	Electronic System Design Laboratory I	PC	4	0	0	4	2
			TOTAL	**25**	**19**	**2**	**4**	**22**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AP5251	Soft Computing and Optimization Techniques	PC	3	3	0	0	3
2.	AP5252	ASIC and FPGA Design	PC	3	3	0	0	3
3.	AP5291	Hardware – Software Co-design	PC	3	3	0	0	3
4.	AP5292	Digital Image Processing	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7.	AP5211	Electronic System Design Laboratory II	PC	4	0	0	4	2
8.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	AP5301	Advanced Microprocessors and Microcontrollers Architectures	PC	3	3	0	0	3
2.		Professional Elective IV	PE	3	3	0	0	3
3.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	AP5311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	AP5411	Project Work Phase II	EEC	24	0	0	24	12
				TOTAL	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5152	Applied Mathematics for Electronics Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AP5151	Advanced Digital System Design	PC	3	3	0	0	3
2.	AP5152	Advanced Digital Signal Processing	PC	5	3	2	0	4
3.	AP5191	Embedded System Design	PC	3	3	0	0	3
4.	AP5101	Sensors, Actuators and Interface Electronics	PC	3	3	0	0	3
5.	AP5111	Electronic System Design Lab I	PC	4	0	0	4	2
6.	AP5251	Soft Computing and Optimization Techniques	PC	3	3	0	0	3
7.	AP5252	ASIC and FPGA Design	PC	3	3	0	0	3
8.	AP5291	Hardware – Software Co-design	PC	3	3	0	0	3
9.	AP5292	Digital Image Processing	PC	3	3	0	0	3
10.	AP5211	Electronic System Design Lab II	PC	4	0	0	4	2
11.	AP5301	Advanced Microprocessor and Microcontroller Architecture	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
2.	AP5311	Project Work Phase – I	EEC	12	0	0	12	6
3.	AP5411	Project Work Phase – II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*
SEMESTER I
ELECTIVE I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AP5091	Digital Control Engineering	PE	3	3	0	0	3
2.	AP5001	Computer Architecture and Parallel Processing	PE	3	3	0	0	3
3.	AP5002	CAD for VLSI Circuits	PE	3	3	0	0	3
4.	CU5292	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3

SEMESTER II
ELECTIVE II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AP5003	VLSI Design Techniques	PE	3	3	0	0	3
2.	AP5071	Nano Electronics	PE	3	3	0	0	3
3.	CU5097	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
4.	AP5004	High Performance Networks	PE	3	3	0	0	3

SEMESTER II
ELECTIVE III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	DS5191	DSP Processor Architecture and Programming	PE	3	3	0	0	3
2.	AP5073	RF System Design	PE	3	3	0	0	3
3.	AP5074	Speech and Audio Signal Processing	PE	3	3	0	0	3
4.	AP5092	Solid State Device Modeling and Simulation	PE	3	3	0	0	3

SEMESTER III
ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5292	Internet of Things	PE	3	3	0	0	3
2.	AP5005	System on Chip Design	PE	3	3	0	0	3
3.	AP5093	Robotics	PE	3	3	0	0	3
4.	AP5006	Physical Design of VLSI Circuits	PE	3	3	0	0	3

SEMESTER III
ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AP5094	Signal Integrity for High Speed Design	PE	3	3	0	0	3
2.	VL5091	MEMS and NEMS	PE	3	3	0	0	3
3.	AP5007	Secure Computing Systems	PE	3	3	0	0	3
4.	AP5008	Pattern Recognition	PE	3	3	0	0	3

MA5152 APPLIED MATHEMATICS FOR ELECTRONICS ENGINEERS L T P C
4 0 0 4

OBJECTIVES:

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

UNIT I FUZZY LOGIC 12

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

UNIT II MATRIX THEORY 12

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT III PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random variable.

UNIT IV DYNAMIC PROGRAMMING 12

Dynamic programming – Principle of optimality – Forward and backward recursion – Applications of dynamic programming – Problem of dimensionality.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and multi server models – Little's formula - Machine interference model – Steady state analysis – Self service queue.

TOTAL: 60 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

- Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and applications of fuzzy logic.
- Apply various methods in matrix theory to solve system of linear equations.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
- Using discrete time Markov chains to model computer systems.

REFERENCES:

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw Hill, 2011.
2. George, J. Klir. and Yuan, B., "Fuzzy sets and Fuzzy logic, Theory and Applications", Prentice Hall of India Pvt. Ltd., 1997.
3. Gross, D., Shortle J. F., Thompson, J.M., and Harris, C. M., "Fundamentals of Queueing Theory", 4th Edition, John Wiley, 2014.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5. Taha, H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education, Asia, New Delhi, 2016.

AP5151 ADVANCED DIGITAL SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To introduce methods to analyze and design synchronous and asynchronous sequential circuits.
- To introduce the architectures of programmable devices.
- To introduce design and implementation of digital circuits using programming tools.

UNIT I SEQUENTIAL CIRCUIT DESIGN 9

Analysis of clocked synchronous sequential circuits and modeling- State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuits design of iterative circuits-ASM chart and realization using ASM

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN 9

Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller

UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS 9

Fault table method-path sensitization method – Boolean difference method-D algorithm - Tolerance techniques – The compact algorithm – Fault in PLA – Test generation-DFT schemes – Built in self test

UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES 9

Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000

UNIT V SYSTEM DESIGN USING VERILOG 9

Hardware Modelling with Verilog HDL – Logic System, Data Types and Operators For Modelling in Verilog HDL - Behavioural Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines– structural modeling – compilation and simulation of Verilog code –Test bench - Realization of combinational and sequential circuits using Verilog – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Analyze and design sequential digital circuits
- Identify the requirements and specifications of the system required for a given application
- Design and use programming tools for implementing digital circuits of industry standards

REFERENCES:

1. Charles H.Roth Jr “Fundamentals of Logic Design” Thomson Learning 2004
2. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999.
3. M.G.Arnold, Verilog Digital – Computer Design, Prentice Hall (PTR), 1999.
4. Nripendra N Biswas “Logic Design Theory” Prentice Hall of India,2001
5. Parag K.Lala “Digital system Design using PLD” B S Publications,2003
6. Parag K.Lala “Fault Tolerant and Fault Testable Hardware Design” B S Publications,2002
7. S. Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson , 2003.

AP5152	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	2	0	4

OBJECTIVES:

- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and random signal processing algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction, filtering, multirate concepts and techniques.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9+6

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices-Properties – White noise process – Weiner Khitchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II SPECTRUM ESTIMATION 9+6

Bias and Consistency of estimators - Non-Parametric methods – Periodogram – Modified Periodogram – Barlett's method – Welch's mehod – Blackman-Tukey method – Parametric methods – AR, MA and ARMA spectrum estimation - Performance analysis of estimators.

UNIT III SIGNAL MODELING AND OPTIMUM FILTERS 9+6

Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Weiner Filter -– Mean square error – Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9+6

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications – Noise cancellation - channel equalization – echo canceller – Adaptive Recursive Filters - RLS adaptive algorithm – Exponentially weighted RLS-sliding window RLS.

UNIT V MULTIRATE SIGNAL PROCESSING 9+6

Decimation - Interpolation – Sampling Rate conversion by a rational factor I/D – Multistage implementation of sampling rate conversion – Polyphase filter structures – Applications of multirate signal processing.

TOTAL45+30: 75 PERIODS

OUTCOMES:

- Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
- State W-K theorem, spectral factorization theorem, spectrum estimation, bias and consistency of estimators.
- Wiener filtering, LMS algorithms, Levinson recursion algorithm, applications of adaptive filters
- Decimation, interpolation, Sampling rate conversion, Applications of multirate signal processing

REFERENCES:

1. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing”, Prentice Hall of India, New Delhi, 2005.
2. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley and Sons Inc., New York, 2006.
3. P. P. Vaidyanathan, “Multirate Systems and Filter Banks”, Prentice Hall, 1992.
4. S. Kay,” Modern spectrum Estimation theory and application”, Prentice Hall, Englehood Cliffs, NJ1988.
5. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ1986.
6. Sophoncles J. Orfanidis, “Optimum Signal Processing “, McGraw-Hill, 2000.

AP5191 EMBEDDED SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn design challenges and design methodologies
- Study general and single purpose processor
- Understand bus structures

UNIT I EMBEDDED SYSTEM OVERVIEW 9

Embedded System Overview, Design Challenges – Optimizing Design Metrics, Design Methodology, RT-Level Combinational and Sequential Components, Optimizing Custom Single-Purpose Processors.

UNIT II GENERAL AND SINGLE PURPOSE PROCESSOR 9

Basic Architecture, Pipelining, Superscalar and VLIW architectures, Programmer’s view, Development Environment, Application-Specific Instruction-Set Processors (ASIPs) Microcontrollers, Timers, Counters and watchdog Timer, UART, LCD Controllers and Analog-to-Digital Converters, Memory Concepts.

UNIT III BUS STRUCTURES 9

Basic Protocol Concepts, Microprocessor Interfacing – I/O Addressing, Port and Bus-Based I/O, Arbitration, Serial Protocols, I^2C, CAN and USB, Parallel Protocols – PCI and ARM Bus, Wireless Protocols – IrDA, Bluetooth, IEEE 802.11**.**

UNIT IV STATE MACHINE AND CONCURRENT PROCESS MODELS 9

Basic State Machine Model, Finite-State Machine with Datapath Model, Capturing State Machine in Sequential Programming Language, Program-State Machine Model, Concurrent Process Model, Communication among Processes, Synchronization among processes, Dataflow Model, Real-time Systems, Automation: Synthesis, Verification : Hardware/Software Co-Simulation, Reuse: Intellectual Property Cores, Design Process Models.

UNIT V EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND RTOS 9

Compilation Process – Libraries – Porting kernels – C extensions for embedded systems – emulation and debugging techniques – RTOS – System design using RTOS.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain different protocols
- Discuss state machine and design process models
- Outline embedded software development tools and RTOS

REFERENCES:

1. Bruce Powel Douglas, "Real time UML, second edition: Developing efficient objects for embedded systems", 3rd Edition 1999, Pearson Education.
2. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.
3. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
4. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.

AP5101 SENSORS, ACTUATORS AND INTERFACE ELECTRONICS L T P C
3 0 0 3

OBJECTIVES:

- Understand static and dynamic characteristics of measurement systems.
- Study various types of sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and semiconductor sensors.

UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static characteristics of measurement systems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors, random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response.

UNIT II RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.

UNIT III SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

UNIT IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Relays, Solenoid drive, Stepper Motors, Voice-Coil actuators, Servo Motors, DC motors and motor control, 4-to-20 mA Drive, Hydraulic actuators, variable transformers: synchros, resolvers, Inductosyn, resolver-to-digital and digital-to-resolver converters.

UNIT V DIGITAL SENSORS AND SEMICONDUCTOR DEVICE SENSORS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters, Sensors based on semiconductor junctions: thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, CCD imaging sensors , ultrasonic sensors, fiber-optic sensors.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course the student will be able to

- Compare Actuators
- Evaluate digital sensors and semiconductor device sensors
- Discuss Self-generating sensors

REFERENCES:

1. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
2. D. Johnson, “Process Control Instrumentation Technology”, John Wiley and Sons.
3. D.Patranabis, “Sensors and Transducers”, TMH 2003.
4. E.O. Doeblin, “Measurement System : Applications and Design”, McGraw Hill publications
5. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
6. Herman K.P. Neubrat, “Instrument Transducers – An Introduction to Their Performance and Design”, Oxford University Press. 22.
7. Ian Sinclair, Sensors and Transducers, Elsevier, 3rd Edition, 2011.
8. Jon Wilson , “Sensor Technology Handbook”, Newne 2004.
9. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.
10. Ramon PallásAreny, John G. Webster, “Sensors and Signal Conditioning”, 2nd edition, John Wiley and Sons, 2000.
11. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press , 2007.

AP5111 ELECTRONICS SYSTEM DESIGN LABORATORY I L T P C
0 0 4 2

OBJECTIVES:

- To study of different interfaces
- To learn asynchronous and clocked synchronous sequential circuits
- To understand the concept of built in self test and fault diagnosis

1. System design using PIC, MSP430, ‘51 Microcontroller and 16- bit Microprocessor - 8086.
2. Study of different interfaces (using embedded microcontroller)
3. Implementation of Adaptive Filters and multistage multirate system in DSP Processor
4. Simulation of QMF using Simulation Packages
5. Analysis of Asynchronous and clocked synchronous sequential circuits

6. Built in self test and fault diagnosis
7. Sensor design using simulation tools
8. Design and analysis of real time signal processing system – Data acquisition and signal processing

TOTAL: 60 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to:

- Apply PIC, MSP430, '51 Microcontroller and 8086 for system design
- Simulate QMF
- Design sensor using simulation tools
- Design and analyze of real time signal processing system

AP5251 SOFT COMPUTING AND OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn various Soft computing frameworks.
- To familiarizes with the design of various neural networks.
- To understand the concept of fuzzy logic.
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in conventional optimization techniques.
- To understand the various evolutionary optimization techniques.

UNIT I NEURAL NETWORKS 9
Machine Learning using Neural Network, Learning algorithms, Supervised Learning Neural Networks – Feed Forward Networks, Radial Basis Function, Unsupervised Learning Neural Networks – Self Organizing map , Adaptive Resonance Architectures, Hopfield network

UNIT II FUZZY LOGIC 9
Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making

UNIT III NEURO-FUZZY MODELING 9
Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

UNIT IV CONVENTIONAL OPTIMIZATION TECHNIQUES 9
Introduction to optimization techniques, Statement of an optimization problem, classification, Unconstrained optimization-gradient search method-Gradient of a function, steepest gradient-conjugate gradient, Newton's Method, Marquardt Method, Constrained optimization –sequential linear programming, Interior penalty function method, external penalty function method.

UNIT V EVOLUTIONARY OPTIMIZATION TECHNIQUES 9
Genetic algorithm - working principle, Basic operators and Terminologies, Building block hypothesis, Travelling Salesman Problem, Particle swam optimization, Ant colony optimization.

TOTAL :45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Able to use the optimization techniques to solve the real world problems

REFERENCES :

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications,Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
6. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.
7. Singiresu S. Rao, Engineering optimization Theory and practice, John Wiley & sons, inc,Fourth Edition, 2009
8. Timothy J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
9. Venkata Rao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, springer 2012

AP5252	**ASIC AND FPGA DESIGN**	**L T P C**
		3 0 0 3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I OVERVIEW OF ASIC AND PLD 9

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

UNIT II ASIC PHYSICAL DESIGN 9

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

UNIT IV FIELD PROGRAMMABLE GATE ARRAYS 9

FPGA Design : FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization.

UNIT V SOC DESIGN 9

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies: Canonical Signed Digit Arithmetic, Knowledge Crunching Machine, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

TOTAL: 45 PERIODS

OUTCOMES:

- To analyze the synthesis, Simulation and testing of systems.
- To apply different high performance algorithms in ASICs.
- To discuss the design issues of SOC.

REFERENCES:

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan. M. Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, Newyork.
6. P.K.Chan& S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall.
7. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
8. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Pub.
9. S.Brown,R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray, Kluwer Pub. 5. Richard FJinder , “Engineering Digital Design,”Academic press

AP5291 HARDWARE - SOFTWARE CO-DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To acquire the knowledge about system specification and modelling.
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation.

UNIT I SYSTEM SPECIFICATION AND MODELLING 9

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Single-Processor Architectures with one ASIC and many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II HARDWARE / SOFTWARE PARTITIONING 9

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization , HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms .

UNIT III HARDWARE / SOFTWARE CO-SYNTHESIS 9

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co-Synthesis Algorithm for Distributed System- Case Studies with any one application.

UNIT IV PROTOTYPING AND EMULATION 9

Introduction, Prototyping and Emulation Techniques , Prototyping and Emulation Environments, Future Developments in Emulation and Prototyping ,Target Architecture- ArchitectureSpecialization Techniques ,System Communication Infrastructure, Target Architectures and Application System Classes, Architectures for Control-Dominated Systems, Architectures for Data-Dominated Systems ,Mixed Systems and Less Specialized Systems

UNIT V DESIGN SPECIFICATION AND VERIFICATION 9

Concurrency, Coordinating Concurrent Computations, Interfacing Components, Verification ,Languages for System-Level Specification and Design System-Level Specification ,Design Representation for System Level Synthesis, System Level Specification Languages, Heterogeneous Specification and Multi-Language Co- simulation.

TOTAL:45 PERIODS

OUTCOMES:

- To assess prototyping and emulation techniques
- To compare hardware / software co-synthesis.
- To formulate the design specification and validate its functionality by simulation

REFERENCES:

1. Giovanni De Micheli , Rolf Ernst Morgon," Reading in Hardware/Software Co-Design "Kaufmann Publishers,2001.
2. Jorgen Staunstrup, Wayne Wolf ,"Hardware/Software Co-Design: Principles and Practice" , Kluwer Academic Pub,1997.
3. Ralf Niemann , "Hardware/Software Co-Design for Data Flow Dominated Embedded Systems", Kluwer Academic Pub, 1998.

AP5292 DIGITAL IMAGE PROCESSING L T P C

3 0 0 3

OBJECTIVES:

The students should be made to:

- Understand fundamentals of digital images
- Learn different image transforms
- Study concept of segmentation

UNITI DIGITAL IMAGE FUNDAMENTALS 9

A simple image model, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images. Basic concepts of digital distances, distance transform, medial axis transform, component labeling, thinning, morphological processing, extension to gray scale morphology.

UNIT II IMAGE TRANSFORMS 9

1D DFT, 2D transforms - DFT, DCT, Discrete Sine, Walsh, Hadamard, Slant, Haar, KLT, SVD, Wavelet transform.

UNIT III SEGMENTATION OF GRAY LEVEL IMAGES 9

Histogram of gray level images, multilevel thresholding, Optimal thresholding using Bayesian classification, Watershed and Dam Construction algorithms for segmenting gray level image. Detection of edges and lines: First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

UNIT IV IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING 9

Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration. Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing.

UNIT V IMAGE COMPRESSION 9

Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Discuss image enhancement techniques
- Explain color image processing
- Compare image compression schemes

REFERENCES:

1. A.K. Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, Addison-Wesley, 1989.
2. B. Jähne, “Practical Handbook on Image Processing for Scientific Applications“, CRC Press,1997.
3. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.
4. Bovik (ed.), “Handbook of Image and Video Processing”, Academic Press, 2000.
5. Gonzalez and Woods, Digital Image Processing, Prentice-Hall.
6. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002.
7. J. S. Lim, “Two-dimensional Signal and Image Processing” Prentice-Hall, 1990.
8. M. Petrou, P. Bosdogianni, “Image Processing, The Fundamentals“, Wiley, 1999.
9. Rudra Pratap, Getting Started With MATLAB 7. Oxford University Press, 2006
10. Stephane Marchand-Maillet, Yazid M. Sharaiha, Binary Digital Image Processing, A Discrete Approach, Academic Press, 2000.
11. W. K. Pratt. Digital image processing, PIKS Inside. Wiley, New York, 3rd, edn., 2001.

AP5211 ELECTRONICS SYSTEM DESIGN LABORATORY II

L	T	P	C
0	0	4	2

OBJECTIVES:

- To study of 32 bit ARM7 microcontroller RTOS and its application
- To understand testing RTOS environment and system programming
- To learn wireless network design using embedded systems
- To learn System design using ASIC
- To know use of Verilog and VHDL in sequential digital system modeling

1. Study of 32 bit ARM7 microcontroller RTOS and its application
2. Testing RTOS environment and system programming
3. Designing of wireless network using embedded systems
4. Implementation of ARM with FPGA
5. Design and Implementation of ALU in FPGA using VHDL and Verilog
6. Modeling of Sequential Digital system using Verilog and VHDL
7. Flash controller programming - data flash with erase, verify and fusing
8. System design using ASIC
9. Design, simulation and analysis of signal integrity

TOTAL: 60 PERIODS

OUTCOMES:
At the end of this course, the students should be able to:
- Utilize ARM with FPGA
- Demonstrate design of ALU in FPGA using VHDL and Verilog
- Assess flash controller programming - data flash with erase, verify and fusing
- Explain design, simulation and analysis of signal integrity

CP5281 TERM PAPER WRITING AND SEMINAR L T P C
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried Out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2^{nd} week	**3 %** Based on clarity of thought, current relevance and clarity in writing

Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered.	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%**(this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL : 30 PERIODS

AP5301 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS ARCHITECTURES

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To familiarize about the features, specification and features of modern microprocessors.
- To gain knowledge about the architecture of Intel 32 and 64 bit microprocessors and salient features associated with them.
- To familiarize about the features, specification and features of modern microcontrollers.
- To gain knowledge about the 32 bit microcontrollers based on ARM and PIC32 architectures

UNIT I FEATURES OF MODERN MICROPROCESSORS 9

Evolution of microprocessors - Data and Address buses – clock speed – memory interface - multi-core architectures – cache memory hierarchy – operating modes – super scaler execution – dynamic execution – over clocking – integrated graphics processing - performance benchmarks.

UNIT I HIGH PERFORMANCE CISC ARCHITECTURES 9

Introduction to IA 32 bit architecture – Intel Pentium Processors family tree – Memory Management – Branch prediction logic - Superscalar architecture – Hyper threading technology – 64 bit extension technology – Intel 64 bit architecture - Intel Core processor family tree – Turbo boost technology – Smart cache - features of Nehalem microarchitecture

UNIT II HIGH PERFORMANCE RISC ARCHITECTURE - ARM 9

RISC architecture merits and demerits – The programmer's model of ARM Architecture – 3-stage pipeline ARM organization - 3-stage pipeline ARM organization – ARM instruction execution – Salient features of ARM instruction set - ARM architecture profiles (A, R and M profiles)

UNIT III FEATURES OF MODERN MICROPROCESSORS 9

Introduction to microcontrollers – microcontroller vs microprocessors – microcontroller architecture - Processor Core – Memory interfaces– Communication interfaces (SPI,I^2C, USB and CAN) – ADC - PWM – Watchdog timers – Interrupts – Debugging interfaces

UNIT IV HIGH PERFORMANCE MICROCONTROLLER ARCHITECTURES 9

Introduction to the Cortex-M Processor Family - ARM 'Cortex-M3' architecture for microcontrollers – Thumb 2 instruction technology – Internal Registers - Nested Vectored Interrupt controller - Memory map - Interrupts and exception handling – Applications of Cotex-M3 architecture

TOTAL : 45 PERIODS

OUTCOMES:

After completion of the course, the students should be able

- To explain the features and important specifications of modern microprocessors
- To explain the salient features CISC microprocessors based on IA-32 bit and IA-64 bit architectures
- To explain the salient features RISC processors based on ARM architecture and different application profiles of ARM core
- To explain the features and important specifications of modern microcontrollers
- To explain about ARM – M3 architecture and its salient features

REFERENCES:
1. Barry. B. Breg," The Intel Microprocessors" , PHI,2008.
2. Gene .H.Miller ." Micro Computer Engineering ," Pearson Education , 2003.
3. Intel Inc, "Intel 64 and IA-32 Architectures Developer's Manual", Volume-I, 2016
4. Joseph Yiu, "The Definitive Guide to the ARM ® Cortex-M3", Newnes, 2010.
5. Scott Mueller, "Upgrading and Repairing PCs", 20th edition, Que.
6. Steve Furber, '' ARM System –On –Chip architecture "Addision Wesley , 2000.
7. Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family", Newnes, 2013.

AP5091 DIGITAL CONTROL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- The student learns the principles of PI,PD,PID controllers.
- The student analyses time and frequency response discrete time control system.
- The student is familiar with digital control algorithms.
- The student has the knowledge to implement PID control algorithms.

UNIT I CONTROLLERS IN FEEDBACK SYSTEMS 9
Review of frequency and time response analysis and specifications of first order and second order feedback control systems, need for controllers, continuous time compensations, continuous time PI, PD, PID controllers, digital PID controllers.

UNIT II BASIC DIGITAL SIGNAL PROCESSING IN CONTROL SYSTEMS 9
Sampling theorem, quantization, aliasing and quantization error, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

UNIT III MODELING OF SAMPLED DATA CONTROL SYSTEM 9
Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state space description, first companion, second companion, Jordan canonical models, discrete state variable models (elementary principles only).

UNIT IV DESIGN OF DIGITAL CONTROL ALGORITHMS 9
Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.

UNIT V PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS 9
Algorithm development of PID control algorithms, standard programmes for microcontroller implementation, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems, DSP implementation of motor control system.

TOTAL: 45 PERIODS

OUTCOMES:

- Describe continuous time and discrete time controllers analytically.
- Define and state basic analog to digital and digital to analog conversion principles.
- Analyze sampled data control system in time and frequency domains.
- Design simple PI, PD, PID continuous and digital controllers.
- Develop schemes for practical implementation of temperature and motor control systems.

REFERENCES:

1. John J. D'Azzo, "Constantive Houpios, Linear Control System Analysis and Design", Mc Graw Hill,1995.
2. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.
3. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.

AP5001 COMPUTER ARCHITECTURE AND PARALLEL PROCESSING **L T P C**
3 0 0 3

OBJECTIVES:

- Understand the difference between pipeline and parallel processing concepts
- Study various types of processor architectures and the importance of scalable architectures
- Study Memory Architectures, Memory Technology and Optimization.

UNIT I COMPUTER DESIGN AND PERFORMANCE MEASURES 9

Fundamentals of Computer Design – Parallel and Scalable Architectures – Multiprocessors –Multi-vector and SIMD architectures – Multithreaded architectures – Stanford Dash multiprocessor – KSR1 - Data-flow architectures - Performance Measures

UNIT II PARALLEL PROCESSING, PIPELINING AND ILP 9

Instruction Level Parallelism and Its Exploitation - Concepts and Challenges - Pipelining processors - Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction - Speculation - Multiple Issue Processors - Performance and Efficiency in Advanced Multiple Issue Processors

UNIT III MEMORY HIERARCHY DESIGN 9

Memory Hierarchy - Memory Technology and Optimizations – Cache memory – Optimizations of Cache Performance – Memory Protection and Virtual Memory - Design of Memory Hierarchies.

UNIT IV MULTIPROCESSORS 9

Symmetric and distributed shared memory architectures – Cache coherence issues – Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.

UNIT V MULTI-CORE ARCHITECTURES 9

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case-studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture – hp architecture.

TOTAL : 45 PERIODS

OUTCOMES:

- Explain design of memory hierarchies
- Assess Performance Issues and Synchronization issues
- Compare multicore architectures

REFERENCES:

1. David E. Culler, Jaswinder Pal Singh, “Parallel Computing Architecture: A hardware/ software approach”, Morgan Kaufmann / Elsevier, 1997
2. Dimitrios Soudris, Axel Jantsch, "Scalable Multi-core Architectures: Design Methodologies and Tools", Springer, 2012
3. Hwang Briggs, “Computer Architecture and parallel processing”, McGraw Hill, 1984.
4. John L. Hennessey and David A. Patterson, “Computer Architecture – A quantitative approach”, Morgan Kaufmann / Elsevier, 4th. edition, 2007
5. John P. Hayes, “Computer Architecture and Organization”, McGraw Hill
6. John P. Shen, “Modern processor design. Fundamentals of super scalar processors”, Tata McGraw Hill 2003
7. Kai Hwang, "Advanced Computer Architecture", McGraw Hill International, 2001
8. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Pearson Education, Seventh Edition, 2006

AP5002 CAD FOR VLSI CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

- To study various physical design methods in VLSI.
- To understand the concepts behind the VLSI design rules and routing techniques.
- To understand the concepts of various algorithms used for floor planning and routing techniques.

UNIT I INTRODUCTION TO VLSI DESIGN FLOW 9

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

UNIT II LAYOUT, PLACEMENT AND PARTITIONING 9

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

UNIT III FLOOR PLANNING AND ROUTING 9

Floor planning concepts, Shape functions and floorplan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

UNIT IV SIMULATION AND LOGIC SYNTHESIS 9

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT V HIGH LEVEL SYNTHESIS 9

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

TOTAL: 45 PERIODS

OUTCOMES:

- To use the simulation techniques at various levels in VLSI design flow
- Discuss the concepts of floor planning and routing
- Outline high level synthesis

REFERENCES:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
3. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World scientific 1999.
4. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.

CU5292 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY **L T P C**
3 0 0 3

OBJECTIVES:
The students should be made to be familiar with:

- The basics of EMI
- EMI sources.
- EMI problems.
- Solution methods in PCB.
- Measurements techniques for emission.
- Measurement techniques for immunity.

UNIT I BASIC THEORY 9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

UNIT II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III EMI MITIGATION TECHNIQUES 9

Working principle of Shielding and Murphy‟s Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

UNIT IV STANDARD AND REGULATION 9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V EMI TEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the student should be able to:

- Identify Standards
- Compare EMI test methods
- Discuss EMI mitigation techniques

REFERENCES:

1. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
2. Clayton Paul, “Introduction to Electromagnetic Compatibility”, Wiley Interscience, 2006.
3. Daryl Gerke and William Kimmel, “EDN‟s Designer‟s Guide to Electromagnetic Compatibility”, Elsevier Science & Technology Books, 2002
4. Dr Kenneth L Kaiser, “The Electromagnetic Compatibility Handbook”, CRC Press 2005.
5. Electromagnetic Compatibility by Norman Violette ,Published by Springer, 2013
6. Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications Volume 1 of A Handbook Series on Electromagnetic Interference and Compatibility, Donald R. J. White Publisher-Don white consultants Original from the University of Michigan Digitized 6 Dec 2007
7. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009
8. V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.
9. W Scott Bennett, “Control and Measurement of Unintentional Electromagnetic Radiation”, John Wiley & Sons Inc., (Wiley Interscience Series) 1997.

AP5003 VLSI DESIGN TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

- This course deals comprehensively with all aspects of transistor level design of all the digital building blocks common to all CMOS microprocessors, DPSs, network processors, digital backend of all wireless systems etc.
- The focus will be on the transistor level design and will address all important issues related to size, speed and power consumption. The units are classified according to the important building and will introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures.

UNIT I MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER 12

MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, Process Variations, Technology Scaling, Internet Parameter and electrical wise models CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static Latches and Registers, Dynamic Latches and Registers, Timing Issues, Pipelines, Pulse and sense amplifier based Registers, Nonbistable Sequential Circuits.

UNIT IV ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES 9

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Speed and Area Tradeoffs, Memory Architectures, and Memory control circuits.

UNIT V INTERCONNECT AND CLOCKING STRATEGIES 6

Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Carry out transistor level design of the most important building blocks used in digital CMOS VLSI circuits.
- Discuss design methodology of arithmetic building block
- Analyze tradeoffs of the various circuit choices for each of the building block.

REFERENCES:

1. Jacob Baker "CMOS: Circuit Design, Layout, and Simulation, Third Edition", Wiley IEEE Press 2010.
2. Jan Rabaey, Anantha Chandrakasan, B Nikolic, "Digital Integrated Circuits: A Design Perspective". Prentice Hall of India 2nd Edition, Feb 2003,
3. M J Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
4. N.Weste, K. Eshraghian, "Principles of CMOS VLSI Design". Addision Wesley, 2nd Edition, 1993

AP5071 NANOELECTRONICS L T P C
3 0 0 3

OBJECTIVES

- To understand how transistor as Nano device
- To understand various forms of Nano Devices
- To understand the Nano Sensors

UNIT I SEMICONDUCTOR NANO DEVICES 9

Single-Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor - Single-Electron Transistors; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers: Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA-Based Nanodevices; Gas-Based Nanodevices.

UNIT II ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS 9

Preparation – Electroluminescent Organic materials - Laser Diodes - Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers - Quantum wire lasers:- White LEDs - LEDs based on nanowires - LEDs based on nanotubes - LEDs based on nanorods - High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

UNIT III THERMAL SENSORS 9

Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

UNIT IV GAS SENSOR MATERIALS 9

Criteria for the choice of materials - Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity; Discussion of sensors for various gases, Gas sensors based on semiconductor devices.

UNIT V BIOSENSORS 9

Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications - fabrication of biosensors - future potential.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to simulate and design the nano device
- To be able to simulate and design the nano sensors

REFERENCES:

1. K.E. Drexler, “Nano systems”, Wiley,1992.
2. M.C. Petty, “Introduction to Molecular Electronics”, 1995.
3. W. Ranier, “Nano Electronics and Information Technology”, Wiley, 2003.

CU5097	WIRELESS ADHOC AND SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

UNIT I MAC & TCP IN AD HOC NETWORKS 9

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

UNIT II ROUTING IN AD HOC NETWORKS 9

Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.

UNIT III MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS 9

Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer support.

UNIT IV SENSOR MANAGEMENT 9

Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to

- Identify different issues in wireless ad hoc and sensor networks.
- To analyze protocols developed for ad hoc and sensor networks.
- To identify and address the security threats in ad hoc and sensor networks.
- Establish a Sensor network environment for different type of applications.

REFERENCES:

1. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011
3. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004.
4. C.K.Toh, “Ad Hoc Mobile Wireless Networks”, Pearson Education, 2002.
5. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
6. Holger Karl, Andreas willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.
7. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
8. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.

AP5004 HIGH PERFORMANCE NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To develop a comprehensive understanding of multimedia networking.
- To study the types of VPN and tunneling protocols for security.
- To learn about network security in many layers and network management.

UNIT I INTRODUCTION 9

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN,ATM.

UNIT II MULTIMEDIA NETWORKING APPLICATIONS 9

Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.

UNIT III ADVANCED NETWORKS CONCEPTS 9

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS- operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

UNIT IV TRAFFIC MODELLING 9

Little's theorem, Need for modeling, Poisson modeling and its failure, Non- poisson models, Network performance evaluation.

UNIT V NETWORK SECURITY AND MANAGEMENT 9

Principles of cryptography – Authentication – integrity – key distribution and certification – Access control and: fire walls – attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1

TOTAL: 45PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Discuss advanced networks concepts
- Outline traffic modeling
- Evaluate network security

REFERENCES:

1. Aunurag Kumar, D. M Anjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 1st edition 2004.
2. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", fifth edition, Pearson education 2006
3. Hersent Gurle & Petit, "IP Telephony, packet Pored Multimedia communication Systems", Pearson education 2003
4. J.F. Kurose & K.W. Ross,"Computer Networking- A top down approach featuring the internet", Pearson, 2nd edition, 2003
5. Larry I.Peterson & Bruce S.David, "Computer Networks: A System Approach"- 1996
6. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint 2002.
7. Nader F.Mir ,Computer and Communication Networks, first edition 2010
8. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000

DS5191 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV ADSP PROCESSORS 9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT V ADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL : 45 PERIODS

OUTCOMES:

Students should be able to:

- Become Digital Signal Processor specialized engineer
- DSP based System Developer

REFERENCES:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012
2. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications” – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
3. RulphChassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005
4. User guides Texas Instrumentation, Analog Devices, Motorola.

AP5073 **RF SYSTEM DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- The CMOS RF Front End (RFE) is a very crucial building block and in all of wireless and many high frequency wire-line systems. The RFE has few important building blocks within ii including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, Power Amplifiers, and impedance matching circuits.
- The present course will introduce the principles of operation and design principles associated with these important blocks.
- The course will also provide and highlight the appropriate digital communication related design objectives and constraints associated with the RFEs

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct upconversion Transmitter, Two step upconversion Transmitter.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

UNIT IV MIXERS AND OSCILLATORS 9

Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, subsampling mixers, Oscillators describing Functions, Colpitts oscillators Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

TOTAL : 45 PERIODS

OUTCOMES:

- The student after completing this course must be able to translate the top level wireless communications system specifications into block level specifications of the RFE.
- The student should be also able to carry out transistor level design of the entire RFE.

REFERENCES:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.
3. Jan Crols, Michiel Steyaert, “CMOS Wireless Transceiver Design”, Kluwer Academic Publishers, 1997.
4. Recorded lectures and notes available at . http://www.ee.iitm.ac.in/~ani/ee6240/
5. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, 2004.

AP5074 **SPEECH AND AUDIO SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To study basic concepts of processing speech and audio signals
- To study and analyse various M-band filter-banks for audio coding
- To understand audio coding based on transform coders.
- To study time and frequency domain speech processing methods

UNIT I MECHANICS OF SPEECH AND AUDIO 9

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non-simultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS 9

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine
Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies

UNIT III AUDIO CODING AND TRANSFORM CODERS 9

Lossless Audio Coding – Lossy Audio Coding - ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder –Brandenburg - Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding –Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization

UNIT IV TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING 9

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders

UNIT V PREDICTIVE ANALYSIS OF SPEECH 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Evaluate audio coding and transform coders
- Discuss time and frequency domain methods for speech processing
- Explain predictive analysis of speech

REFERENCES:

1. B.Gold and N.Morgan, “Speech and Audio Signal Processing”, Wiley and Sons, 2000.
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech Signals", Prentice Hall, 1978.
3. Mark Kahrs, Karlheinz Brandenburg, Kluwer Applications of Digital Signal Processing to Audio And Acoustics, Academic Publishers,
4. Udo Zölzer, "Digital Audio Signal Processing", Second Edition A John Wiley& sons Ltd

AP5092 SOLID STATE DEVICE MODELLING AND SIMULATION L T P C
3 0 0 3

OBJECTIVES:

- To understand the concept of device modeling
- To learn multistep method
- To study device simulations

UNIT I MOSFET DEVICE PHYSICS MOSFET 9

capacitor, Basic operation, Basic modeling, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling, model parameter extraction, modeling parasitic BJT, Resistors, Capacitors, Inductors.

UNIT II DEVICE MODELLING 9

Prime importance of circuit and device simulations in VLSI; Nodal, mesh, modified nodal and hybrid analysis equations. Solution of network equations: Sparse matrix techniques, solution of nonlinear networks through Newton-Raphson technique, convergence and stability.

UNIT III MULTISTEP METHODS 9

Solution of stiff systems of equations, adaptation of multistep methods to the solution of electrical networks, general purpose circuit simulators.

UNIT IV MATHEMATICAL TECHNIQUES DEVICE SIMULATIONS 9

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

UNIT V SIMULATION OF DEVICES 9

Computation of characteristics of simple devices like p-n junction, MOS capacitor and MOSFET; Small-signal analysis.

TOTAL :45PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Explain the importance of MOS Capacitor and Small signal modeling
- Apply and determine the drift diffusion equation and stiff system equation.
- Analyze circuits using parasitic BJT parameters and newton Raphson method.
- Model the MOS transistor using schrodinger equation and Multistep methods.

REFERENCES:
1. Arora, N., “MOSFET Modeling for VLSI Simulation”, Cadence Design Systems, 2007
2. Chua, L.O. and Lin, P.M., “Computer-Aided Analysis of Electronic Circuits: Algorithms and Computational Techniques”, Prentice-Hall., 1975
3. Fjeldly, T., Yetterdal, T. and Shur, M., “Introduction to Device Modeling and Circuit Simulation”, Wiley-Interscience., 1997
4. Grasser, T., “Advanced Device Modeling and Simulation”, World Scientific Publishing Company., 2003
5. Selberherr, S., “Analysis and Simulation of Semiconductor Devices”, Springer- Verlag.,1984
6. Trond Ytterdal, Yuhua Cheng and Tor A. FjeldlyWayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, John Wiley & Sons Ltd.

CP5292	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario

UNIT I INTRODUCTION TO IoT 9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL :45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012

AP5005	SYSTEM ON CHIP DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- understanding of the concepts, issues, and process of designing highly integrated SoCs following systematic hardware/software co-design & co-verification principles

UNIT I INTRODUCTION 9

Introduction to SoC Design, system level design, methodologies and tools, system hardware: IO, communication, processing units, memories; operating systems: prediction of execution, real time scheduling, embedded OS, middle ware; Platform based SoC design, multiprocessor SoC and Network on Chip, Low power SoC Design

UNIT II SYSTEM LEVEL MODELLING 9

SystemC: overview, Data types, modules, notion of time, dynamic process, basic channels, structure communication, ports and interfaces, Design with examples

UNIT III HARDWARE SOFTWARE CO-DESIGN 9

Analysis, partitioning, high level optimisations, real-time scheduling, hardware acceleration, voltage scaling and power management; Virtual platform models, co-simulation and FPGAs for prototyping of HW/SW systems.

UNIT IV SYNTHESIS 9

System synthesis: Transaction Level Modelling (TLM) based design, automaticTLM generation and mapping, platform synthesis; software synthesis: code generation, multi task synthesis, internal and external communication; Hardware synthesis: RTL architecture, Input models, estimation and optimisation, resource sharing and pipelining and scheduling

UNIT V SOC VERIFICATION AND TESTING 9

SoC and IP integration, Verification : Verification technology options, verification methodology, overview: system level verification, physical verification, hardware/software co-verification; Test requirements and methodologies, SoC design for testability - System modeling, test power dissipation, test access mechanism

TOTAL : 45 PERIODS

OUTCOMES:

- Analyse algorithms and architecture of hardware software inorder to optimise the system based on requirements and implementation constraints
- Model and specify systems at high level of abstraction
- appreciate the co-design approach and virtual platform models
- Understand hardware, software and interface synthesis

REFERENCES

1. D. Black, J. Donovan, SystemC: From the Ground Up, Springer, 2004.
2. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, Springer, 2009
3. Erik Larson, Introduction to advanced system-on-chip test design and optimisation, Springer 2005
4. Grotker, T., Liao, S., Martin, G. & Swan, S. System design with System C, Springer, 2002.
5. Ghenassia, F. Transaction-level modeling with SystemC: TLM concepts and applications for embedded systems, Springer, 2010.
6. Hoi-junyoo, Kangmin Lee, Jun Kyoungkim, “Low power NoC for high performance SoCdesing”,CRC press, 2008.
7. M. L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits, Springer, 2005
8. M. Abramovici, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, IEEE Press, 1994
9. P. Marwedel, Embedded System Design, Springer, 2003. G. De Micheli, Synthesis and Optimization of Digital Circuits
10. Prakash Rashinkar, Peter Paterson and Leena Singh, System-on-a chip verification: Methodology and techniques, kluwer Academic Publishers 2002
11. T. Noergaard, Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Newnes.
12. Vijay K. MadisettiChonlamethArpikanondt, “A Platform-Centric Approach to System-on-Chip (SOC) Design”, Springer, 2005.
13. Youn-Long Steve Lin, Essential Issues in SOC Design Designing Complex Systems-on-Chip, Springer, 2006

AP5093	**ROBOTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation

UNIT I LOCOMOTION AND KINEMATICS 9

Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability

UNIT II ROBOT PERCEPTION 9

Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data

UNIT III MOBILE ROBOT LOCALIZATION 9

Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments

UNIT IV MOBILE ROBOT MAPPING 9

Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM –extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm.

UNIT V PLANNING AND NAVIGATION 9

Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms

TOTAL 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Explain robot locomotion
- Apply kinematics models and constraints
- Implement vision algorithms for robotics
- Implement robot localization techniques
- Implement robot mapping techniques
- Implement SLAM algorithms
- Explain planning and navigation in robotics

REFERENCES:

1. Gregory DudekandMichael Jenkin, "Computational Principles of Mobile Robotics", Second Edition, Cambridge University Press, 2010.
2. Howie Choset et al., "Principles of Robot Motion: Theory, Algorithms, and Implementations", A Bradford Book, 2005.
3. Maja J. Mataric, "The Robotics Primer", MIT Press, 2007.
4. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to autonomous mobile robots", Second Edition, MIT Press, 2011.
5. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.

AP5006 **PHYSICAL DESIGN OF VLSI CIRCUITS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the physical design concepts such as routing, placement, partitioning and packaging
- To study the performance of circuits layout designs, compaction techniques.

UNIT I INTRODUCTION TO VLSI TECHNOLOGY 9

Layout Rules-Circuit abstraction Cell generation using programmable logic array transistor chaining, Wein Berger arrays and gate matrices-layout of standard cells gate arrays and sea of gates, field programmable gate array(FPGA)-layout methodologies Packaging-Computational Complexity - Algorithmic Paradigms.

UNIT II PLACEMENT USING TOP-DOWN APPROACH 9

Partitioning: Approximation of Hyper Graphs with Graphs, Kernighan-Lin Heuristic Ratio cut partition with capacity and i/o constrants. Floor planning: Rectangular dual floor planning hierarchical approach- simulated annealing- Floor plan sizing Placement: Cost function- force directed method- placement by simulated annealing partitioning placement- module placement on a resistive network – regular placement linear placement.

UNIT III ROUTING USING TOP DOWN APPROACH 9

Fundamentals: Maze Running- line searching- Steiner trees Global Routing: Sequential Approaches - hierarchial approaches - multi commodity flow based techniques - Randomised Routing- One Step approach - Integer Linear Programming Detailed Routing: Channel Routing - Switch box routing. Routing in FPGA: Array based FPGA- Row based FPGAs

UNIT IV PERFORMANCE ISSUES IN CIRCUIT LAYOUT 9

Delay Models: Gate Delay Models- Models for interconnected Delay- Delay in RC trees. Timing – Driven Placement: Zero Stack Algorithm- Weight based placement- Linear Programming Approach Timing riving Routing: Delay Minimization- Click Skew Problem- Buffered Clock Trees. Minimization: constrained via Minimization unconstrained via Minimization- Other issues in minimization

UNIT V SINGLE LAYER ROUTING, CELL GENERATION AND COMPACTION 9

Planar subset problem(PSP)- Single Layer Global Routing- Single Layer detailed Routing- Wire length and bend minimization technique – Over The Cell (OTC) Routing Multiple chip modules(MCM)- programmable Logic Arrays- Transistor chaining- Wein Burger Arrays- Gate matrix layout- 1D compaction- 2D compaction.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Explain different types of routing
- Discuss performance issues in circuit layout
- Outline 1D compaction- 2D compaction.

REFERENCES:

1. Preas M. Lorenzatti, “Physical Design and Automation of VLSI systems”, The Benjamin Cummins Publishers, 1998.
2. Sarafzadeh, C.K. Wong, “An Introduction to VLSI Physical Design”, McGraw Hill Int. Edition 1995

AP5094 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs*. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossles models

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic ,SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eye diagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to identify sources affecting the speed of digital circuits.
- Able to improve the signal transmission characteristics.

REFERENCES:

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003
2. Eric Bogatin , Signal Integrity – Simplified , Prentice Hall PTR, 2003.
3. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
4. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.

TOOLS REQUIRED

1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html
2. HSPICE from synopsis, www.synopsys.com/products/ mixedsignal/hspice/hspice.html
3. SPECCTRAQUEST from Cadence, http://www.specctraquest.com

VL5091 **MEMS AND NEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of quantum mechanics and nano systems.

UNIT I OVERVIEW 9

New trends in Engineering and Science: Micro and Nanoscale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the student should be able to:

- Discuss micro sensors
- Explain micro actuators
- Outline nanosystems and Quantum mechanics

REFERENCES:

1. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.
2. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997
3. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001
4. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.
5. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture” ,Tata McGraw Hill, 2002

AP5007 SECURE COMPUTING SYSTEMS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To learn computer hardware, system software and data concepts from a security perspective

UNIT I UNIT I COMPUTER SECURITY AND MANAGEMENT 9

Overview of Computer Security, Threats, Malware, Vulnerabilities, Authentication, Access Control, Security Management Models, Security Management Practices, Protection Mechanisms, Legal aspects of security, Ethical Hacking.

UNIT II HARDWARE SECURITY 9

Need for Hardware Security, Computer Memory and storage, Bus and Interconnection, I/O and Network Interface, CPU; Side channel Analysis: Power Analysis Attack, Timing Attack, Fault attack. Countermeasures of Side Channel Attack, Secure Hardware Intellectual Properties, Physically Unclonable Functions(PUFs), Secure PUF.

UNIT III ASSEMBLY AND OPERATING SYSTEMS SECURITY 9

Opcode, Operands, Addressing Modes, Stack and Buffer Overflow, FIFO and M/M/1 Problem, Kernel, Drivers and OS Security; Secure Design Principles, Trusted Operating Systems, Trusted System Functions

UNIT IV ADVANCED COMPUTER ARCHITECTURE 9

Security aspects : Multiprocessors, parallel processing, Ubiquitous computing, Grid, Distributed and cloud computing, Internet computing, Virtualization

UNIT V NETWORK AND WEBSECURITY 9

TCP/IP Protocol, Network switches, Routers, Gateways, Wireless Networks and Network Address Translation (NAT); Network Security Issues in TCP/IP, Threat Models, Denial of Service Attacks, Firewalls, Intrusion Detection, Browser Attacks, Web Attacks Targeting Users, Email Attacks, Secure Shell (SSH), HTTPS

TOTAL : 45 PERIODS

OUTCOMES:

- Aware of Security aspects
- Able to appreciate security in hardware, OS and it future need
- Learn security issues in various types of computing networks

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007
2. Debdeep Mukhopadhyay, Rajat Subhra Chakraborty, “Hardware Security - Design Threats and Safeguards”, CRC Press, 2015
3. Michael Whitman, Herbert J. Mattord, “Management of Information Security”, Third Edition, Course Technology, 2010
4. Shuangbao Wang, Robert S.Ledley, Computer Architecture and Security, Wiley, 2013
5. William Stallings, “Network Security Essentials, Applications and Standards”, Dorling Kindersley I P Ltd, Delhi, 2008.

AP5008	PATTERN RECOGNITION	L T P C 3 0 0 3

OBJECTIVES:

- To learn about supervised and unsupervised pattern classifiers.
- To familiarize about different feature extraction techniques.
- To explore the role of Hidden Marko model and SVM in pattern recognition.
- To understand the application of Fuzzy logic and genetic algorithms for pattern classifier

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

Principle component analysis, Independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars, Syntactic description – Stochastic grammars – Structural Representation.

UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V RECENT ADVANCES 9

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of the course the student will be able to

- Differentiate between supervised and unsupervised classifiers
- Classify the data and identify the patterns.
- Extract feature set and select the features from given data set.
- Apply fuzzy logic and genetic algorithms for classification problems

REFERENCES:

1. Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London,1999
2. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
3. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
4. Menahem Friedman , Abraham Kandel, “Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches”, World Scientific publishing Co. Ltd, 2000.
5. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992.
6. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001
7. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4^{th} Ed., Academic Press. 2009.

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REGULATIONS 2021

B. TECH. CHEMICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

1. Progra mme Educational Objectives (PEOs)

Graduates of B. Tech. Chemical Engineering will

a) Apply principles of mathematics, science, and engineering to analyze and solve problems encountered in chemical engineering and related areas.

b) Think critically and creatively, especially about the use of technology to addresslocal and global problems and become a socially responsible engineer by involving with community and professional organizations.

c) Exhibit professional, ethical codes of conduct, team work and continuous learning for catering the ever changing needs of the society.

2. Programme Outcomes (POs)

On successful completion of the B. Tech. Chemical Engineering programme,

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
4. Conduct investigations of complex problems: Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to proceed valid conclusions.
5. Modern tool usage: create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PEOs / POs Mapping

PEOs /POs	1	2	3	4	5	6	7	8	9	10	11	12
a	√	√	√	√								√
b			√	√	√	√	√				√	
c								√	√	√		

4. Semester Course wise POs Mapping

		Course Title	1	2	3	4	5	6	7	8	9	10	11	12
Year I	SEMESTER I	Communicative English						√	√	√	√			√
		Engineering Mathematics – I	√				√					√		
		Engineering Physics	√				√							
		Engineering Chemistry	√				√							
		Problem solving and Python Programming	√	√		√								
		Engineering Graphics	√	√		√								
		Problem solving and Python Programming Laboratory	√		√			√			√			√
		Physics and Chemistry Laboratory	√		√							√		

	SEMESTER II	Professional English						√	√	√		√		
		Engineering Mathematics – II	√				√							
		Physics of Materials	√		√								√	
		Environmental Science and Engineering	√		√									
		Basic Civil and Mechanical Engineering	√		√			√						
		Introduction to Chemical Engineering					√	√						
		Engineering Practices Laboratory	√		√			√				√		√
		Technical Analysis Laboratory	√		√									
Year II	SEMESTER III	Applied numerical analysis	√				√				√		√	
		Process Calculations	√		√	√	√	√		√				
		Fluid Mechanics for chemical Engineers	√		√	√	√	√						
		Principles of electrical and electronics engineering	√		√			√						√
		Solid Mechanics for technologists	√		√									
		Fluid Mechanics Laboratory	√	√		√					√			
		Electrical Engineering Laboratory	√	√		√				√				
	SEMESTER IV	Applied probability and statistics	√				√							
		Chemistry for chemical Engineers	√	√	√			√	√		√	√		
		Computer applications in Chemical Engineering (Integrated Lab)	√		√								√	
		Mechanical operations	√		√	√	√	√						
		Chemical Process Industries	√		√									
		Instrumental Methods Of Chemical Analysis	√		√	√	√	√						√
		Mechanical operations Laboratory												
		Professional Skills Laboratory	√								√			
Year III	SEMESTER V	Chemical Reaction Engineering I	√	√		√							√	
		Heat Transfer	√	√		√								
		Mass Transfer I				√	√	√	√					
		Heat and mass Transfer Laboratory	√		√	√	√	√						
		Computational Programming Laboratory for Chemical Engineers	√		√	√	√	√						
	SEMESTER VI	Chemical Reaction Engineering II	√		√	√	√	√	√				√	
		Mass Transfer II (Integrated Laboratory)	√		√	√	√	√	√					
		Chemical Engineering Thermodynamics	√			√	√	√						√
		Process Dynamics and Control												
		Process Economics and Industrial Management						√	√	√				
		Professional Ethical Practice	√		√	√	√	√						
		Chemical Reaction Engineering Laboratory	√		√	√	√	√					√	
Year IV	SEMESTER VII	Transport Phenomena	√		√	√	√	√						
		Chemical Process Equipment Design (Integrated Lab)	√		√	√	√	√	√		√			√
		Industrial Safety	√	√		√								
		Mini Project	√	√		√								
		Process Control and dynamics Laboratory	√		√	√	√	√	√		√			

		Internship	√	√		√								
	SEMESTER VIII	Project Work	√	√	√		√		√	√		√		

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REGULATION 2021

B. TECH CHEMICAL ENGINEERING – CHOICE BASED CREDIT SYSTEM

(APPLICABLE FOR THE STUDENTS JOINED IN THE YEAR 2021 – 2022)

I TO VIII SEMESTERS (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
TOTAL CREDITS FOR THEORY				**22**	**18**	**0**	**4**	**20**
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**30**	**18**	**0**	**12**	**24**

SEMESTER II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1255	Physics of Materials	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	PCC	3	3	0	0	3
6.	CH1206	Introduction to Chemical Engineering	PCC	3	3	0	0	2
TOTAL CREDITS FOR THEORY				**19**	**19**	**0**	**0**	**18**
PRACTICALS								
7.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2

8.	CH1208	Technical Analysis Laboratory	BSC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**27**	**19**	**0**	**8**	**22**

SEMESTER III

SI. No	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	EE1353	Principles of Electrical and Electronics Engineering	ESC	3	3	0	0	3
5.	CH1303	Solid Mechanics for Technologists	ESC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**17**	**15**	**2**	**0**	**17**
PRACTICALS								
6.	CH1307	Fluid Mechanics Laboratory	PCC	4	0	0	4	2
7.	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**25**	**15**	**2**	**8**	**21**

SEMESTER IV

SI. No	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
2.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
3.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
4.	CH1403	Mechanical operations	PCC	3	3	0	0	3
5.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
6.	CH1405	Instrumental Methods of Chemical Analysis	BSC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**21**	**18**	**1**	**2**	**20**
PRACTICALS								
7.	CH1407	Mechanical operations Laboratory	PCC	4	0	0	4	2
8.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
TOTAL CREDITS FOR LAB				**6**	**0**	**0**	**6**	**3**
SEMESTER TOTAL (THEORY + LABORATORY)				**27**	**18**	**1**	**8**	**23**

SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
2.	CH1502	Heat Transfer	PCC	3	2	1	0	3
3.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
4.		Professional Elective I	PEC	3	3	0	0	3
5.		Open Elective I	OEC	3	3	0	0	3
6.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
TOTAL CREDITS FOR THEORY				17	**14**	**3**	**0**	15
PRACTICALS								
7.	CH1507	Heat and mass Transfer Laboratory	PCC	4	0	0	4	2
8.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**25**	**14**	**3**	**8**	**19**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
2.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
3.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
4.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
5.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
6.		Professional Elective II	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**15**	**4**	**2**	**20**
PRACTICALS								
7.	CH1607	Professional Ethical Practice *(Internal Assessment only)	PCC	2	0	0	2	1
8.	CH1608	Chemical Reaction Engineering Laboratory	PCC	4	0	0	3	2
TOTAL CREDITS FOR LAB				**6**	**0**	**0**	**5**	**3**
SEMESTER TOTAL (THEORY + LABORATORY)				**26**	**15**	**4**	**7**	**23**
CHVA01		**Value added course***(Internal Assessment only)		**1 WEEK**				**2**

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
2.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
3.	CH1703	Safety and Hazard analysis	PCC	3	3	0	0	3
4.		Professional Elective III	PEC	3	3	0	0	3
5.		Professional Elective IV	PEC	3	3	0	0	3
6.		Open Elective II	OEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**16**	**2**	**2**	**19**
PRACTICALS								
7.	CH1707	Mini Project	PCC	4	0	0	4	2
8.	CH1708	Process Control and dynamics Laboratory	PCC	4	0	0	4	2
9.	CH1709	Internship (Undergone during 6th Semester summer holidays, evaluated in the 7th semester)	EEC	0	0	0	0	1
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**5**
SEMESTER TOTAL (THEORY + LABORATORY)				**28**	**16**	**2**	**10**	**24**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1801	Professional Elective V	PEC	3	3	0	0	3
2.	CH1802	Professional Elective VI	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**6**	**6**	**0**	**0**	**6**
PRACTICALS								
3.	CH1807	Project Work	EEC	20	0	0	20	12
TOTAL CREDITS FOR LAB				**20**	**0**	**0**	**20**	**12**
SEMESTER TOTAL (THEORY + LABORATORY)				**26**	**6**	**0**	**20**	**18**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1509	Chemical Works Organization and Management	PEC	3	3	0	0	3
2.	CH1510	Membrane Science and Engineering	PEC	3	3	0	0	3
3.	CH1511	Polymer Technology	PEC	3	3	0	0	3
4.	CH1512	Fundamentals of Thermodynamics	PEC	3	2	1	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1609	Industrial Air Pollution	PEC	3	3	0	0	3
2.	CH1610	Industrial Instrumentation	PEC	3	3	0	0	3
3.	CH1611	Electrochemical Engineering	PEC	3	3	0	0	3
4.	CH1612	Process Plant Utilities	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1710	Modern Separation Techniques	PEC	3	3	0	0	3
2.	CH1711	Waste Water Treatment	PEC	3	3	0	0	3
3.	CH1712	Fluidization Engineering	PEC	3	2	1	0	3
4.	CH1713	Distillation	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1714	Piping and Instrumentation	PEC	3	3	0	0	3
2.	CH1715	Food Technology	PEC	3	3	0	0	3
3.	CH1716	Biochemical Engineering	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1808	Optimization of Chemical Processes	PEC	3	3	0	0	3
2.	CH1809	Fermentation Engineering	PEC	3	3	0	0	3
3.	CH1810	Nuclear Engineering	PEC	3	3	0	0	3
4.	CH1811	Energy Technology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1812	Fertilizer Technology	PEC	3	3	0	0	3
2.	CH1813	Pulp and Paper Technology	PEC	3	3	0	0	3
3.	CH1814	Mixing Theory and Practice	PEC	3	3	0	0	3
4.	CH1815	Petroleum Refining and Petrochemicals	PEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE103	Environmental Impact Assessments	OEC	3	3	0	0	3
2.	OCS101	Introduction to C Programming	OEC	3	3	0	0	3
3.	OEE105	Solar Energy Utilization	OEC	3	3	0	0	3
4.	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
5.	OBT102	Hazardous Waste Management	OEC	3	3	0	0	3
6.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE II, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBT103	Fuel Cell Chemistry	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OME102	Design of Experiments	OEC	3	3	0	0	3
4.	OBT104	Biosensors	OEC	3	3	0	0	3
5.	OME106	Testing of Materials	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3

AUDIT COURSE

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES (HSMC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCES (BSC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	GE112	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	CH1207	Technical Analysis Laboratory	BSC	4	0	0	4	2
8.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
9.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
10.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
11.	CH1405	Instrumental Methods Of Chemical Analysis	BSC	3	3	0	0	3

ENGINEERING SCIENCES (ESC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1101	Python Programming	ESC	4	3	1	0	3
2.	GE1102	Engineering Graphics	ESC	5	2	0	4	4
3.	GE213	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
5.	GE1207	Engineering Practices	ESC	4	0	0	4	2
6.	EE1353	Principles of electrical and electronics engineering	ESC	3	3	0	0	3
7.	CH1303	Solid Mechanics for technologists	ESC	3	3	0	0	3
8.	EE1358	Electrical Engineering Laboratory	ESC	3	0	0	3	2

PROFESSIONAL CORE (PCC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1201	Introduction to Chemical Engineering	PCC	3	3	0	0	2
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	CH1307	Fluid Mechanics Laboratory	PCC	3	0	0	3	2
5.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
6.	CH1403	Mechanical operations	PCC	3	3	0	0	3
7.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
8.	CH1407	Mechanical operations Laboratory	PCC	3	0	0	3	2
9.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
10.	CH1502	Heat Transfer	PCC	3	2	1	0	3
11.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
12.	CH1507	Heat and mass Transfer Laboratory	PCC	3	0	0	3	2
13.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	3	0	0	3	2
14.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
15.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
16.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
17.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
18.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
19.	CH1607	Professional Ethical Practice	PCC	2	0	0	2	1
20.	CH1608	Chemical Reaction Engineering Laboratory	PCC	3	0	0	3	2
21.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
22.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
23.	CH1703	Safety & Hazard Analysis	PCC	3	3	0	0	3
24.	CH1707	Mini Project	PCC	3	0	0	3	2
25.	CH1708	Process Control Laboratory	PCC	3	0	0	3	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1410	Professional Skills Laboratory	**EEC**	2	0	0	3	1
2.	CH1709	Internship	**EEC**	0	0	0	0	1
3.	CH1807	Project Work	**EEC**	20	0	0	20	12

SUMMARY

S. No.	Subject Area	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	6	-	-	-	-	-	-	9
2	BSC	12	9	4	10	-	-	-	-	35
3	ESC	9	5	8	-	-	-	-	-	22
4	PCC	-	2	9	12	13	20	14	-	70
5	PEC	-	-	-	-	3	3	6	6	18
6	OEC	-	-	-	-	3	-	3	-	6
7	EEC	-	-	-	1	-	-	1	12	14
8	AC	-	-	-	-	-	-	-	-	-
Total		24	22	21	23	19	23	24	18	174

Signature of HOD

Signature of Principal

Signature of Dean of Academics

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

REGULATION 2021

B. TECH CHEMICAL ENGINEERING – CHOICE BASED CREDIT SYSTEM

(APPLICABLE FOR THE STUDENTS JOINED IN THE YEAR 2022 – 2023)

I TO VIII SEMESTERS (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
TOTAL CREDITS FOR THEORY				**22**	**18**	**0**	**4**	**20**
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	4
SEMESTER TOTAL (THEORY + LABORATORY)				**30**	**18**	**0**	**12**	**24**

SEMESTER II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1255	Physics of Materials	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	PCC	3	3	0	0	3
6.	CH1206	Introduction to Chemical Engineering	PCC	3	3	0	0	2
7.	GE1209	Heritage of Tamils	HSMC	1	1	0	0	1
TOTAL CREDITS FOR THEORY				**20**	**20**	**0**	**0**	**19**

PRACTICALS								
8.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9.	CH1208	Technical Analysis Laboratory	BSC	4	0	0	4	2
		TOTAL CREDITS FOR LAB		**8**	**0**	**0**	**8**	**4**
		SEMESTER TOTAL (THEORY + LABORATORY)		**28**	**20**	**0**	**8**	**23**

SEMESTER III

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	EE1353	Principles of Electrical and Electronics Engineering	ESC	3	3	0	0	3
5.	CH1303	Solid Mechanics for Technologists	ESC	3	3	0	0	3
6.	GE1210	Tamils and Technology	HSMC	1	1	0	0	1
		TOTAL CREDITS FOR THEORY		**18**	**16**	**2**	**0**	**18**
PRACTICALS								
6.	CH1307	Fluid Mechanics Laboratory	PCC	4	0	0	4	2
7.	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
		TOTAL CREDITS FOR LAB		**8**	0	0	**8**	**4**
		SEMESTER TOTAL (THEORY + LABORATORY)		**26**	**16**	**2**	**8**	**21**

SEMESTER IV

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
2.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
3.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
4.	CH1403	Mechanical operations	PCC	3	3	0	0	3
5.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
6.	CH1405	Instrumental Methods of Chemical Analysis	BSC	3	3	0	0	3
		TOTAL CREDITS FOR THEORY		**21**	**18**	**1**	**2**	**20**
PRACTICALS								

7.	CH1407	Mechanical operations Laboratory	PCC	4	0	0	4	2
8.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
TOTAL CREDITS FOR LAB				**6**	**0**	**0**	**5**	**3**
SEMESTER TOTAL (THEORY + LABORATORY)				**27**	**18**	**1**	**7**	**23**

SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
2.	CH1502	Heat Transfer	PCC	3	2	1	0	3
3.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
4.		Professional Elective I	PEC	3	3	0	0	3
5.		Open Elective I	OEC	3	3	0	0	3
6.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
TOTAL CREDITS FOR THEORY				**17**	**14**	**3**	**0**	**15**
PRACTICALS								
7.	CH1507	Heat and mass Transfer Laboratory	PCC	4	0	0	4	2
8.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**25**	**14**	**3**	**8**	**19**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
2.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
3.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
4.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
5.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
6.		Professional Elective II	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**15**	**4**	**2**	**20**
PRACTICALS								
7.	CH1607	Professional Ethical Practice *(Internal Assessment only)	PCC	2	0	0	2	1
8.	CH1608	Chemical Reaction Engineering Laboratory	PCC	4	0	0	4	2

TOTAL CREDITS FOR LAB		**6**	**0**	**0**	**6**	**3**
SEMESTER TOTAL (THEORY + LABORATORY)		**26**	**15**	**4**	**8**	**23**
CHVA01	**Value added course***(Internal Assessment only)	**1 WEEK**				**2**

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
2.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
3.	CH1703	Safety and Hazard analysis	PCC	3	3	0	0	3
4.		Professional Elective III	PEC	3	3	0	0	3
5.		Professional Elective IV	PEC	3	3	0	0	3
6.		Open Elective II	OEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**16**	**2**	**2**	**19**
PRACTICALS								
7.	CH1707	Mini Project	PCC	4	0	0	4	2
8.	CH1708	Process Control and dynamics Laboratory	PCC	4	0	0	4	2
9.	CH1709	Internship (Undergone during 6th Semester summer holidays, evaluated in the 7th semester)	EEC	0	0	0	0	1
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**5**
SEMESTER TOTAL (THEORY + LABORATORY)				**28**	**16**	**2**	**10**	**24**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1801	Professional Elective V	PEC	3	3	0	0	3
2.	CH1802	Professional Elective VI	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**6**	**6**	**0**	**0**	**6**
PRACTICALS								
3.	CH1807	Project Work	EEC	20	0	0	20	12
TOTAL CREDITS FOR LAB				**20**	**0**	**0**	**20**	**12**
SEMESTER TOTAL (THEORY + LABORATORY)				**26**	**6**	**0**	**20**	**18**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1509	Chemical Works Organization and Management	PEC	3	3	0	0	3
2.	CH1510	Membrane Science and Engineering	PEC	3	3	0	0	3
3.	CH1511	Polymer Technology	PEC	3	3	0	0	3
4.	CH1512	Fundamentals of Thermodynamics	PEC	3	2	1	0	3
5.	CH1513	Essentials of Thermodynamics	PEC	3	2	1	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1609	Industrial Air Pollution	PEC	3	3	0	0	3
2.	CH1610	Industrial Instrumentation	PEC	3	3	0	0	3
3.	CH1611	Electrochemical Engineering	PEC	3	3	0	0	3
4.	CH1612	Process Plant Utilities	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1710	Modern Separation Techniques	PEC	3	3	0	0	3
2.	CH1711	Waste Water Treatment	PEC	3	3	0	0	3
3.	CH1712	Fluidization Engineering	PEC	3	2	1	0	3
4.	CH1713	Distillation	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1714	Piping and Instrumentation	PEC	3	3	0	0	3
2.	CH1715	Food Technology	PEC	3	3	0	0	3
3.	CH1716	Biochemical Engineering	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1808	Optimization of Chemical Processes	PEC	3	3	0	0	3
2.	CH1809	Fermentation Engineering	PEC	3	3	0	0	3
3.	CH1810	Nuclear Engineering	PEC	3	3	0	0	3
4.	CH1811	Energy Technology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1812	Fertilizer Technology	PEC	3	3	0	0	3
2.	CH1813	Pulp and Paper Technology	PEC	3	3	0	0	3
3.	CH1814	Mixing Theory and Practice	PEC	3	3	0	0	3
4.	CH1815	Petroleum Refining and Petrochemicals	PEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE103	Environmental Impact Assessments	OEC	3	3	0	0	3
2.	OCS101	Introduction to C Programming	OEC	3	3	0	0	3
3.	OEE105	Solar Energy Utilization	OEC	3	3	0	0	3
4.	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
5.	OBT102	Hazardous Waste Management	OEC	3	3	0	0	3
6.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE II, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBT103	Fuel Cell Chemistry	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OME102	Design of Experiments	OEC	3	3	0	0	3
4.	OBT104	Biosensors	OEC	3	3	0	0	3
5.	OME106	Testing of Materials	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3

AUDIT COURSE

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES (HSMC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCES (BSC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	GE112	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	CH1207	Technical Analysis Laboratory	BSC	4	0	0	4	2
8.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
9.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
10.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
11.	CH1405	Instrumental Methods Of Chemical Analysis	BSC	3	3	0	0	3

ENGINEERING SCIENCES (ESC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1101	Python Programming	ESC	4	3	1	0	3
2.	GE1102	Engineering Graphics	ESC	5	2	0	4	4
3.	GE213	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
5.	GE1207	Engineering Practices	ESC	4	0	0	4	2
6.	EE1353	Principles of electrical and electronics engineering	ESC	3	3	0	0	3
7.	CH1303	Solid Mechanics for technologists	ESC	3	3	0	0	3
8.	EE1358	Electrical Engineering Laboratory	ESC	3	0	0	3	2

PROFESSIONAL CORE (PCC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1201	Introduction to Chemical Engineering	PCC	3	3	0	0	2
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	CH1307	Fluid Mechanics Laboratory	PCC	3	0	0	3	2
5.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	3	0	2	4
6.	CH1403	Mechanical operations	PCC	3	3	0	0	3
7.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
8.	CH1407	Mechanical operations Laboratory	PCC	3	0	0	3	2
9.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
10.	CH1502	Heat Transfer	PCC	3	2	1	0	3
11.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
12.	CH1507	Heat and mass Transfer Laboratory	PCC	3	0	0	3	2
13.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	3	0	0	3	2
14.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
15.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
16.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
17.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
18.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
19.	CH1607	Professional Ethical Practice	PCC	2	0	0	2	1
20.	CH1608	Chemical Reaction Engineering Laboratory	PCC	3	0	0	3	2
21.	CH1701	Transport Phenomena	PCC	3	3	0	0	3
22.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
23.	CH1703	Safety & Hazard Analysis	PCC	3	3	0	0	3
24.	CH1707	Mini Project	PCC	3	0	0	3	2
25.	CH1708	Process Control Laboratory	PCC	3	0	0	3	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1410	Professional Skills Laboratory	**EEC**	2	0	0	3	1
2.	CH1709	Internship	**EEC**	0	0	0	0	1
3.	CH1807	Project Work	**EEC**	20	0	0	20	12

SUMMARY

S. No.	Subject Area	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	7	1	-	-	-	-	-	11
2	BSC	12	9	4	10	-	-	-	-	35
3	ESC	9	5	8	-	-	-	-	-	22
4	PCC	-	2	9	12	13	20	14	-	70
5	PEC	-	-	-	-	3	3	6	6	18
6	OEC	-	-	-	-	3	-	3	-	6
7	EEC	-	-	-	1	-	-	1	12	14
8	AC	-	-	-	-	-	-	-	-	-
Total		24	23	22	23	19	23	24	18	176

Signature of HOD

Signature of Principal

Signature of Dean of Academics

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

REGULATION 2021

B. TECH CHEMICAL ENGINEERING – CHOICE BASED CREDIT SYSTEM

(APPLICABLE FOR THE STUDENTS JOINED IN THE YEAR 2023 – 2024)

I TO VIII SEMESTERS (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7.	GE1209	Heritage of Tamils	HSMC	1	1	0	0	1
TOTAL CREDITS FOR THEORY				23	**19**	**0**	**4**	**21**
PRACTICALS								
8.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
9.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	4
SEMESTER TOTAL (THEORY + LABORATORY)				**30**	**19**	**0**	**12**	**25**

SEMESTER II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1255	Physics of Materials	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	PCC	3	3	0	0	3
6.	CH1206	Introduction to Chemical Engineering	PCC	3	3	0	0	2
7.	GE1210	Tamils and Technology	ESC	1	1	0	0	1
TOTAL CREDITS FOR THEORY				**20**	**20**	**0**	**0**	19

PRACTICALS								
8.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9.	CH1208	Technical Analysis Laboratory	BSC	4	0	0	4	2
			TOTAL CREDITS FOR LAB	**8**	**0**	**0**	**8**	**4**
			SEMESTER TOTAL (THEORY + LABORATORY)	**28**	**20**	**0**	**8**	**23**

SEMESTER III

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	EE1353	Principles of Electrical and Electronics Engineering	ESC	3	3	0	0	3
5.	CH1303	Solid Mechanics for Technologists	ESC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**17**	**15**	**2**	**0**	17
PRACTICALS								
7.	CH1307	Fluid Mechanics Laboratory	PCC	4	0	0	4	2
8.	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
			TOTAL CREDITS FOR LAB	**8**	**0**	**0**	**8**	4
			SEMESTER TOTAL (THEORY + LABORATORY)	**25**	**15**	**2**	**8**	**21**

SEMESTER IV

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
2.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
3.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
4.	CH1403	Mechanical operations	PCC	3	3	0	0	3
5.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
6.	CH1405	Instrumental Methods of Chemical Analysis	BSC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**21**	**18**	**1**	**2**	**20**
PRACTICALS								
7.	CH1407	Mechanical operations Laboratory	PCC	4	0	0	4	2

8.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
		TOTAL CREDITS FOR LAB		**6**	**0**	**0**	**6**	**3**
		SEMESTER TOTAL (THEORY + LABORATORY)		**27**	**18**	**1**	**8**	**23**

SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
2.	CH1502	Heat Transfer	PCC	3	2	1	0	3
3.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
4.		Professional Elective I	PEC	3	3	0	0	3
5.		Open Elective I	OEC	3	3	0	0	3
6.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
		TOTAL CREDITS FOR THEORY		**17**	**14**	**3**	**0**	15
		PRACTICALS						
7.	CH1507	Heat and mass Transfer Laboratory	PCC	4	0	0	4	2
8.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	4	0	0	4	2
		TOTAL CREDITS FOR LAB		**8**	**0**	**0**	**8**	**4**
		SEMESTER TOTAL (THEORY + LABORATORY)		**25**	**14**	**3**	**8**	**19**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
2.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
3.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
4.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
5.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
6.		Professional Elective II	PEC	3	3	0	0	3
		TOTAL CREDITS FOR THEORY		**20**	**15**	**4**	**2**	**20**
		PRACTICALS						
7.	CH1607	Professional Ethical Practice *(Internal Assessment only)	PCC	2	0	0	2	1
8.	CH1608	Chemical Reaction Engineering Laboratory	PCC	4	0	0	4	2

TOTAL CREDITS FOR LAB		6	0	0	6	3
SEMESTER TOTAL (THEORY + LABORATORY)		26	15	4	8	23
CHVA01	Value added course*(Internal Assessment only)	1 WEEK				2

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
2.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
3.	CH1703	Safety and Hazard analysis	PCC	3	3	0	0	3
4.		Professional Elective III	PEC	3	3	0	0	3
5.		Professional Elective IV	PEC	3	3	0	0	3
6.		Open Elective II	OEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**16**	**2**	**2**	**19**
PRACTICALS								
7.	CH1707	Mini Project	PCC	4	0	0	4	2
8.	CH1708	Process Control and dynamics Laboratory	PCC	4	0	0	4	2
9.	CH1709	Internship (Undergone during 6th Semester summer holidays, evaluated in the 7th semester)	EEC	0	0	0	0	1
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**5**
SEMESTER TOTAL (THEORY + LABORATORY)				**28**	**16**	**2**	**10**	**24**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1801	Professional Elective V	PEC	3	3	0	0	3
2.	CH1802	Professional Elective VI	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**6**	**6**	**0**	**0**	**6**
PRACTICALS								
3.	CH1807	Project Work	EEC	20	0	0	20	12
TOTAL CREDITS FOR LAB				**20**	**0**	**0**	**20**	**12**
SEMESTER TOTAL (THEORY + LABORATORY)				**26**	**6**	**0**	**20**	**18**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1509	Chemical Works Organization and Management	PEC	3	3	0	0	3
2.	CH1510	Membrane Science and Engineering	PEC	3	3	0	0	3
3.	CH1511	Polymer Technology	PEC	3	3	0	0	3
4.	CH1512	Fundamentals of Thermodynamics	PEC	3	2	1	0	3
5.	CH1513	Essentials of Thermodynamics	PEC	3	2	1	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1609	Industrial Air Pollution	PEC	3	3	0	0	3
2.	CH1610	Industrial Instrumentation	PEC	3	3	0	0	3
3.	CH1611	Electrochemical Engineering	PEC	3	3	0	0	3
4.	CH1612	Process Plant Utilities	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1710	Modern Separation Techniques	PEC	3	3	0	0	3
2.	CH1711	Waste Water Treatment	PEC	3	3	0	0	3
3.	CH1712	Fluidization Engineering	PEC	3	2	1	0	3
4.	CH1713	Distillation	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1714	Piping and Instrumentation	PEC	3	3	0	0	3
2.	CH1715	Food Technology	PEC	3	3	0	0	3
3.	CH1716	Biochemical Engineering	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1808	Optimization of Chemical Processes	PEC	3	3	0	0	3
2.	CH1809	Fermentation Engineering	PEC	3	3	0	0	3
3.	CH1810	Nuclear Engineering	PEC	3	3	0	0	3
4.	CH1811	Energy Technology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1812	Fertilizer Technology	PEC	3	3	0	0	3
2.	CH1813	Pulp and Paper Technology	PEC	3	3	0	0	3
3.	CH1814	Mixing Theory and Practice	PEC	3	3	0	0	3
4.	CH1815	Petroleum Refining and Petrochemicals	PEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE103	Environmental Impact Assessments	OEC	3	3	0	0	3
2.	OCS101	Introduction to C Programming	OEC	3	3	0	0	3
3.	OEE105	Solar Energy Utilization	OEC	3	3	0	0	3
4.	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
5.	OBT102	Hazardous Waste Management	OEC	3	3	0	0	3
6.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE II, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBT103	Fuel Cell Chemistry	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OME102	Design of Experiments	OEC	3	3	0	0	3
4.	OBT104	Biosensors	OEC	3	3	0	0	3
5.	OME106	Testing of Materials	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3

AUDIT COURSE

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES

(HSMC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCES (BSC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	GE112	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	CH1207	Technical Analysis Laboratory	BSC	4	0	0	4	2
8.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
9.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
10.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
11.	CH1405	Instrumental Methods Of Chemical Analysis	BSC	3	3	0	0	3

ENGINEERING SCIENCES (ESC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1101	Python Programming	ESC	4	3	1	0	3
2.	GE1102	Engineering Graphics	ESC	5	2	0	4	4
3.	GE213	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
5.	GE1207	Engineering Practices	ESC	4	0	0	4	2
6.	EE1353	Principles of electrical and electronics engineering	ESC	3	3	0	0	3
7.	CH1303	Solid Mechanics for technologists	ESC	3	3	0	0	3
8.	EE1358	Electrical Engineering Laboratory	ESC	3	0	0	3	2

PROFESSIONAL CORE (PCC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1201	Introduction to Chemical Engineering	PCC	3	3	0	0	2
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	CH1307	Fluid Mechanics Laboratory	PCC	3	0	0	3	2
5.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
6.	CH1403	Mechanical operations	PCC	3	3	0	0	3
7.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
8.	CH1407	Mechanical operations Laboratory	PCC	3	0	0	3	2
9.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
10.	CH1502	Heat Transfer	PCC	3	2	1	0	3
11.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
12.	CH1507	Heat and mass Transfer Laboratory	PCC	3	0	0	3	2
13.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	3	0	0	3	2
14.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
15.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
16.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
17.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
18.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
19.	CH1607	Professional Ethical Practice	PCC	2	0	0	2	1
20.	CH1608	Chemical Reaction Engineering Laboratory	PCC	3	0	0	3	2
21.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
22.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
23.	CH1703	Safety & Hazard Analysis	PCC	3	3	0	0	3
24.	CH1707	Mini Project	PCC	3	0	0	3	2
25.	CH1708	Process Control Laboratory	PCC	3	0	0	3	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1410	Professional Skills Laboratory	**EEC**	2	0	0	3	1
2.	CH1709	Internship	**EEC**	0	0	0	0	1
3.	CH1807	Project Work	**EEC**	20	0	0	20	12

SUMMARY

S. No.	Subject Area	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	7	-	-	-	-	-	-	11
2	BSC	12	9	4	10	-	-	-	-	35
3	ESC	9	5	8	-	-	-	-	-	22
4	PCC	-	2	9	12	13	20	14	-	70
5	PEC	-	-	-	-	3	3	6	6	18
6	OEC	-	-	-	-	3	-	3	-	6
7	EEC	-	-	-	1	-	-	1	12	14
8	AC	-	-	-	-	-	-	-	-	-
Total		25	23	21	23	19	23	24	18	176

Signature of
HOD

Signature of
Principal

Signature of
Dean of Academics

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

REGULATION 2021

B. TECH CHEMICAL ENGINEERING – CHOICE BASED CREDIT SYSTEM

(APPLICABLE FOR THE STUDENTS JOINED IN THE YEAR 2024 – 2025)

I TO VIII SEMESTERS (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1109	Problem solving and Programming in C	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7.	GE1209	Heritage of Tamils	HSMC	1	1	0	0	1
TOTAL CREDITS FOR THEORY				23	**19**	**0**	**4**	**21**
PRACTICALS								
8.	GE1110	Programming in C Laboratory	ESC	4	0	0	4	2
9.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	4
SEMESTER TOTAL (THEORY + LABORATORY)				**30**	**19**	**0**	**12**	**25**

SEMESTER II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1255	Physics of Materials	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	PCC	3	3	0	0	3
6.	CH1206	Introduction to Chemical Engineering	PCC	3	3	0	0	2
7.	GE1210	Tamils and Technology	ESC	1	1	0	0	1
TOTAL CREDITS FOR THEORY				**20**	**20**	**0**	**0**	19

PRACTICALS								
8.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9.	CH1208	Technical Analysis Laboratory	BSC	4	0	0	4	2
			TOTAL CREDITS FOR LAB	**8**	**0**	**0**	**8**	**4**
			SEMESTER TOTAL (THEORY + LABORATORY)	**28**	**20**	**0**	**8**	**23**

SEMESTER III

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	EE1353	Principles of Electrical and Electronics Engineering	ESC	3	3	0	0	3
5.	CH1303	Solid Mechanics for Technologists	ESC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**17**	**15**	**2**	**0**	17
PRACTICALS								
6.	CH1307	Fluid Mechanics Laboratory	PCC	4	0	0	4	2
7.	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
			TOTAL CREDITS FOR LAB	**8**	**0**	**0**	**8**	4
			SEMESTER TOTAL (THEORY + LABORATORY)	**25**	**15**	**2**	**8**	**21**

SEMESTER IV

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
2.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
3.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	2	1	2	4
4.	CH1403	Mechanical operations	PCC	3	3	0	0	3
5.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
6.	CH1405	Instrumental Methods of Chemical Analysis	BSC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**21**	**18**	**1**	**2**	**20**
PRACTICALS								
7.	CH1407	Mechanical operations Laboratory	PCC	4	0	0	4	2

8.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
TOTAL CREDITS FOR LAB				**6**	**0**	**0**	**6**	**3**
SEMESTER TOTAL (THEORY + LABORATORY)				**27**	**18**	**1**	**8**	**23**

SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
2.	CH1502	Heat Transfer	PCC	3	2	1	0	3
3.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
4.		Professional Elective I	PEC	3	3	0	0	3
5.		Open Elective I	OEC	3	3	0	0	3
6.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
TOTAL CREDITS FOR THEORY				**17**	**14**	**3**	**0**	**15**
PRACTICALS								
7.	CH1507	Heat and mass Transfer Laboratory	PCC	4	0	0	4	2
8.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**8**	**0**	**0**	**8**	**4**
SEMESTER TOTAL (THEORY + LABORATORY)				**25**	**14**	**3**	**8**	**19**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
2.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
3.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
4.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
5.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
6.		Professional Elective II	PEC	3	3	0	0	3
TOTAL CREDITS FOR THEORY				**20**	**15**	**4**	**2**	**20**
PRACTICALS								
7.	CH1607	Professional Ethical Practice *(Internal Assessment only)	PCC	2	0	0	2	1
8.	CH1608	Chemical Reaction Engineering Laboratory	PCC	4	0	0	4	2
TOTAL CREDITS FOR LAB				**6**	**0**	**0**	**6**	**3**

SEMESTER TOTAL (THEORY + LABORATORY)		**26**	**15**	**4**	**8**	**23**
CHVA01	**Value added course***(Internal Assessment only)	**1 WEEK**				**2**

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
2.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
3.	CH1703	Safety and Hazard analysis	PCC	3	3	0	0	3
4.		Professional Elective III	PEC	3	3	0	0	3
5.		Professional Elective IV	PEC	3	3	0	0	3
6.		Open Elective II	OEC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**20**	**16**	**2**	**2**	**19**
		PRACTICALS						
7.	CH1707	Mini Project	PCC	4	0	0	4	2
8.	CH1708	Process Control and dynamics Laboratory	PCC	4	0	0	4	2
9.	CH1709	Internship (Undergone during 6th Semester summer holidays, evaluated in the 7th semester)	EEC	0	0	0	0	1
			TOTAL CREDITS FOR LAB	**8**	**0**	**0**	**8**	**5**
			SEMESTER TOTAL (THEORY + LABORATORY)	**28**	**16**	**2**	**10**	**24**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	CH1801	Professional Elective V	PEC	3	3	0	0	3
2.	CH1802	Professional Elective VI	PEC	3	3	0	0	3
			TOTAL CREDITS FOR THEORY	**6**	**6**	**0**	**0**	**6**
		PRACTICALS						
3.	CH1807	Project Work	EEC	20	0	0	20	12
			TOTAL CREDITS FOR LAB	**20**	**0**	**0**	**20**	**12**
			SEMESTER TOTAL (THEORY + LABORATORY)	**26**	**6**	**0**	**20**	**18**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1509	Chemical Works Organization and Management	PEC	3	3	0	0	3
2.	CH1510	Membrane Science and Engineering	PEC	3	3	0	0	3
3.	CH1511	Polymer Technology	PEC	3	3	0	0	3
4.	CH1512	Fundamentals of Thermodynamics	PEC	3	2	1	0	3
5.	CH1513	Essentials of Thermodynamics	PEC	3	2	1	0	3

PROFESSIONAL ELECTIVE II, SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1609	Industrial Air Pollution	PEC	3	3	0	0	3
2.	CH1610	Industrial Instrumentation	PEC	3	3	0	0	3
3.	CH1611	Electrochemical Engineering	PEC	3	3	0	0	3
4.	CH1612	Process Plant Utilities	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE III, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1710	Modern Separation Techniques	PEC	3	3	0	0	3
2.	CH1711	Waste Water Treatment	PEC	3	3	0	0	3
3.	CH1712	Fluidization Engineering	PEC	3	2	1	0	3
4.	CH1713	Distillation	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE IV, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1714	Piping and Instrumentation	PEC	3	3	0	0	3
2.	CH1715	Food Technology	PEC	3	3	0	0	3
3.	CH1716	Biochemical Engineering	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE V, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1808	Optimization of Chemical Processes	PEC	3	3	0	0	3
2.	CH1809	Fermentation Engineering	PEC	3	3	0	0	3
3.	CH1810	Nuclear Engineering	PEC	3	3	0	0	3
4.	CH1811	Energy Technology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE VI, SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1812	Fertilizer Technology	PEC	3	3	0	0	3
2.	CH1813	Pulp and Paper Technology	PEC	3	3	0	0	3
3.	CH1814	Mixing Theory and Practice	PEC	3	3	0	0	3
4.	CH1815	Petroleum Refining and Petrochemicals	PEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE I, SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE103	Environmental Impact Assessments	OEC	3	3	0	0	3
2.	OCS101	Introduction to C Programming	OEC	3	3	0	0	3
3.	OEE105	Solar Energy Utilization	OEC	3	3	0	0	3
4.	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
5.	OBT102	Hazardous Waste Management	OEC	3	3	0	0	3
6.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3

LIST OF COURSES FOR OPEN ELECTIVE II, SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBT103	Fuel Cell Chemistry	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OME102	Design of Experiments	OEC	3	3	0	0	3
4.	OBT104	Biosensors	OEC	3	3	0	0	3
5.	OME106	Testing of Materials	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3

AUDIT COURSE

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

SUBJECT AREAWISE DETAILS

HUMANITIES AND SOCIAL SCIENCES

(HSMC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCES (BSC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	GE112	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	CH1207	Technical Analysis Laboratory	BSC	4	0	0	4	2
8.	MA1353	Applied numerical analysis	BSC	4	4	0	0	4
9.	MA1452	Applied probability and statistics	BSC	4	4	0	0	4
10.	CH1401	Chemistry for chemical Engineers	BSC	3	3	0	0	3
11.	CH1405	Instrumental Methods Of Chemical Analysis	BSC	3	3	0	0	3

ENGINEERING SCIENCES (ESC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1101	Python Programming	ESC	4	3	1	0	3
2.	GE1102	Engineering Graphics	ESC	5	2	0	4	4
3.	GE213	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
5.	GE1207	Engineering Practices	ESC	4	0	0	4	2
6.	EE1353	Principles of electrical and electronics engineering	ESC	3	3	0	0	3
7.	CH1303	Solid Mechanics for technologists	ESC	3	3	0	0	3
8.	EE1358	Electrical Engineering Laboratory	ESC	3	0	0	3	2

PROFESSIONAL CORE (PCC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CH1201	Introduction to Chemical Engineering	PCC	3	3	0	0	2
2.	CH1301	Process Calculations	PCC	4	3	1	0	4
3.	CH1302	Fluid Mechanics for chemical Engineers	PCC	3	2	1	0	3
4.	CH1307	Fluid Mechanics Laboratory	PCC	3	0	0	3	2
5.	CH1402	Computer applications in Chemical Engineering (Integrated Lab)	PCC	5	3	0	2	4
6.	CH1403	Mechanical operations	PCC	3	3	0	0	3
7.	CH1404	Chemical Process Industries	PCC	3	3	0	0	3
8.	CH1407	Mechanical operations Laboratory	PCC	3	0	0	3	2
9.	CH1501	Chemical Reaction Engineering I	PCC	3	2	1	0	3
10.	CH1502	Heat Transfer	PCC	3	2	1	0	3
11.	CH1503	Mass Transfer I	PCC	3	2	1	0	3
12.	CH1507	Heat and mass Transfer Laboratory	PCC	3	0	0	3	2
13.	CH1508	Computational Programming Laboratory for Chemical Engineers	PCC	3	0	0	3	2
14.	CH1601	Chemical Reaction Engineering II	PCC	4	3	1	0	4
15.	CH1602	Mass Transfer II (Integrated Laboratory)	PCC	4	2	1	2	4
16.	CH1603	Chemical Engineering Thermodynamics	PCC	3	2	1	0	3
17.	CH1604	Process Dynamics and Control	PCC	3	2	1	0	3
18.	CH1605	Process Economics and Industrial Management	PCC	3	3	0	0	3
19.	CH1607	Professional Ethical Practice	PCC	2	0	0	2	1
20.	CH1608	Chemical Reaction Engineering Laboratory	PCC	3	0	0	3	2
21.	CH1701	Transport Phenomena	PCC	3	2	1	0	3
22.	CH1702	Chemical Process Equipment Design (Integrated Lab)	PCC	5	2	1	2	4
23.	CH1703	Safety & Hazard Analysis	PCC	3	3	0	0	3
24.	CH1707	Mini Project	PCC	3	0	0	3	2
25.	CH1708	Process Control Laboratory	PCC	3	0	0	3	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1410	Professional Skills Laboratory	**EEC**	2	0	0	3	1
2.	CH1709	Internship	**EEC**	0	0	0	0	1
3.	CH1807	Project Work	**EEC**	20	0	0	20	12

SUMMARY

S. No.	Subject Area	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	7	-	-	-	-	-	-	11
2	BSC	12	9	4	10	-	-	-	-	35
3	ESC	9	5	8	-	-	-	-	-	22
4	PCC	-	2	9	12	13	20	14	-	70
5	PEC	-	-	-	-	3	3	6	6	18
6	OEC	-	-	-	-	3	-	3	-	6
7	EEC	-	-	-	1	-	-	1	12	14
8	AC	-	-	-	-	-	-	-	-	-
Total		25	23	21	23	19	23	24	18	176

Signature of HOD

Signature of Principal

Signature of Dean of Academics

SEMESTER I

HS1101	Communicative English	L	T	P	C
		3	0	0	3

Objectives

- ✓ To develop the basic reading and writing skills of first year engineering and technology students
- ✓ To help learners develop their listening skills, which will, enable them listen to lectures andcomprehend them by asking questions; seeking clarifications.
- ✓ To help learners develop their speaking skills and speak fluently in real contexts.
- ✓ To help learners develop vocabulary of a general kind by developing their reading skills

Course Outcomes (CO)

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

UNIT - I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9

Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking-basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- WH- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.

UNIT - II	GENERAL READING AND FREE WRITING	9

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types - Writing – paragraph writing - topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking — describing a simple process —asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context –use of sequence words.

UNIT - III	GRAMMAR AND LANGUAGE DEVELOPMENT	9

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing —types of paragraph and writing essays — rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays -asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development– idioms and phrases- cause & effect expressions, adverbs.

UNIT - IV	READING AND LANGUAGE DEVELOPMENT	9
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals — if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		

UNIT - V	EXTENDED WRITING	9
Reading: Reading for comparisons and contrast and other deeper levels of meaning – Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening- popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary Development-Phrasal verbs- fixed and semi-fixed expressions		
	Total Periods:	**45 PERIODS**

Text Books:

1. Board of Editors. Using English, A Course book for Undergraduate Engineers and Technologists. Orient Black SwanLimited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

Reference Books:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning, USA: 2007
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student 's Book& Workbook) CambridgeUniversity Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	0	0	3	0	0	3	0	0	3	0	0	3	1	2
CO2	0	0	0	0	0	0	0	0	0	0	0	0	1	2
CO3	3	0	1	3	0	1	3	0	1	3	0	1	1	2
CO4	1	0	2	1	0	2	1	0	2	1	0	2	1	2
CO5	1	0	1	1	0	1	1	0	1	1	0	1	1	2

MA1102	Engineering Mathematics – I	L	T	P	C
		3	1	0	4

Objectives

- ✓ The goal of this course is to achieve conceptual understanding and to retain the best traditions oftraditional calculus.
- ✓ The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling theengineering problems mathematically and obtaining solutions.
- ✓ Matrix Algebra is one of the powerful tools to handle practical problems arising in the field ofengineering.
- ✓ This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

Course Outcomes (CO)

CO1	To have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	To understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	To have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	To understand the concept of integration through fundamental theorem of calculus. Also, acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	To do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

UNIT - I	**MATRICES**	**12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors– Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form byorthogonal transformation – Nature of quadratic forms

UNIT - II	**CALCULUS OF ONE VARIABLE**	**12**

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasingfunctions – Maxima and Minima - Intervals of concavity and convexity.

UNIT - III	**CALCULUS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables –Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables –Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.

UNIT - IV	**INTEGRAL CALCULUS**	**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT - V	**MULTIPLE INTEGRALS**	**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals- Triple integrals – Volume of solids

Total Periods:	**60 PERIODS**

Text Books:
1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014. 2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I &III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2
Reference Books:
1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016. 2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition,2007. 3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd.,Chennai, 2007. 4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015. 5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	1	2	3	0	0	3	2	3	3	2	2
CO2	3	3	3	2	2	1	0	0	0	0	1	2	2	1
CO3	3	3	3	2	2	1	0	0	0	0	1	2	2	2
CO4	3	3	3	2	2	1	0	0	0	0	1	2	2	2
CO5	3	3	3	2	1	1	0	0	0	0	1	2	2	2

PH1103	**Engineering Physics**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To make the students conversant with

- ✓ Elastic properties of materials and various moduli of elasticity.
- ✓ Principles of laser and fiber optics and its various technological applications.
- ✓ Thermal conduction in solids, heat exchangers and its applications in various devices.
- ✓ Quantum concepts to explain black body radiation, Compton effect and matter waves.
- ✓ Various crystal structures, Miller indices and crystal growth techniques.

Course Outcomes (CO)

CO1	To understand the elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young's modulus by various methods.
CO2	To understand the principle of laser, Einstein's coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.
CO3	To understand the heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee's disc method and radial flow of heat.
CO4	To know the quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunneling electron microscopy and its applications.
CO5	To understand the importance of various crystal structures, Miller indices and various growth techniques.

UNIT - I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity- I shaped girders - stress due to bending in beams.		
UNIT - II	**LASER AND FIBER OPTICS**	**9**
Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – ND-YAG Laser-Semiconductor lasers: homo junction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber- Double crucible method-fiber optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.		
UNIT - III	**THERMAL PHYSICS**	**9**
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat-conduction through compound media (series and parallel)- Lee's disc method: theory and experiment - Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		
UNIT - IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunneling (qualitative) - scanning tunneling microscope-Applications of electron microscopy.		
UNIT - V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices,directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC,BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burgervectors, stacking faults – growth of single crystals: solution and melt growth techniques- Epitaxial growth-Applications of Single crystal (Qualitative).		
	Total Periods:	**45 PERIODS**

Text Books:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2013.

Reference Books:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2014.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3

CY1104	Engineering Chemistry	L	T	P	C
		3	0	0	3

Objectives

To make the student conversant with the

- ✓ Principles of water characterization and treatment for industrial purposes.
- ✓ Principles and applications of surface chemistry and catalysis.
- ✓ Phase rule and various types of alloys
- ✓ Various types of fuels, applications and combustion
- ✓ Conventional and non–conventional energy sources and energy storage device

Course Outcomes (CO)

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses ofalloys, phase rule, reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

UNIT - I | WATER AND ITS TREATMENT | 9

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.

UNIT - II | SURFACE CHEMISTRY AND CATALYSIS | 9

Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC.

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT -III | PHASE RULE AND ALLOYS | 9

Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process.

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.

UNIT -IV | FUELS AND COMBUSTION | 9

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate) – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) –Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking –Octane number– Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcoholand biodiesel.

Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculationof calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.

UNIT -V	NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES	9

Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell.

Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries

Total Periods: 45 PERIODS

Text Books:

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd., Chennai, (2009).

Reference Books:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media, New Delhi., (2010).
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	2
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2

GE1109	**Problem Solving and Programming in C (Common for all branches of B.E. /B. Tech Programmes)**	L	T	P	C
		3	0	0	3

Objectives

- ✓ To know the problem solving and develop C Program using basic programming constructs.
- ✓ To develop C programs using decision control and looping statements, functions and arrays.
- ✓ To use python predefined data structures
- ✓ To develop applications in C using structures and union.
- ✓ To develop applications using sequential and random-access file processing.

Course Outcomes (CO)

CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C using structures and union.
CO5	Design applications using sequential and random-access file processing.

UNIT - I	**PROBLEM SOLVING AND BASICS OF C PROGRAMMING**	**9**
A Introduction, Algorithms, building blocks of algorithms, Algorithmic problem-solving steps; Simple Strategies and notation for developing algorithms: Control flow, Flow charts, Pseudo codes, Programming languages; Introduction to C; Structure of a C Program; Compiling and Executing C Programmes, C Tokens and character set, Keywords, Identifiers, Basic Data types, Variables, Constants, Input/ Output statements, Operators, Type conversion and Type Casting.		
UNIT – II	**DECISION CONTROL, LOOPING STATEMENTS, FUNCTIONS, AND ARRAYS**	**9**
Conditional Branching statements, Iterative statements, Nested loops, The Break and continue statements, go to statements; Introduction to Functions: Function declaration, Function definition, Function call, return statement, passing parameters to the function, Recursive Functions; Introduction to Arrays: Declaration, Accessing the Elements, storing values, operations on arrays, Passing Arrays to functions, two-dimensional array, Multidimensional arrays.		
UNIT - III	**STRINGS AND POINTERS**	**9**
String: Introduction to String, Suppressing Input, String Taxonomy, String operation; Pointers: Introduction to Pointers, declaring pointers variables, Pointer expression and Pointer arithmetic, passing arguments to Function using Pointers, Pointers and Arrays, Array of pointers; Function Pointers, Pointers to Pointers, memory allocation in C Programs, Dynamic memory allocation; Drawbacks of pointers.		
UNIT - IV	**STRUCTURES, UNIONS AND ENUMERATED DATA TYPE**	**9**
Structure: declaration and initialization, accessing members of structure; Nested structures; Array of structures; Structures and functions; Self-referential structures; Union: declaration and initialization, Accessing members of Union; Array of Union variable; Unions inside Structures, Structures inside unions, Enumerated Data type.		
UNIT - V	**FILE PROCESSING**	**9**
Introduction to files, using files in C, read data from files, Writing Data to files, Detecting the End of file, Error Handling during file operations; Accepting Command line arguments, Function for selecting a record randomly, Remove and renaming the File, Creating temporary file, Preprocessor directives.		
	Total Periods:	**45 PERIODS**
Text Books:		
1. Reema Thareja, Programming in C, Oxford University Press, Third Edition, 2023. 2. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill, 2017. 3. Kernighan, B.W and Ritchie, D.M, The C Programming language, Second Edition, Pearson Education, 2015.		
Reference Books:		
1. Paul Deitel and Harvey Deitel, How to Program, Ninth edition, Pearson Publication 2. Dhabal Prasad Sethi and Manoranjan, Concepts and Techniques of Programming In C, Wiley India,2020. 3. Mamta Bhusry, C Concepts & Programming, Wiley India, 2019 4. Dr. Rupinder Singh, Inderpreet Kaur, and Davinder Kaur, C programming Beginners guide, Notion Press, 2020. 5. M.T. Somashekara, D. S. Guru and K. S. Manjunatha, Problem Solving with C, PHI Learning,2018.		

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	2	-	-	2	2	2	-	2	1	1
CO2	3	3	3	3	2	-	-	2	2	2	-	2	1	1
CO3	3	3	3	3	2	-	-	2	2	2	-	2	1	1
CO4	3	3	3	3	2	-	-	2	2	2	-	2	1	1
CO5	3	3	3	3	2	-	-	2	2	2	-	2	1	1

GE1106	**Engineering Graphics** (Common for all branches of B.E. /B. Tech Programmes)	**L**	**T**	**P**	**C**
		2	0	4	4

Objectives

- ✓ To develop graphic skills for communication of concepts, ideas and design of engineering products.
- ✓ To inculcate drawing practice in standardized form whenever technical drawing is needed.
- ✓ To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

- ✓ Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions andspecifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

Course Outcomes (CO)

CO1	To understand the fundamentals and standards of Engineering graphics
CO2	To perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	To understand the concept of orthographic projections of lines and plane surfaces
CO4	To draw the projections of section of solids and development of surfaces
CO5	To visualize and to project isometric and perspective sections of simple solids

UNIT - I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloidal curves – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects– Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)

UNIT - II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**

Orthographic projection- Principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III	PROJECTION OF SOLIDS	5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to oneof the principal planes when the solid is simply suspended by rotating object method.		
UNIT - IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENTOFSURFACES**	**5+12**
Sectioning of simple solids like prisms, pyramids, cylinder, cone in simple vertical position when the cutting plane isinclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points.		
UNIT - V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections and isometric views of simple solids andtruncated solids – Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		
	Total Periods:	**90 PERIODS**

Text Books:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty ninth edition 2017
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.
3. S. Ramachandran and K. Pandian, "Engineering Graphics" Airwalk Publications; 8th edition 2014

Reference Books:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	2	1	1	-	-	3	3	2	3	1	-
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	-
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	-
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	-
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	-

GE1110	**Programming in C Laboratory** (Common for all branches of B.E. /B. Tech Programmes)	**L**	**T**	**P**	**C**
		0	0	4	2

Objectives

- ✓ To develop programs in C using basic constructs.
- ✓ To develop applications in C using strings, pointers, functions, structures.
- ✓ To develop applications in C using file processing.

Course Outcomes (CO)

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving Arrays.
CO3	Develop C programs for string, functions, and recursion.
CO4	Develop C Programs for pointers, structures and Union.
CO5	Design applications using sequential and random-access file processing.

1. C programming using simple statements and expressions.
2. Scientific problem-solving using decision making and looping.
3. Generating different patterns using multiple control statements.
4. Problems solving using one dimensional array.
5. Mathematical problem solving using two dimensional arrays.
6. Solving problems using string functions.
7. Solving problems with user defined functions.
8. Solving problems using recursive function.
9. Solving problems with dynamic memory allocation.
10. Real-time application using structures and unions.
11. Real time problem solving using sequential and random-access
12. Solving problems with command line argument.

Total Periods: **60 PERIODS**

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	1
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	1
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	1
CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	1
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	1

Reference Books:

1. Problem Solving and Program Design in C, 4th edition, by Jeri R. Hanly and Elli B.Koffman..
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
6. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

BS1108	Physics and Chemistry laboratory	L	T	P	C
		0	0	4	2

Objectives

The students will be trained to perform experiments to study the following.

- ✓ The Properties of Matter
- ✓ The Optical properties, Characteristics of Lasers & Optical Fibre
- ✓ Electrical & Thermal properties of Materials
- ✓ Enable the students to enhance accuracy in experimental measurements.
- ✓ To make the student to acquire practical skills in the determination of water quality parametersthrough volumetric analysis
- ✓ Instrumental method of analysis such as potentiometry, conductometry and pH metry

Course Outcomes (CO)

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the procedure to estimate the amount of dissolved oxygen present in the water.
CO2	Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometergrating. Able to understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.
CO3	Able to understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor. Able to understand the principle and procedure involved in the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of microscope and its applications in determining the moduli. Able to understand the concept of determining the emf values by using potentiometer.
CO5	Able to calculate the particle size of poly crystalline solids. Able to understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

Total Periods:	**60 PERIODS**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

- ✓ Python 3 interpreter for Windows/Linux

LIST OF EXPERIMENTS – PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of wavelength of mercury spectra using Spectrometer and grating.
4. Determination of dispersive power of prism using Spectrometer.
5. (a) Determination of wavelength and particle size using a laser.
   (b) Determination of numerical aperture and acceptance angle of an optical fibre.
   (c) Determination of width of the groove of compact disc using laser.
6. Determination of Young's modulus of the material of the given beam by uniform bending method.
7. Determination of energy band gap of the semiconductor.
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Estimation of HCl using Na2CO3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Conductometric titration of strong acid vs strong base.

DEMONSTRATION EXPERIMENTS

Estimation of iron content of the water sample using spectrophotometer (1, 10- Phenanthroline / thiocyanatemethod).
Estimation of sodium and potassium present in water using flame photometer.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1

SEMESTER II

HS1201	Professional English	L	T	P	C
		3	0	0	3

Objectives

The Course prepares second semester engineering and Technology students to:

- ✓ Develop strategies and skills to enhance their ability to read and comprehendEngineering and technology texts.
- ✓ Foster their ability to write convincing job applications and effective reports.
- ✓ Develop their speaking skills to make technical presentations, participate in group discussions.
- ✓ Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

Course Outcomes (CO)		
CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.	
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.	
CO3	Read different genres of texts adopting various reading strategies.	
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents	
CO5	Identify topics and formulate questions for productive inquiry	
UNIT - I	**INTRODUCTION TO PROFESSIONAL ENGLISH**	**9**
Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists- recommendations- Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.		
UNIT - II	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		
UNIT - III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing- Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal Substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		
UNIT - IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing Opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation (via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		
UNIT - V	**GROUP DISCUSSION AND JOBAPPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences – Vocabulary Development- verbal analogies. Language Development- reported speech.		
	Total Periods:	**45 PERIODS**

Text Books:

1. Board of editors. Fluency in English a Course book for Engineering and Technology. Orient Blackswan, Hyderabad:2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press: 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi,2016

Reference Books:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford UniversityPress: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	0	0	3	0	0	3	0	0	3	0	0	3	1	2
CO2	0	0	0	0	0	0	0	0	0	0	0	0	1	2
CO3	3	0	1	3	0	1	3	0	1	3	0	1	1	2
CO4	1	0	2	1	0	2	1	0	2	1	0	2	1	2
CO5	1	0	1	1	0	1	1	0	1	1	0	1	1	2

MA1202	**Engineering Mathematics – II** (Common to branches of B.E / B. Tech Programmes except AI&DS andAI&ML)	**L**	**T**	**P**	**C**
		3	1	0	4

Objectives

- ✓ This course is designed to cover topics such as Differential Equations, Vector Calculus, ComplexAnalysis and Laplace Transform.
- ✓ The various methods of complex analysis and Laplace transforms can be used for efficiently
- ✓ solving the problems that occur in various branches of engineering disciplines.

Course Outcomes (CO)

CO1	The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems
CO2	The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.
CO3	The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction,elasticity, fluid dynamics and flow of electric current .
CO4	The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.
CO5	Students will understand the purpose of using transforms to create new domain in which can give easier ways to handle the problem that is being investigated.

UNIT - I	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler 's and Legendre 's type – System of simultaneous first order linear differential equations with constant coefficients

UNIT - II	VECTOR CALCUCUS	12
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green 's, Gauss divergence and Stoke's theorems – Verification and simple application in evaluating line, surface and volume integrals.		
UNIT - III	**COMPLEX VARIABLES**	**12**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-Requations) - Properties – Harmonic conjugates – Construction of analytic function (Milne-Thomson method) –Conformal mapping – Standard transformations W = Z +C, CZ, 1/Z - Bilinear transformation.		
UNIT - IV	**COMPLEX INTEGRATION**	**12**
Cauchy integral theorem – Cauchy integral formula – Taylor and Laurent series – Singularities – Residues – Cauchy'sResidue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour(excluding poles on the real line).		
UNIT - V	**LAPLACE TRANSFORMS**	**12**
Existence conditions — Transforms of elementary functions — Transform of unit step function and unit impulse function - Basic properties - Shifting theorems – transforms of derivatives and integrals –Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem — Application to solution of linear second order ordinary differential equations with constant coefficients.		
	Total Periods:	**60 PERIODS**

Text Books:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44th Edition, 2018.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

Reference Books:

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of LakshmiPublications Pvt., Ltd.,), New Delhi, 7th Edition, 2017.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition,2007.
3. O 'Neil, P.V. Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics – II, McGraw Hill Education; First edition 2017.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	2	1	0	0	0	0	1	2	1	1
CO2	3	3	3	1	1	1	0	0	0	0	2	1	2	2
CO3	3	3	3	2	1	1	0	1	0	0	1	1	1	2
CO4	3	3	3	1	0	0	0	0	0	0	1	0	2	1
CO5	3	3	3	1	0	0	0	0	0	0	1	0	1	2

PH1255	**Physics of Materials** (Common to BIO & CHEM)	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To make the student conversant with the

- ✓ Electronic properties in metals, properties of superconductors and its applications.
- ✓ Intrinsic and extrinsic semiconductors, Hall effect, LED, organic LED and solar cells.
- ✓ Types of magnetic materials and their applications, types of polarization and application
- ✓ Types, synthesis, properties and applications of nanostructured materials.
- ✓ Importance of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

Course Outcomes (CO)

CO1	Have the knowledge about carrier density calculation in metals, properties of superconductors and its applications.
CO2	Have the knowledge about carrier density calculation in intrinsic and extrinsic semiconductors, Halleffect, LED, OLED and solar cells.
CO3	Obtain the knowledge about magnetic and dielectric materials and their applications.
CO4	Explore the knowledge about types, synthesis, properties and applications of nanostructured materials.
CO5	Understand the importance, properties and applications of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

UNIT - I **CONDUCTING AND SUPERCONDUCTING MATERIALS** **9**

Classical free electron theory – expression for electrical conductivity – thermal conductivity, Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box (Qualitative) – degenerate states – Fermi-Dirac statistics– density of energy states – electron in periodic potential (concept only) – electron effective mass – concept of hole – Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type Iand Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT - II **SEMICONDUCTING MATERIALS** **9**

Elemental Semiconductors – Compound semiconductors – Origin of band gap in solids (qualitative) – carrierconcentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature– electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors(derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination ofHall coefficient –LED – Organic LED-Solar cells.

UNIT - III **DIELECTRIC AND MAGNETIC MATERIALS** **9**

Dielectric materials – Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation –Frequency and temperature variation of dielectric materials- dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites - magnetoresistance - Giant magneto-resistance - Introduction to spintronics.

UNIT - IV **NANO MATERIALS** **9**

Nanoscience and technology – Surface to volume ratio – Classifications of nanostructured materials – nano particles – quantum dots, nanowires, ultra-thin films-multilayered materials.Bottom-up Synthesis –Top-down Approach: Co-Precipitation, Ultrasonication, ball Milling, sol- gel method-Properties: electrical, magnetic, catalytic and antimicrobial resistance – Applications of nanomaterials in agriculture and medicine.

UNIT - V **NEW MATERIALS AND APPLICATIONS** **9**

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene, graphene oxide and its properties – Ceramics: types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone – Sensors: Chemical Sensors - Bio-sensors – conducting and semiconducting polymers – Nanofluids-Electro and magneto rheological fluids.

	Total Periods:	45 PERIODS

Text Books:

1. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. “Principles of Electronic Materials and Devices”. McGraw-Hill Education, 2017.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

Reference Books:

1. Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010
2. Raghavan, V. “Materials Science and Engineering: A First course”. PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. “Materials Science and Engineering”. Tata McGraw Hill Education Pvt. Ltd.,2014.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	1	1	1	1	1	1	1	1	1	2	1
CO2	3	3	2	2	1	1	1	1	1	1	1	2	2	1
CO3	3	3	2	3	2	1	1	1	1	1	1	3	3	1
CO4	3	3	3	3	2	3	3	1	2	1	2	3	3	2
CO5	3	3	3	3	2	3	2	1	2	1	2	3	3	2

GE1204	Environmental Science and Engineering	L	T	P	C
		3	0	0	3

Objectives

- ✓ To study the inter relationship between living organisms and environment.
- ✓ To appreciate the importance of environment by assessing its impact on the human world; envision thesurrounding environment, its functions and its value.
- ✓ To find and implement scientific, technological, economic and political solutions to environmentalproblems.
- ✓ To study the integrated themes and biodiversity, natural resources, pollution control and wastemanagement.
- ✓ To study the dynamic processes and understand the features of the earth’s interior and surface.

Course Outcomes (CO)

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to the environmental problems.
CO5	To understand the impact of environment on human population and human health.

UNIT - I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	11
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids –Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels –India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.		
UNIT - II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone,tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		
UNIT - III	**NATURAL RESOURCES**	**9**
Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as aresource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local areato document environmental assets – River / Forest / Grassland / Hill / Mountain.		
UNIT - IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**8**
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		
UNIT - V	**HUMAN POPULATION AND THE ENVIRONMENT**	**8**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV /AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies		
	Total Periods:	**45 PERIODS**
Text Books:		
1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014). 2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004). 3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).		

Reference Books:
1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007). 2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hyderabad, (2015). 3. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd, Delhi,(2014). 4. R. Rajagopalan, 'Environmental Studies - From Crisis to Cure', Oxford University Press, (2005). 5. Anubha Kaushik, C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd,New Delhi, (2004). 6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2

GE1205	**Basic Civil and Mechanical Engineering** (Common to Bio Tech, CHEMICAL, EEE, EIE)	**L**	**T**	**P**	**C**
		3	0	0	3
Objectives					
✓ The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System					
Course Outcomes (CO)					
CO1	To impart basic knowledge on Civil and Mechanical Engineering.				
CO2	To familiarize the materials and measurements used in Civil Engineering.				
CO3	To provide the exposure on the fundamental elements of civil engineering structures.				
CO4	To enable the students to distinguish the components and working principle of power plant, IC engines				
CO5	To provide the exposure on the fundamental elements of R & AC system.				
UNIT - I	**SCOPE OF CIVIL AND MECHANICAL ENGINEERING**				**6**
Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society – Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.					
UNIT - II	**SURVEYING AND CIVIL ENGINEERING MATERIALS**				**9**
Surveying: Objects – classification – principles – measurements of distances – angles –leveling – determinationof areas– contours - examples. Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel – timber - modern materials					

UNIT - III	BUILDING COMPONENTS AND STRUCTURES	12
Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.		
UNIT - IV	**INTERNAL COMBUSTION ENGINES AND POWER PLANTS**	**12**
Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petroland Diesel Engines — Four stroke and two stroke cycles — Comparison of four stroke and two stroke engines —Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps		
UNIT - V	**REFRIGERATION AND AIR CONDITIONING SYSTEM**	**6**
Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.		
	Total Periods:	**45 PERIODS**

Text Books:

1. Shanmugam G and Palanichamy MS,“Basic Civil and Mechanical Engineering”, Tata McGraw Hill PublishingCo.,NewDelhi,1996.

Reference Books:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S., “BasicCivil Engineering”, AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,2000.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	3	3	3	-	3	2	2	3	2	2
CO2	3	2	3	3	3	3	2	-	2	1	1	3	3	2
CO3	3	2	3	3	2	3	2	-	3	2	1	3	3	2
CO4	3	2	3	2	2	3	2	-	3	2	2	3	3	2
CO5	3	2	3	2	2	3	2	-	2	2	1	3	2	2

CH1206	INTRODUCTION TO CHEMICAL ENGINEERING	L	T	P	C
		3	0	0	2

Objectives

- ✓ To understand the overview of Chemical Engineering
- ✓ To gain knowledge on role of basic sciences in Chemical Engineering
- ✓ To know about the various unit operations and unit process in Chemical Engineering
- ✓ To understand the importance of computer applications in Chemical Engineering
- ✓ To know about the future and various opportunities for Chemical Engineers

Course Outcomes (CO)

CO1	To Learn about basics of chemical Engineering
CO2	To Understand the concept of components of Chemical Engineering

CO3	To learn about the Unit Operation and Unit Processes of Chemical Engineering
CO4	To Understand the role of various disciplines in Chemical Engineering
CO5	To learn about paradigm shifts, Opportunities in Chemical Engineering.

UNIT - I	**INTRODUCTION**	**5**
Historical overview of Chemical Engineering – Chemistry and Chemical Engineering - Chemical process industries– Chemical Engineering in everyday life - Recent developments in Chemical Engineering		
UNIT - II	**ROLE OF BASIC SCIENCES IN CHEMICAL ENGINEERING**	**5**
Units and dimensions - Role of physics, chemistry, biology, mathematics in Chemical Engineering – Concepts offluid flow- Velocity and stress field - Newtonian and non-Newtonian fluids - Scope of thermodynamics; laws of thermodynamics – Chemical Kinetics- Rate equation, elementary, non-elementary reactions, order and molecularity		
UNIT - III	**REPRESENTATION OF UNIT OPERATIONS & FLOWSHEETING**	**5**
Description and representation of different Unit Processes and Unit Operations; Heat and mass transfer operation; Modes of heat transfer - Fourier's law of heat conduction; Fick's Law; Designing of equipment; Flow sheet representation of process plants, Evolution of an Industry		
UNIT - IV	**ROLE OF SOFTWARES & OTHER DISCIPLINES IN CHEMICAL ENGINEERING**	**10**
Role of Computers simulations (MATLAB, ASPEN PLUS, ASPEN HYSYS, ANSYS FLUENT) and their Applications; Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical –Introduction to Process control		
UNIT - V	**FUTURE & RECENT ADVANCES IN CHEMICAL ENGINEERING**	**5**
Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers – Process Intensification, Biomass conversions		
	Total Periods:	**30 PERIODS**

Text Books:

1. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", 7th Edition, Tata McGraw Hill, 2015.
2. Ghosal, S.K, Sanyal S.K. and Dutta.S, "Introduction to Chemical Engineering" TMH Publications, New Delhi, 2012.
3. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig,2nd Edition, Affiliated East-West press, 2016.
4. Randolph Norris Shreve, George T. Austin, "Shreve's Chemical Process Industries", 5th edition, McGrawHill, 2020

Reference Books:

1. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill, 7thEdition, 2015.
2. Finlayson, B. A., "Introduction to Chemical Engineering Computing", John Wiley & Sons, New Jersey,2012.
3. Pushpavanam, S, "Introduction to Chemical Engineering", PHI Learning Private Ltd, New Delhi, 2012
4. Bhatt B. I. and Vora, S. M, "Stoichiometry", 4th edition, McGraw Hill, 2014.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	1	1	2	1	1	1	2	1	2	1	1
CO2	3	3	3	3	3	3	2	1	1	1	2	3	2	2
CO3	3	3	3	3	3	3	2	1	2	2	2	3	2	3
CO4	3	3	3	3	3	3	2	1	2	1	2	3	2	3
CO5	3	3	3	3	3	3	2	1	2	2	2	3	2	3

GE1207	Engineering Practices Laboratory	L	T	P	C
		0	0	4	2
Objectives					
✓ To provide exposure to the students with hands on experience on various basic engineering practices inCivil, Mechanical, Electrical and Electronics Engineering					
Course Outcomes (CO)					
CO1	Able to fabricate carpentry components and pipe connections including plumbing works.				
CO2	Able to use welding equipment to join the structures, carry out the basic machining operations, and make the models using sheet metal works.				
CO3	Able to illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.				
CO4	Able to carry out basic home electrical works and appliances, measure the electrical quantities.				
CO5	Able to elaborate on the electronic components and gates, soldering practices.				
	Total Periods:	**60 PERIODS**			

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS
GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows inhousehold fittings.
b) Study of pipe connections requirements for pumps and turbines.
c) Preparation of plumbing line sketches for water supply and sewage works.
d) Hands-on-exercise:
   Basic pipe connections – Mixed pipe material connection – Pipe connections with different joiningcomponents.
e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise:
   Wood work, joints by sawing, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of electronic components and equipment – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR

Total periods:60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**

3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	**1 each**
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	3	-	-	3	2	-	1	1	-	3	2	2
CO2	3	2	3	-	-	3	1	-	2	1	-	3	2	2
CO3	3	1	2	-	-	2	2	-	1	1	-	3	2	2
CO4	3	2	3	3	1	3	1	1	1	1	2	3	1	2
CO5	3	2	3	3	1	2	1	1	1	1	2	3	1	2

CH1208	**Technical Analysis Laboratory**	**L**	**T**	**P**	**C**
		0	0	4	2

Objectives

- ✓ To make the student acquire practical skills in the wet chemical and instrumental methods forquantitative estimation of nitrite in water, cement, oil, coal and Pheno

Course Outcomes (CO)

CO1	Able to analyze oil, soap and bleaching powder
CO2	Able to analyze cement phenol and
CO3	Able to analyze fuel and fertilizer.
CO4	Able to analysis of water
CO5	Able to viscosity of sample

LIST OF EXPERIMENTS

1. Oil Analysis: (3 experiments)
   (a) Acid value
   (b) Saponification value
   (c) Iodine value
2. Soap Analysis: (2 experiments)
   (a) Alkali Content
   (b) Fatty acid content of Soap
3. Estimation of purity of glycerol: by Dichromatic method
4. Analysis of water:
5. Determination chlorine demand in water: Estimation of residual chlorine in water by Volumetric method
6. Cement Analysis (3 experiments)
7. Estimation of silica content
8. Estimation of calcium oxide content
9. Estimation of mixed oxide content
10. Fertilizer Analysis: Estimation of Nitrogen in Urea by Kjeldals method
11. Estimation of Phenol
12. Estimation of available chlorine present in bleaching powder
13. Estimation of viscosity of given sample of oil
14. Estimation of flash point, fire point, cloud point, pour point of fuel
15. Estimation of aniline point of fuel
16. Applications: Implementing GUI using turtle, pygame.

Total Periods:	**60 PERIODS**

Reference Books:

1. Vogel's Textbook of Quantitative Chemical Analysis, J Mendham & M Thomas, Pearson Publications, 2015.
2. Evironmental pollution analysis, S.M.Khopkar, New age international, 2011
3. Manual of environmental analysis, N.C Aery, Ane books, 2014

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	2	1	3	3	2	3	1	3	3	3	3
CO2	2	2	2	2	1	3	3	2	3	1	3	3	3	3
CO3	2	2	2	2	1	3	3	2	3	1	3	3	3	3

SEMESTER III

MA1353	APPLIED NUMERICAL ANALYSIS	L	T	P	C
		4	0	0	4

Objectives

- ✓ To introduce the basic concepts of solving algebraic and transcendental equations.
- ✓ To introduce the numerical techniques of interpolation in various intervals in real life
- ✓ To acquaint the student with understanding of numerical techniques of differentiation and integration this playsan important role in engineering and technology disciplines.
- ✓ To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
- ✓ To understand the knowledge of various techniques and methods of solving various types of partial differentialequations

Course Outcomes (CO)	
CO1	Do curve fitting , solve algebraic , transcendental equation and system of linear equations
CO2	Interpolate using standard methods like finite difference methods and cubic splines
CO3	Apply Numerical differentiation and integration for the observed data
CO4	Have an insight of finding the numerical solution of first order differential equation by Standardsingle step methods and multi-step methods.
CO5	Understand the finite difference solution of second order ordinary differential equation and getthe solution of the standard engineering partial differential equation by explicit method and implicit method

UNIT - I	**CURVE FITTING AND SOLUTION OF EQUATIONS**	**12**

Introduction – Method of least square -Curve fitting - Fitting a straight line and parabola -Calculation of sum of the squares of residuals. Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method– Iterative method - Gauss Seidel, method

UNIT - II	**INTERPOLATION AND APPROXIMATION**	**12**

Interpolation with unequal intervals - Lagrange's interpolation – Newton’s divided difference interpolation – CubicSplines - Difference operators and relations - Interpolation with equal intervals - Newton’s forward and backward difference formulae.

UNIT - III	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**12**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson’s 1/3 rule and 3/8 rule – Romberg’s Method - Two point and three point Gaussian quadrature formulae – Evaluation ofdouble integrals by Trapezoidal and Simpson’s 1/3 rules.

UNIT - IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Single step methods - Taylor’s series method - Euler’s method - Modified Euler’s method–Fourth order Runge – Kuttamethod for solving first order equations -Multistep Methods-Milne’s and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT - V	BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIALDIFFERENTIAL EQUATIONS	12

Finite difference methods for solving second order two - point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain–One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Total Periods: 60 PERIODS

Text Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 10th Edition, Cengage Learning, 2017.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition,New Delhi,2015.

Reference Books:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia,New Delhi,2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia,7th Edition, New Delhi,2007.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall,1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 4th Edition, New Delhi,2018.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	3	3	2	2	1	0	0	0	0	0	2	2	2
CO2	3	2	3	1	2	1	0	0	0	0	1	2	2	1
CO3	3	2	2	1	2	1	0	0	0	0	1	2	2	2
CO4	3	3	3	2	2	1	0	0	0	0	0	2	1	2
CO5	3	3	2	1	2	1	0	0	0	0	0	2	2	1

CH1301	Process Calculations	L	T	P	C
		3	1	0	4

Objectives

- ✓ To acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations for single and network of units and introduce to process simulators.

Course Outcomes (CO)

CO1	To familiarize the student's basic concepts of units, dimensions, and other technical terms, and enable them to do unit conversions.
CO2	To introduce the concepts of material balances by taking industrial examples and train in mathematical computations with respect to bypass, purging and recycle operations
CO3	To introduce the concept of ideal and non-ideal systems and related problems and training the students with combustion problems.
CO4	Effectively bring in the concept of energy balances and computations in various types of energy balance problems related to chemical industries.
CO5	To bring in the latest advancements in design and modelling, related process simulators and problems on non-ideal systems.

UNIT - I — **12**

Base and derived Units - Composition of Mixture and solutions - calculations of pressure, volume and temperature using ideal gas law. Use of partial pressure and pure component volume in gas calculations, applications of real gasrelationship in gas calculation.

UNIT - II — **12**

Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying etc., - Material balance with chemical reaction - Limiting and excess reactants - recycle – bypass and purging - Unsteady state material balances.

UNIT - III — **12**

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT - IV — **12**

Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involvingsensible heat and latent heats, evaluation of enthalpy. Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems with and without chemical reaction - Unsteady state energy balances

UNIT - V — **12**

Determination of Composition by Orsat analysis of products of combustion of solid, liquid and gas fuels - Calculationof excess air from orsat technique, problems on sulphur and sulphur burning compounds - Application of Process simulators in energy and material balance problems.

Total Periods: 60 PERIODS

Text Books:

1. Bhatt, B.L., Vora, S.M., "Stoichiometry ", 4th Edition, Tata McGraw-Hill (2004)
2. Himmelblau, D.M., "Basic Principles and Calculations in Chemical Engineering", EEE Sixth Edition, Prentice Hall Inc., 2003
3. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes",3rdEdn., John Wiley & Sons, New York, 2000.

Reference Books:

1. Hougen O A, Watson K M and Ragatz R A, "Chemical process principles" Part I, CBS publishers (1973).

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1	0	1	2	1	1	1	2	2	1
CO2	2	3	3	2	1	0	1	2	1	1	1	2	3	2
CO3	3	3	3	2	1	0	1	1	2	1	1	2	3	2
CO4	3	3	3	3	1	0	1	1	2	1	1	2	3	3
CO5	3	3	3	3	3	0	3	1	2	1	1	2	3	3

CH1302	**Fluid Mechanics for Chemical Engineers**	**L**	**T**	**P**	**C**
		2	1	0	3

Objectives

- ✓ To acquire a sound knowledge on fluid properties, fluid statics, dynamic characteristics of fluid flow for through pipes and porous medium, flow measurement and fluid machineries

Course Outcomes (CO)

CO1	To gain engineering knowledge on types of fluids based on Newton's law of viscosity.
CO2	To educate the students about hydrostatic pressure distribution, manometry and law of conservation of mass.
CO3	To score engineering knowledge on analyzing the system using dimensional analysis and scale-up.
CO4	To be conversant with types of fluid flow and pressure drop involved with it, major losses and minorlosses and flow through fluidized and packed beds.
CO5	Able to understand the Flow measurement techniques.

UNIT – I	**INTRODUCTION**	**9**

Methods of analysis and description - fluid as a continuum – Velocity and stress field -Newtonian and non-Newtonian fluids – Classification of fluid motion

UNIT – II	**FLUID STATICS**	**9**

Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application tomanometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

UNIT – III	DIMENSIONAL ANALYSIS	9
The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi-theorem - non-dimensional action of the basic equations - similitude – relationship between dimensional analysis and similitude – use of dimensional analysis for scale up studies.		
UNIT – IV	**FLOW THROUGH PIPES**	**9**
Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; Line sizing; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.		
UNIT - V	**FLOW MEASUREMENT**	**9**
Flow measurement - Constant and variable head meters; Velocity measurement techniques; Types, characteristics, and sizing of valves; Classification, performance characteristics and sizing of pumps, compressors, and fans		
	Total Periods:	**45**

Text Books:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers ", Second Edition, McGraw-Hill, (1991).
2. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGraw Hill, VII Edition, 2005
3. Munson, B. R., Young, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 5th Edition ", John Wiley, 2006

Reference Books:

1. White, F.M., "Fluid Mechanics ", IV Edition, McGraw-Hill Inc., 1999.
2. James O Wilkes and Stacy G Bike, "Fluid Mechanics for Chemical Engineers' Prentice Hall PTR (International series in Chemical Engineering) (1999)

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	3	0	0	0	0	1	1	1	1	2	2
CO2	2	2	2	3	0	0	0	0	1	1	1	1	2	3
CO3	2	2	2	3	1	0	0	0	1	1	2	1	2	3
CO4	2	2	2	3	2	0	1	0	1	1	1	1	3	3
CO5	2	2	2	3	1	1	1	1	1	1	1	1	2	3

EE1353	Principles of Electrical and Electronics Engineering	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge on

- ✓ Electric circuit laws, single and three phase circuits and wiring
- ✓ Working Principles of Electrical Machines
- ✓ Various Electronic Devices and Measuring Instruments

Course Outcomes (CO)

CO1	To explain the basic laws and theorems used in Electrical circuits
CO2	To impart knowledge on single phase and three phase AC circuit and wiring
CO3	To comprehend the construction and working principle of Electrical machines
CO4	To explain the fundamentals of semiconductor and applications.
CO5	To impart knowledge on different measuring instruments

UNIT – I	**ELECTRICAL CIRCUITS**	**9**

Basic principles involved in power generation, transmission and distribution, Basic circuit components - Ohms Law,Kirchoff's Law, steady state solution of DC circuits, Thevenin's Theorem, Norton's Theorem, Superposition Theorem, Maximum power transfer theorem.

UNIT – II	**AC CIRCUITS**	**9**

Introduction to AC circuits – waveforms and RMS value – power and power factor, single phase and three-phase balanced circuits, housing wiring, industrial wiring, materials of wiring.

UNIT – III	**ELECTRICAL MACHINES**	**9**

Construction, Principles of operation and characteristics of DC machines, Transformers (single and three phase),Synchronous machines, single phase and three phase induction motors.

UNIT – IV	**ELECTRONIC DEVICES AND CIRCUITS**	**9**

Types of Materials –Silicon & Germanium- N type and P type materials – PN Junction –Forward and Reverse Bias – Semiconductor Diodes –Bipolar Junction Transistor – Characteristics – transistor as an Amplifier – Introduction tooperational Amplifier –Inverting Amplifier –Non Inverting Amplifier –DAC– ADC.

UNIT – V	**MEASUREMENTS AND INSTRUMENTATION**	**9**

Introduction to transducers: pressure, temperature, position, electrical measurements, Classification of instruments –moving coil and moving iron Ammeter and Voltmeter – multimeters – dynamometer type Wattmeter – three-phase power measurements – energy meter – megger – instrument transformers (CT and PT)

Total: 45 Periods

Text Books:

1. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw HillEducation(India) Private Limited, Third Reprint ,2016
2. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

Reference Books:

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elsevier, First Indian Edition,2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. V.K Mehta and Rohit Mehta, "Principle of Electrical Engineering", S.Chand & Company, 2008

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO2	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO3	3	3	2	2	1	3	1	1	1	1	1	1	3	2
CO4	3	3	2	2	1	1	1	1	1	1	1	1	3	2
CO5	3	3	2	1	1	1	1	1	1	1	1	1	3	2

CH1303	**Solid Mechanics for Technologists**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- ✓ To obtain skill in creating database retrieval of data and to solve Mathematical models through linear and non-linear programming.

Course Outcomes (CO)

CO1	Define various types of stresses and strain developed on determinate and indeterminate members
CO2	Draw shear force and bending moment diagram for various types of transverse loading and support
CO3	Compute the slope and deflection, bending stresses and shear stresses on a beam
CO4	Apply the concept of principal stresses and theories of failure to determine stresses
CO5	Calculate the Torsional shear stress in shaft and buckling on the column

UNIT - I	**STRESS, STRAINAND DEFORMATION OF SOLIDS**	**9**

Stress and Strain: Load and its effect, Types of stresses, Types of strain, Support and free body diagram, Hooke's law and simple problems – compound bars – thermal stresses – elastic constants and poission's ratio.

UNIT - II	**TRANSVERSE LOADING ON BEAMS**	**9**

Beams –support conditions–types of Beams –transverse loading on beams–shear force and bending moment in beams–analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M.Inbeams and their applications– S.F.& B.M. diagrams.

UNIT - III	**DEFLECTIONS OF BEAMS**	**9**

Double integration method – Macaulay's method –Area – moment theorems for computation of slopes and deflectionsin beams.

UNIT - IV	**STRESSES IN BEAMS**	**9**

Theory of simple bending – assumptions and derivation of bending equation (M/I=F/Y= E/R)– analysis of stresses inbeams–loads carrying capacity of beams–proportioning beam sections – leaf springs – flitched beams.

UNIT - V	TORSION AND COLUMNS	9
Torsion of circular shafts – derivation of torsion equation (T/J = fs/R = Cθ/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts–Euler's theory of long columns		
	Total Periods:	**45**

Text Books:

1. Junarkar, S. B., Mechanics of Structure Vol.1, 21st Edition, Character Publishing House, Anand, Indian, (1995).
2. William A.Nash, Theory and Problems of Strength of Materials, Schaum's Outline Series.
3. McGraw Hill International Editions, Third Edition, 1994.
4. Bansal, R.K, Strength of Materials, Laxmi Publications(P) Ltd., Fourth Edition 2010

Reference Books:

1. Elangovan A. ,Thinma VisaiIyal (Mechanics of Solids in Tamil), Anna University, Madras, 1995.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	2	2	3	1	1	1	1	1	1	1	1	2	2
CO2	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO3	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO4	2	2	2	3	2	1	1	1	1	1	1	1	3	3
CO5	2	2	2	3	1	1	1	1	1	1	1	1	2	3

CH1307	Fluid Mechanics Laboratory	L	T	P	C
		0	0	3	2

Objectives

- ✓ To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pumpcharacteristics.

Course Outcomes (CO)

CO1	Identify and characterize of flow patterns and regimes
CO2	Calibrate flow measurement devices
CO3	Correlate the difference between fixed and fluidized bed columns and its application.
CO4	Select pumps for the transportation of fluids based on process conditions/requirements and fluid properties
CO5	Compare the results of theoretical analytical models to the actual behavior of real fluid flows and draw sustainable conclusions

LIST OF EXPERIMENTS

1. Viscosity measurement of non-Newtonian fluids
2. Calibration of constant and variable head meters
3. Calibration of weirs and notches
4. Open drum orifice and draining time
5. Flow through straight pipe
6. Flow through annular pipe
7. Flow through helical coil and spiral coil
8. Losses in pipe fittings and valves
9. Characteristic curves of pumps (Centrifugal / Gear / Reciprocating)
10. Pressure drop studies in packed column
11. Hydrodynamics of fluidized bed
12. Drag coefficient of solid particle

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Viscometer
2. Venturi meter
3. Orifice meter
4. Rotameter
5. Weir
6. Open drum with orifice
7. Pipes and fittings
8. Helical and spiral coils
9. Centrifugal pump
10. Packed column
11. Fluidized bed

Total Periods:	**60 PERIODS**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	3	0	0	0	0	1	1	1	1	2	2
CO2	2	2	2	3	0	0	0	0	1	1	1	1	2	3
CO3	2	2	2	3	1	0	0	0	1	1	2	1	2	3
CO4	2	2	2	3	2	0	1	0	1	1	1	1	3	3
CO5	2	2	2	3	1	1	1	1	1	1	1	1	2	3

EE1358	Electrical Engineering Laboratory	L	T	P	C
		0	0	3	2

Objectives

- ✓ To validate the principles studied in theory by performing experiments in the laboratory

Course Outcomes (CO)

CO1	Ability to perform DC Shunt and Series Motor characteristics and to analyze the speed control behaviour of DC shunt Motor.
CO2	Ability to perform the characteristics of DC Shunt generator on O.C and Load conditions.
CO3	Ability to perform Open circuit, Short Circuit and Load test on Single Phase Transformer.
CO4	Ability to perform regulation characteristics on the alternator and to analyze the V-curve and Inverted V-curve of a Synchronous motor.
CO5	Ability to perform the speed control behaviour of an induction motor and also to know the working principles of AC and DC motor starters.

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. No.	NAME OF THE EQUIPMENT	Qty.
1	DC Shunt motor	2
2	DC Series motor	1
3	DC shunt motor-DC Shunt Generator set	1
4	DC Shunt motor-DC Series Generator set	1
5	Single phase transformer	2
6	Three phase alternator	2
7	Three phase synchronous motor	1
8	Three phase Squirrel cage Induction motor	1
9	Three phase Slip ring Induction motor	1

Total Periods: 60 PERIODS

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	1	3	1	3	2	1	2	2	2	3	3	3
CO2	3	3	1	3	1	3	2	1	2	2	2	3	3	3
CO3	3	3	1	3	1	3	2	1	2	2	2	3	3	3
CO4	3	3	1	3	1	3	2	1	2	2	2	3	3	3
CO5	3	3	1	3	1	3	2	1	2	2	2	3	3	3

SEMESTER IV

MA1452	**Applied Probability and Statistics** (Common to BIO, CHEM)	**L**	**T**	**P**	**C**
		4	0	0	4

Objectives

- ✓ This course aims at providing the required skill to apply the statistical tools in engineering problems.
- ✓ To introduce the basic concepts of probability and random variables.
- ✓ To introduce the basic concepts of two dimensional random variables.
- ✓ To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important rolein real life problems.
- ✓ To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

Course Outcomes (CO)

CO1	Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Get ideas to handle situations involving more than one random variable
CO3	Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economic and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO4	Apply the basic concepts of design of experiments and handle the same.
CO5	Understand the concept of the Control charts to apply in the field of quality assessment, Production processes, to monitor process stability and control of the manufacturing product.

UNIT - I	**PROBABILITY AND RANDOM VARIABLES**	**12**

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous randomvariables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT - II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Centrallimit theorem (for independent and identically distributed random variables).

UNIT - III	**TESTING OF HYPOTHESIS**	**12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, varianceand proportion - Contingency table (test for independent) – Goodness of fit.

UNIT - IV	**DESIGN OF EXPERIMENTS**	**12**

One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design

UNIT - V	**STATISTICAL QUALITY CONTROL**	**12**

Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) –Tolerance limits -Acceptance sampling.

Total:	**60 PERIODS**

Text Books:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Indian Edition, 2017.

Reference Books:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 9thEdition, 2017.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic
3. Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4th Edition, Elsevier, 2009.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum’s Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists",Pearson Education, Asia, 9th Edition, 2012.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	2	1	0	0	0	0	1	1	2	2
CO2	3	3	2	2	2	1	0	0	0	0	1	1	2	1
CO3	3	3	2	3	3	2	1	0	0	0	2	2	2	2
CO4	3	3	2	3	2	2	1	0	0	0	1	2	1	2
CO5	3	3	3	3	2	2	1	0	0	0	2	1	2	1

CH1401	**Chemistry for Chemical Engineers**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

The course is aimed to

- ✓ To provide the knowledge of basic chemistry to understand the fundamental principles of chemical engineering.
- ✓ To familiarize the basic terms of reaction engineering.
- ✓ To understand the basic concepts of reaction components and systems.

Course Outcomes (CO)

CO1	Understand the basic principles of chemistry applicable to chemical engineering.
CO2	Understand the basics of organic compounds
CO3	Familiarize the basic reaction concepts.
CO4	Familiarize the basic terms of reaction engineering.
CO5	Understand electrochemistry.

UNIT - I		9
Preparation, Physical & Chemical properties and Uses of Pyrrole, Furan, Furfural, Tetrahydro Furan, Thiophene, Indole, Pyridine, Quinoline and Isoquinoline. Synthesis of Antimalarial drugs – isopentaquine and chloroquine Synthesis of Antibacterial drugs – Sulphaniliamide, Sulphapyridine, Sulphathiazole and Phenacetin.		
UNIT - II		**9**
Carbohydrates – classification. Monosaccharides- reaction of Glucose and fructose, open chain and cyclic structures ofglucose and fructose, mutarotation, epimerzation, KillianiFisher synthesis, Ruff degradation, conversion of aldoses to ketoses and Ketoses to aldoses. Disaccharides – properties and structure of sucrose. Polysaccharides – properties and structure of starch and cellulose		
UNIT - III		**9**
Elimination Reaction – E1, E2 elimination – Bredt's rule – Zartsev's rule – Condensation reaction – Benzoin Condensation – Aldol Condensation and Claisen Condensation – Preparation and synthetic uses of acetoacetic and malonic esters – Molecular rearrangement – Hofmann rearrangement – Schmidt rearrangement – Beckmann rearrangement.		
UNIT - IV		**9**
Electrolytic conductance – Specific, Equivalent and Molar conductance – Kohlrauch's law and its applications. Electropotential, Electro chemical cell – EMF of a cell and its measurements – Reference electrodes – Hydrogen, calomel and glass electrodes. The Nernst equation and applications – Concentrations cell. Conductometry – Cell constant –Conductometric titrations – Potentiometry – Principle of acid – base – and oxidation, reduction titrations.		
UNIT - V		**9**
Rate of reaction – Rate constants – Order and molecularity of reaction – First, second, third and zero order reactions – Method of determining order of reactions – Differential and integral rate expressions – Rate measurement method – Volumetry – Spectrophotometry. Complex reactions – Reverse reactions – Parallel or side reactions, chain reactions, consecutive reactions and explosive reaction. Effect of temperature and solvent on reaction rate. Theories of reaction rates – Activated complex theory of Bi-molecular reactions, the lindemann theory of unimolecular reactions.		
	Total:	**45 PERIODS**

Text Books:

1. Advance organic Chemistry – B.S. Bahl and Arun Bahl
2. Text book of organic chemistry – P.L.Soni
3. Principles of Physical Chemistry - B. R. Puri, L.R. Sharma, M.S. Pathania

Reference Books:

1. R.P.Singh, Handbook of Chemistry, 3rd Edition, 2015, Arihant Publications
2. Jain & Jain, Engineering Chemistry, 16th Edition, 2015, , Dhanpat Rai Pulishing Compnay

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	2	1	0	0	0	0	1	1	2	2
CO2	3	3	2	2	2	1	0	0	0	0	1	1	2	1
CO3	3	3	2	3	3	2	1	0	0	0	2	2	2	2
CO4	3	3	2	3	2	2	1	0	0	0	1	2	1	2
CO5	3	3	3	3	2	2	1	0	0	0	2	1	2	1

CH1402	Computer applications in Chemical Engineering	L	T	P	C
		2	1	2	4

Objectives

- ✓ Students will be equipped with the software applications and the numerical solutions of chemical engineering
problems.

Course Outcomes (CO)

CO1	Map ER model to Relational model to perform database design effectively
CO2	Write queries using normalization criteria and optimize queries
CO3	Design the Query Processor and Transaction Processor
CO4	Learn different database concepts like distributed databases, spatial databases and mobile databases.
CO5	Apply security concepts to databases, review cloud databases, streaming and graph databases.

UNIT - I **9 + 3**

Review on Programming languages- Basic, Application in Density, molecular weight, mole and percentage compositions, Empirical and Molecular formula calculations, Heat of mixing, Gas laws, Vapor pressure, Chemical Kinetics calculations.

Lab Component

- Calculation of average molecular weight of given gas mixture.
- Find out Empirical and molecular weight using MS Excel

UNIT - II **9 + 3**

Application in data processing, Statistical analysis of data, Regression. Analysis of variance, Interpolation, Graphical representations of various Chemical Engineering problem both in laboratory exercise and core subjects such as Mechanical operation, Reaction Engineering, Distillation etc.

Lab Component

- Regression Analysis using spread sheet
- Find out the number of theoretical plates using spread sheet

UNIT - III **9 + 3**

Design and developments of simple databases on Chemical and Physical properties of substances. Retrieval and Database in report, query and other formats, Interfacing with other software. Preparation of Material and energy Balances preparation of plant layout.

Lab Component

- Material and energy balance using spread sheet
- Find out the physical and Chemical properties using spread sheet

UNIT - IV **9 + 3**

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart - Pseudo code.Introduction to C – C tokens – data types – Operators and expressions – I/O functions

Lab Component

- Solve quadratic equation for different sets of inputs.
- Use of spreadsheet to create Charts(XY, Bar, Pie) and apply the formulae wherever necessary C Programming(Flowcharts and algorithms are essential for the programming exercises)

UNIT - V **9 + 3**

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion –Passing array to functions Storage classes – Strings – String library functions

Lab Component

- Matrix operations- Addition - Transpose – Multiplication
- Greatest of three numbers using conditional operator and if statement

PRACTICALS: 15 PERIODS	THEORY: 45 PERIODS	TOTAL : 60 PERIODS

Text Books:
1. Hanna, O.T. Scandell, O.C. Computational Methods in Chemical Engineering, Prentice Hall, 1995. 2. R.K. Taxali, T.K. dBase IV made simple, Tata McGraw-Hill 1991. 80
Reference Books:
1. Jerry, O., Breneman, G.L. Spreadsheet Chemistry, Prentice Hall, Englewood Cliffs, 1991. 2. Myers, A.L. Seider W.D. Introduction to Chemical engineering and Computer Calculations.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3

CH1403	**Mechanical Operations**	**L**	**T**	**P**	**C**
		3	0	0	3
Objectives					
✓ To impact knowledge in the field of particle size reduction and deals with the detail construction and working of equipment's used for mechanical operations.					
Course Outcomes (CO)					
CO1	To gain engineering knowledge on particle size, shape and its characteristics including various methods of screen analysis, equipment's, and its effectiveness.				
CO2	To educate the students about various laws of crushing and suitable design equipment's.				
CO3	To score engineering knowledge on settling characteristics, its types and design of continuous thickeners using batch sedimentation.				
CO4	To be conversant with types of filtrations, design of various filtration equipment's and optimum cycle of operation.				
CO5	To make the students understand the importance of mixing and agitation of different mixtures, storage, and transportation of solids.				
UNIT - I	**PARTICLE CHARACTERIZATION AND MEASUREMENT**				**9**
General characteristics of solids, different techniques of size analysis- Static - Image analysis and Dynamic analysis -Light scattering techniques, shape factor, surface area determination, estimation of particle size. Advanced particle size analysis techniques. Screening methods and equipment, screen efficiency, ideal and actual screens.					
UNIT - II	**PARTICLE SIZE REDUCTION AND SIZE ENLARGEMENT**				**9**
Laws of size reduction, energy relationships in size reduction, methods of size reduction, classification of equipment's, crushers, grinders, disintegrators for coarse, intermediate, and fine grinding, power requirement, work index; Advanced size reduction techniques - Nano particle fabrication - Top down 49 approach - Bottom-up approach. Size enlargement- Importance of size enlargement, principle of granulation, briquetting, pelletisation, and flocculation. Fundamentals of particle generation.					

UNIT - III	PARTICLE SEPARATION (GAS-SOLID AND LIQUID-SOLID SYSTEM)	9
Gravity settling, sedimentation, thickening, elutriation, double cone classifier, rake classifier, bowl classifier. Centrifugal separation - continuous centrifuges, super centrifuges, design of basket centrifuges; industrial dust removingequipment, cyclones, and hydro cyclones, electrostatic and magnetic separators, heavy media separations, floatation, jigging		
UNIT - IV	**FILTRATION AND FILTRATION EQUIPMENTS**	**9**
Theory of filtration, Batch and continuous filters, Flow through filter cake and filter media, compressible and incompressible filter cakes, filtration equipment's - selection, operation and design of filters and optimum cycle ofoperation, filter aids.		
UNIT - V	**MIXING AND PARTICLE HANDLING**	**9**
Mixing and agitation - Mixing of liquids (with or without solids), mixing of powders, selection of suitable mixers, powerrequirement for mixing. Storage and conveying of solids - Bunkers, silos, bins and hoppers, transportation of solids in bulk, Powder hazards, conveyer selection, different types of conveyers and their performance characteristics.		
	Total:	**45 PERIODS**

Text Books:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edn., McGraw-Hill,2005.
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.
3. Foust, A. S., Wenzel, L.A., Clump, C.W., Naus, L., and Anderson, L.B., "Principles of Unit
4. Operations", 2nd Edn., John Wiley & Sons, 1994.
5. Hiroaki Masuda , KoHigashitani and Hideto Yoshida, Powder Technology Handbook, 3rd Edition.

Reference Books:

1. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. II, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
2. Christie J. Geankoplis, Transport processes and unit operations.
3. Sunggyu Lee, Kimberly H. Henthorn, Particle Technology and Applications.
4. Martin Rhodes, Introduction to Particle Technology, Second Edition.
5. Richard R. Klimpel, Introduction to the Principles of Size Reduction of Particles by Mechanical Means, NSFEngineering Research Center for Particle Science & Technology. University of Florida, 1997.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	3	1	1	1	1	1	1	1	1	2	2
CO2	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO3	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO4	2	2	2	3	2	1	1	1	1	1	1	1	3	3
CO5	2	2	2	3	1	1	1	1	1	1	1	1	2	3

CH1404	Chemical Process Industries	L	T	P	C
		3	0	0	3

Objectives

- ✓ To impart knowledge on various aspects of production engineering and make the student understand the practical methods of production in a chemical factory.

Course Outcomes (CO)

CO1	To gain engineering knowledge on various aspects of production engineering and the practical methods of production of sulphur, sulphuric acid and cement
CO2	To understand the practical methods of production of fertilizer products
CO3	To learn &understand the practical methods of production of pulp, paper, sugar and starch industries
CO4	To gain engineering knowledge on various aspects of production of petroleum and petro chemical industries
CO5	To learn &understand and analyse the fuel and industrial gases

UNIT - I	**SULFUR, SULFURIC ACID AND CEMENT**	**9**

Sulfur, Raw materials Sources, Mining and production of Sulfur – Sulfuric acid, Methods of production of Sulfuric acid – Contact process – Chamber process. Cement – properties of Cement – Methods of production – Overall factors forCement industry.

UNIT - II	**FERTILIZER INDUSTRY**	**9**

Major Components of Fertilizer industries – Nitrogen industries, ammonia, nitric acid, urea – Phosphorus industries -Phosphorus, Phosphoric acid, Super Phosphate – Potassium chloride, Potassium Sulphate

UNIT - III	**PULP, PAPER, SUGAR AND STARCH INDUSTRIES**	**9**

Pulp – Methods of production – Comparison of pulping processes. Paper – types of paper products, Raw materials, Methods of production. Sugar – Methods of production – by products of the Sugar industry – Starch – Methods ofproduction, Starch derivations.

UNIT - IV	**PETROLEUM AND PETRO CHEMICAL INDUSTRIES**	**9**

Petroleum – Chemical Composition, Classification of crude petroleum, Petroleum Refinery products – Petroleum Conversion processes – Pyrolysis and Cracking, Reforming Polymerization, isomerization and Alkylation – petrochemicals – methanol, chloro methanol, Acetylene and ethylene, Isopropanol, Acrylonitrile, Butadiane – Chemicals from Aromatics - Benzene, Toluene and Xylene.

UNIT - V	**FUEL AND INDUSTRIAL GASES**	**9**

Fuel Gases – Producer gas, Water gas, Coke oven gas, Natural gas, Liquefied natural gas – Industrial gases – Carbon dioxide, hydrogen, nitrogen and oxygen.

Total:	**45 PERIODS**

Text Books:

1. Dryden, C.E, Outlines of Chemical technology, II Ed., Affiliate East West press, 2003.
2. Moulin, J.A., M. Makkee, and Diepen, A.V., Chemical Process Technology, Wiley, 2001.on.

Reference Books:

1. Austin, G.T., Shreve's "Chemical Process Industries", 5th ed., McGraw-Hill, 1998.
2. Srikumar Koyikkal, "Chemical Process Technology and Simulation", PHI Learning Ltd

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	1	3	2	2	2	1	2	2	2	2
CO2	3	3	3	2	1	3	2	2	2	1	2	2	2	3
CO3	3	3	3	2	1	3	2	2	2	1	2	2	2	3
CO4	3	3	3	2	1	3	2	2	2	1	2	2	3	3
CO5	3	3	3	2	1	3	2	2	2	1	2	2	2	3

CH1405	**Instrumental Methods of Chemical Analysis**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- ✓ To know the principle and importance of various analytical instruments used for the characterization of variousmaterials.

Course Outcomes (CO)

CO1	To Learn About Introduction of Spectrometry
CO2	To Understand concept of molecular spectroscopy
CO3	To learn about magnetic resonance spectroscopy and mass spectroscopy
CO4	To Understand separation methods
CO5	To learn about electro analysis and surface microscopy

UNIT – I INTRODUCTION TO SPECTROSCOPICAL METHODS OF ANALYSIS 9

Electromagnetic radiation: various ranges, dual properties, various energy levels, interaction of photons with matter, absorbance & transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules, various electronic transitions in organic and inorganic compounds effected by UV, and visible radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and visible radiations, choice of solvents, cut off wavelengths for solvents

UNIT - II QUALITATIVE ANALYSIS BY UV AND VISIBLE SPECTROCOPY 9

Lamda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) fordienes and carbonyl compounds, Effects of auxochromes and effects of conjugation on the absorption maxima, Differentshifts of absorption peaks (Bathochromic, hypsochromic, hypochromic), Instrumentation for UV and Visible spectrophotometers (source, optical parts, and detectors), Applications of UV and Visible spectroscopy.

UNIT - III QUANTITATIVE ANALYSIS BY UV AND VISIBLE SPECTROCOPY 9

Beer-Lambert's law, limitations, deviations (real, chemical, instrumental), estimation of inorganic ions such as Fe, Ni and estimation of nitrite using Beer -Lambert's law, multicomponent analysis (no overlap, single way overlap and two-way overlap), photometric titration (experimental set -up and various types of titrations and their corresponding curves).

UNIT - IV IR SPECTROSCOPY 9

Theory of IR spectroscopy, various stretching, and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (near, mid, fingerprint and far) and their usefulness, Instrumentation (only the sources and detectors used in different regions), sample preparation techniques, qualitative analysis of alkanes, alkenes, and carbonyl compounds.

UNIT - V CHROMATOGRAPHIC METHODS 9

Classification of chromatographic methods, column, thin layer, paper, gas, High Performance Liquid Chromatographical methods (principle, mode of separation and technique).

	Total:	45 PERIODS
Text Books:		
1. Sivasankar B., “Instrumental Methods of Analysis”, Oxford University Press, 2012. 2. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007.		
Reference Books:		
1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Instrumental Analysis, CENGAGE 2. Learning, India, 7th Edition, 2007. 3. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition, Wadsworth Publishing Company, 1988. 4. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, NewDelhi, 2014 5. John R Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prenticehall of India Pvt. Ltd., 2012 6. Robert M. Silverstein, Francis X. Webstrer, David Kiemle, David L. Bryce, Spectrometric Identification of OrganicCompounds, Wiley, 8th Edition, 2010.		

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	1	1	1	1	1	1	3	3	2	3
CO2	3	3	2	3	2	1	1	1	1	1	3	3	2	3
CO3	3	3	1	1	1	1	1	1	1	1	3	3	2	3
CO4	3	3	2	3	1	1	1	1	1	1	3	3	2	3
CO5	3	3	1	1	1	1	1	1	1	1	3	3	2	3

CH1407	Mechanical Operations Laboratory	L	T	P	C
		0	0	3	2
Objectives					
✓ To learn experimentally to calibrate flow meters, find pressure loss for fluid flows and determine pump characteristics.					
Course Outcomes (CO)					
CO1	Determine the size analysis in solid- solid separation systems				
CO2	Capability to select different solid - fluid separation equipment.				
CO3	Evaluate the size reduction and various crushing parameters				
CO4	Estimate the separation characteristics				
CO5	Understand the technical methods related to unit operations in process plant				

LIST OF EXPERIMENTS

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Batch filtration studies using a Plate and Frame Filter press
4. Characteristics of batch Sedimentation
5. Reduction ratio in Jaw Crusher / Pulverizer/ Hammer Mill
6. Reduction ratio in Ball mill
7. Separation characteristics of Cyclone separator
8. Reduction ratio of Roll Crusher
9. Separation characteristics of Elutriator
10. Reduction ratio of Drop weight crusher
11. Size separation using Sub-Sieving
12. Determination of specific surface area using air permeability set up

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Sieve shaker
2. Leaf filter
3. Plate and Frame Filter Press
4. Sedimentation Jar
5. Jaw Crusher
6. Ball Mill
7. Cyclone Separator
8. Roll Crusher
9. Elutriator
10. Drop Weight Crusher
11. Sieves

Total Periods:	**60 PERIODS**

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	2	2	3	1	1	1	1	1	1	1	1	2	2
CO2	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO3	2	2	2	3	1	1	1	1	1	1	1	1	2	3
CO4	2	2	2	3	2	1	1	1	1	1	1	1	3	3
CO5	2	2	2	3	1	1	1	1	1	1	1	1	2	3

HS1310	Professional Skills Lab	L	T	P	C
		0	0	2	1

Objectives

- ✓ Enhance the Employability and Career Skills of students
- ✓ Orient the students towards grooming as a professional
- ✓ Make them Employable Graduates
- ✓ Develop their confidence and help them attend interviews successfully.

Course Outcomes (CO)

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

UNIT – I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suitthe audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.

UNIT - II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice–– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience duringpresentation; Projecting a positive image while speaking; Emphasis on effective body language

UNIT - III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstormingthe topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc

UNIT - IV **6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Typesof interview questions and how to answer them.

UNIT - V **6**

Recognizing differences between groups and teams- managing time managing stress- networking professionally-respecting social protocols understanding career management- developing a long- term career plan making career changes

Total: 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

- One Server
- 30 Desktop ComputersOne Hand Mike
- One LCD Projector

Reference Books:
1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015 2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015 3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014 4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010 5. Interact English Lab Manual for Undergraduate Students,.Orient Balck Swan: Hyderabad, 2016.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	0	2	0	2	1	0	0	0	2	3	0	0	1	2
CO2	0	2	0	2	0	0	0	0	2	3	0	0	1	2
CO3	0	0	0	0	0	0	0	0	2	2	0	0	1	2
CO4	0	0	0	0	0	0	0	0	2	2	0	2	1	2
CO5	0	2	1	1	2	0	2	0	2	3	0	2	1	2

SEMESTER V

CH1501	**Chemical Reaction Engineering I**	**L**	**T**	**P**	**C**
		2	1	0	3
Objectives					
The course is aimed to ✓ Learn reaction kinetics, types of reactors, design of reactors, understand the isothermal, nonisothermal operationof reactors and gain knowledge about non ideal reactors.					
Course Outcomes (CO)					
CO1	To understand the kinetics of homogenous reactions				
CO2	To develop performance equation and determine the conversion for different reactors				
CO3	To understand the design of reactor for multiple reactions				
CO4	To understand the non-isotherm operation of the reactor				
CO5	To understand the residence time distribution function and analyze the non-ideality in the reactor				
UNIT – I	**KINETICS OF HOMOGENEOUS REACTIONS**				**9**
Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation forconstant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis. Half-life calculation.					
UNIT – II	**IDEAL REACTORS AND ITS COMBINATIONS**				**9**
Ideal reactor classification. Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, combination of reactors, and size comparison of reactors.					
UNIT – III	**DESIGN OF PARALLEL REACTIONS**				**9**
Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.					

UNIT – IV	TEMPERATURE EFFECTS ON REACTORS	9
Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimumtemperature progression.		
UNIT – V	**NON IDEAL REACTORS AND ITS MODELS**	**9**
The residence time distribution for chemical reactors, residence time functions and relationship between them in reactor; Models for non-ideal reactors, conversion in non-ideal reactors.		
	Total:	**45 PERIODS**

Text Books:

1. O. Levenspiel, Chemical Reaction Engineering, Third Edition, John Wiley 1999
2. H.S. Fogler, Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999
3. Lanny D. Schmidth The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005

Reference Books:

1. L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press , 2014
2. G.Fronment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 1979
3. J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO2	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO3	3	3	2	2	1	3	1	1	1	1	1	1	3	2
CO4	3	3	2	2	1	1	1	1	1	1	1	1	3	2
CO5	3	3	2	1	1	1	1	1	1	1	1	1	3	2

CH1502	Heat Transfer	L	T	P	C
		2	1	0	3

Objectives

The course is aimed to

- ✓ Teach the fundamental concepts of heat transfer viz., conduction, convection, radiation, boiling and condensation and its application to the students

Course Outcomes (CO)

CO1	To familiarize the students with the fundamental concepts of Heat Transfer. provide the student with knowledge about heat transfer by conduction in solids for steady state
CO2	Students will understand convective heat transfer and use of heat transfer coefficients for laminar and turbulent flows
CO3	Students will understand radiative heat transfer including blackbody radiation and Kirchoff's law and will be able to solve radiative problems apply knowledge of heat transfer to solve thermal engineeringproblems
CO4	Students will be able to calculate and use overall heat transfer coefficients in designing heat exchangers
CO5	The course provides the student with knowledge about heat transfer with phase change (boiling and condensation) and evaporation

UNIT – I	BASIC CONCEPTS & CONDUCTIVE HEAT TRANSFER	9

Importance of heat transfer in Chemical Engineering operations - Modes of heat transfer – Mean temperature difference- Concept of heat conduction - Fourier's law of heat conduction – One dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere – Heat conduction through a series of resistances - Analogy between flow of heat and flow of electricity - Effect of temperature on thermal conductivity- Conduction through liquids- Individual and overall heat transfer coefficients and the relationship between them - Transient heat conduction.

UNIT – II	CONVECTION	9

Concept of heat transfer by convection - Natural and forced convection - Application of dimensional analysis for convection - Equations for forced convection under laminar, transition and turbulent conditions - Equations for naturalconvection - Heat transfer from condensing vapors- Heat transfer to boiling liquids - Influence of boundary layer on heat transfer - Heat transfer to molten metals – Heat transfer in packed and fluidized beds.

UNIT – III	RADIATION	9

Concept of thermal radiations - Black body concept - Stefan Boltzman's law - Emissive power – Black body radiation – Emissivity - Plank's Law - Radiation between black surfaces - Gray surfaces - Radiation Shields - RadiationApplications

UNIT – IV	HEAT EXCHANGERS	9

Parallel and counter flow heat exchangers - Log mean temperature difference - Single pass and multipass heat Exchangers-Plate Heat Exchangers-Use of correction factor charts- Heat Exchangers Effectiveness-Number of transfer unit - Chart for different configurations - Fouling factors and Wilson's plot - Design of various types of heat exchangers - Design of condensers.

UNIT – V	EVAPORATION	9

Types of evaporation - Single effect and multiple effect evaporation - Design calculation for single and multiple effectevaporation- Boiling Point Elevation - Effect of Liquid Head - Capacity and Economy of multiple effect evaporators -Evaporation Equipment's.

Total: 45 PERIODS

Text Books:

1. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997.
2. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984
3. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999.

Reference Books:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering",6th Edn., McGraw-Hill, 2001.
2. Coulson, J.M. and Richardson, J.F., "Chemical Engineering " Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO2	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO3	3	3	2	2	1	3	1	1	1	1	1	1	3	2
CO4	3	3	2	2	1	1	1	1	1	1	1	1	3	2
CO5	3	3	2	1	1	1	1	1	1	1	1	1	3	2

CH1503	Mass Transfer I	L	T	P	C
		2	1	0	3

Objectives

The course is aimed to

- ✓ Learn and determine mass transfer rates under laminar and turbulent conditions and apply these concepts in thedesign of humidification columns, dryers and crystallisers.

Course Outcomes (CO)

CO1	To understand the fundamentals, types and mechanism of mass transfer operations
CO2	To understand the theories of mass transfer and the concept of inter-phase mass transfer
CO3	To understand the basics of humidification process and its application
CO4	To understand the concept and mechanism of drying operations
CO5	To understand the concept of crystallization process and identification of suitable crystallizer

UNIT – I	**MOLECULAR DIFFUSION**	**9**

Introduction to mass transfer operations. Molecular diffusion in gases, liquids and solids. Diffusivity measurement and prediction; multi-component diffusion

UNIT – II	**CONVECTIVE & INTERPHASE MASS TRANSFER**	**9**

Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients. NTU and NTP concepts, Stage-wise and differential contractors.

UNIT – III	**HUMIDIFICATION & DE – HUMIDIFICATION OPERATIONS**	**9**

Humidification – Equilibrium, humidity chart, adiabatic and wet bulb temperatures; humidification operations; theory and design of cooling towers, dehumidifiers and humidifiers using enthalpy transfer unit concept.

UNIT – IV	**DRYING**	**9**

Drying – Equilibrium. Classification of dryers, batch drying – Mechanism and time of cross through circulation drying, theoretical estimation of drying rate and time. Continuous dryers – material and energy balance. Advance dryingtechniques such as freeze drying, microwave drying.

UNIT – V	**CRYSTALLIZATION**	**9**

Crystal geometry. Equilibrium, yield and purity of products, theory of super saturation, nucleation and crystal growth, classification of crystallizers, design of batch crystallizers and continuous crystallizers.

Total:	**45 PERIODS**

Text Books:

1. Treybal, R. E., “Mass Transfer Operations”, 3rd Edition, McGraw-Hill,1981.
2. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice HallInc., NewJersey, 2003.
3. Narayanan K.V. and Lakshmikutty, B “Mass Transfer – Theory and Applications”, 1st Edition, CBS Publishers &Distributors Pvt Ltd, New Delhi, 2014.

Reference Books:

1. McCabe, W.L., Smith, J.C., and Harriot, P., “Unit Operations in Chemical Engineering”, 7th Edition., McGraw-Hill, 2005.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I and II, 4th Edition, Asian Books Pvt. Ltd., India,1998.
3. Seader J.D. and Henley E.J., “Separation Process Principles”, 2nd Ed., John Wiley, 2006

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO2	3	3	3	2	1	3	1	1	1	1	1	1	3	2
CO3	3	3	2	2	1	3	1	1	1	1	1	1	3	2
CO4	3	3	2	2	1	1	1	1	1	1	1	1	3	2
CO5	3	3	2	1	1	1	1	1	1	1	1	1	3	2

CH1507	Heat and Mass Transfer Laboratory	L	T	P	C
		0	0	3	2

Objectives

The course is aimed to

- ✓ Develop sound practical knowledge for students on different types of heat transfer equipment
- ✓ Develop sound practical knowledge for students on different types of mass transfer equipment

Course Outcomes (CO)

CO1	Apply the concepts of heat transfer and fluid dynamics to the operation of heat transfer equipment’s.
CO2	Estimate the heat transfer rate and heat transfer co-efficient
CO3	Determine the diffusivity practically and compare the results with the empirical correlations.
CO4	Estimate the mass transfer rate and mass transfer co-efficient
CO5	Evaluate the performance/calculate the parameters in different distillation processes

LIST OF EXPERIMENTS

1. Heat Transfer in a Double Pipe Heat Exchanger
2. Heat transfer by Forced / Natural Convection
3. Batch drying kinetics using Tray Dryer
4. Heat Transfer in Helical column
5. Heat Transfer through Packed Bed
6. Heat Transfer through bare type heat exchanger
7. Heat Transfer through finned type heat exchanger
8. Drying characteristics of Vacuum Dryer
9. Drying characteristics of Rotary dryer
10. Measurement of diffusivity
11. Surface evaporation
12. Mass transfer coefficient determination by Wetted wall column

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Double pipe Heat Exchanger
2. Tray drier
3. Helical column
4. Packed Bed
5. Bare type heat exchanger
6. Finned type heat exchanger
7. Vacuum Dryer
8. Rotary dryer
9. Diffusivity set-up
10. Surface evaporation set-up
11. Wetted wall column set-up

Total Periods: 60 PERIODS

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1508	Computational Programming Laboratory for Chemical Engineers	L	T	P	C
		0	0	3	2

Objectives

The course is aimed to

- ✓ To give the students an understanding the fundamentals concepts in mathematics, problems solving andcomputer programming.

Course Outcomes (CO)

CO1	Solving chemical engineering problems using different tools available in the excel software
CO2	Solving simultaneous equation and differential equation using polymath
CO3	Simulation of simple chemical process with controller using simulink tool
CO4	Estimation of fluid property and understand the unit operation simulation using Aspen Plus
CO5	Dynamic simulation of chemical process using aspen plus

Suggested Exercises

1. Equations of state using Newton's method
2. Regression for parameter estimation using a set of data points
3. Equilibrium flash distillation (Multicomponent Ideal)
4. Batch Reactor
5. CSTR in Series Stage wise contacting equipment
6. Solving a simple flow sheet by simultaneous approach
7. Simulation of batch Distillation (binary ideal).
8. Gravity Flow Tank
9. Heat Exchanger
10. Plug Flow Reactor
11. Absorber

Specific examples in ASPEN/HYSYs/MATLAB/EXCEL

1. Solving equation of state, regression of parameters using EXCEL/MATLAB
2. Calculation of Reynolds number, friction factor and pressure drop using EXCEL/MATLAB
3. Calculation of heat transfer coefficient in a Heat Exchanger using EXCEL/MATLAB
4. Calculation of minimum Reflux ratio for binary/tertiary system in a fractionator using EXCEL/MATLAB
5. Calculation of HTU and NTU in a Absorber using EXCEL/MATLAB
6. Calculation of Antoine's coefficient using EXCEL/MATLAB
7. Estimation of settling velocity of solids in liquids using Stoke's law using EXCEL/MATLAB
8. Calculation of minimum number of stages in a distillation column using EXCEL/MATLAB
9. Solving mass and energy balance problems using EXCEL/MATLAB
10. Calculation of Power in Reciprocating compressor using EXCEL/MATLAB
11. Steady state simulation of Heat Exchanger using ASPEN PLUS/ HYSYS
12. Steady state simulation of a CSTR using ASPEN PLUS/ HYSYS
13. Steady state simulation of Flash vessel using ASPEN PLUS/ HYSYS
14. Steady state simulation of Distillation Column using ASPEN PLUS/ HYSYS
15. Steady state simulation of an Absorption column using ASPEN PLUS/ HYSYS
16. Dynamic simulation of Heat Exchanger using ASPEN PLUS/ HYSYS
17. Dynamic simulation of a CSTR using ASPEN PLUS/HYSYS
18. Dynamic simulation of Flash vessel using ASPEN PLUS/ HYSYS
19. Dynamic simulation of Distillation Column using ASPEN PLUS/ HYSYS
20. Dynamic simulation of an Absorption column using ASPEN PLUS/ HYSYS

Total Periods:	**60 PERIODS**

TEXT BOOKS:

1. Bequette. B.W, "Process Dynamics": Modelling, Analysis and Simulation," Prentice Hall (1998)
2. Himmelblau. D.M. and Bischoff. K.B, "Process Analysis and Simulation", Wiley, 1988.
3. Strang.G. ,"Introduction to Linear Algebra", Cambridge Press, 4th edition,2009.
4. William. Luyben, "Process Modelling, simulation and control for Chemical Engineers, 2nd Edn., McGraw HillInternational Editions, New York, 1990
5. Chapra.S.C. and Canale.R.P. "Numerical Methods for Engineers", McGraw Hill, 2001.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	3	1	3	1	2	3	2	1	2	1
CO2	2	3	1	2	1	3	2	2	1	2	1	1	2	1
CO3	1	3	2	1	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	3	2	1	1	1	2	2	1	2	1	1
CO5	3	1	2	1	2	1	2	1	1	2	1	1	2	1

SEMESTER VI

CH1601	Chemical Reaction Engineering II	L	T	P	C
		3	1	0	4

Objectives

The course is aimed to

- ✓ Learn gas solid non catalytic, gas solid catalytic and fluid- fluid reaction and apply the knowledge for the reactordesign.

Course Outcomes (CO)

CO1	To understand the gas solid non catalytic reaction and different models for non-catalytic reaction.
CO2	To understand catalyst, catalyst preparation, property estimation and isotherm study.
CO3	To understand the gas solid catalytic reaction and their mechanism
CO4	To design of catalytic reactor for gas solid reaction.
CO5	To understand the concept of Mass Transfer and Mass transfer with reaction for fluid- fluid reaction and tower design.

UNIT – I	FLUID SOLID NON CATALYTIC KINETICS	12

Gas solid non catalytic reaction. Reaction kinetics, Shrinking Core Model and Progressive conversion model, Controlling resistances (diffusion through gas film, ash layer and chemical reaction controlling), rate controlling steps;time for Complete Conversion for Single and Mixed Sizes, design of fluid –particle reactors.

UNIT – II	CATALYSIS & ADSORPTION	12

Catalysis and adsorption: physical properties of catalyst, surface area, void volume, solid density, volume determination, catalyst classification and preparation, catalyst promoters, catalyst inhibitors, catalyst poisons. Adsorption Isotherms Freundlich and Langumir isotherms.

UNIT – III	KINETICS OF CATALYTIC REACTIONS	12

Gas solid catalytic reaction: steps in catalytic reaction, Single site, dual site mechanisms, Langmuir Hinshelwood, Rate controlling steps. Experimental methods for determining rate, differential , integral reactor and reactor deign

UNIT – IV	FLUID SOLID CATALYTIC KINETICS	12

Diffusion Within Catalyst Particle, Mass and Heat Transfer Within Catalyst Pellets, Effectiveness Factor, Thiele Modulus, Effectiveness factor for non-isothermal condition.

UNIT – V	FLUID -FLUID KINETICS	12

Fluid-Fluid reaction. Kinetics and design of Fluid-Fluid Reactions. Rate equation, Kinetic regimes for absorptioncombined with chemical reaction. Various cases of mass transfer with chemical reaction , Factors to select the contactor, Tower Reactor Design

Total:	**60 PERIODS**

Text Books:
1. J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981 2. O. Levenspiel, Chemical Reaction Engineering, Third Edition, John Wiley 1999 3. H.S. Fogler, Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999
Reference Books:
1. Lanny D. Schmidt The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005 2. L.K Doraiswamy, DenizUner, Chemical Reaction Engineering Beyond the fundamentals, CRC Press, 2014 3. G.F. Froment, K.B.Bischoff Chemical Reactor Analysis and Design , John Wiley and Sons, 1979

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1602	**Mass Transfer II**	**L**	**T**	**P**	**C**
		2	1	2	4

Objectives

The course is aimed to

- ✓ Impart knowledge on how certain substances undergo the change in composition, change in phases and exhibit their properties according to the changed environment. Also, to design absorber and stripper, distillation column,extraction and leaching equipment and adsorber.

Course Outcomes (CO)

CO1	To understand concept and determine the theoretical stages, number of transfer units and height requirements for a gas absorption process
CO2	To identify the suitable distillation techniques, determine the number of trays for stage wise contact and determine the height of the packed tower.
CO3	To apply the ternary equilibrium diagram concepts to determine the number of stages required for separation of liquid-liquid extraction process.
CO4	To describe core principles of leaching, setting up mass balances, use graphical methods to estimate the number of ideal stages in leaching operation.
CO5	To understand the concept of adsorption techniques, various isotherms and ion exchange process

UNIT – I	**ABSORPTION**	**9 + 3**

Absorption factor, Equipments in gas liquid operations, design of packed and plate type absorbers; Operating characteristics of stage wise and differential contactors, concepts of NTU, HTU and overall volumetric mass transfercoefficients; Absorption with chemical reaction.

Lab Component

- To study the Packed bed Absorber

UNIT – II	DISTILLATION	9 + 3
Vapour liquid equilibria - Raoult's law, Ideal and non-ideal systems, Principle of distillation - flash distillation, differential distillation, steam distillation, Azeotropic and extractive distillation, Number of ideal stages by Mc.Cabe -Thiele method, Introduction to Ponchan - Savarit method, Total reflux, minimum reflux ratio, optimum reflux ratio. **Lab Component** • To study the Simple, Steam and Packed distillation column		
UNIT – III	**LIQUID LIQUID EXTRACTION**	**9 + 3**
Equipments used in Liquid - liquid extraction – differential contact equipment-spray, packed and mechanically agitated contactors, Pulsed extractors, centrifugal extractors-Supercritical extraction, Selection of solvent, stage wisecontact – partially soluble and insoluble, cross current and counter current extraction. **Lab Component** • To study the Liquid-Liquid extraction and RDC Extractor		
UNIT – IV	**LEACHING**	**9 + 3**
Single stage leaching, Solid-liquid equilibria- leaching equipment for batch and continuous operations, calculation ofnumber of stages - Leaching - Leaching by percolation through stationary solid beds, moving bed leaching, counter current multiple contact (shank's system), multi stage continuous cross current and countercurrent leaching, stage calculations, stage efficiency. **Lab Component** • Experimental studies of Single stage leaching		
UNIT – V	**ADSORPTION, ION EXCHANGE, MEMBRANE SEPARATION PROCESSES**	**9 + 3**
Adsorption - Types of adsorption, nature of adsorbents, adsorption equilibria, effect of pressure and temperature on adsorption isotherms, Adsorption operations - stage wise operations, Principle of Ion exchange, techniques and applications. Solid and liquid membranes; concept of osmosis; reverse osmosis; electro dialysis; ultrafiltration, membrane distillation, recent development. **Lab Component** • Adsorption studies using Silica gel		
	Total:	**60 PERIODS**

Text Books:

1. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.
2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice HallInc., New Jersey, 2003.
3. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993.

Reference Books:

1. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw-Hill,2005.
2. Seader J.D. and Henley E.J., "Separation Process Principles", 2nd Ed., John Wiley, 2006.
3. King,C.J.,"SeparationProcesses",2ndEdn.,TataMcGraw-Hill1980

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1603	Chemical Engineering Thermodynamics	L	T	P	C
		2	1	0	3

Objectives

The course is aimed to

- ✓ Understand the phase Behavior of fluids under different PVT conditions and apply them for practical purposes.The course will render a comprehensive understanding of theory and application of solution thermodynamics.

Course Outcomes (CO)

CO1	To understand the systematic development of new class of properties to describe real mixtures
CO2	To develop the idea of chemical potential to derive the idea of phase equilibria
CO3	To understand the concept of equilibrium between combination of two co existing phases other than liquid and vapour
CO4	To understand the principle of chemical reaction thermodynamics for the prediction of equilibrium conversion.
CO5	To analyze the ideal and actual vapor-compression refrigeration cycle and Evaluate the performance of innovative vapor compression refrigeration systems

UNIT – I	**SOLUTION THERMODYNAMICS**	**9**

Thermodynamic formulation, Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures, pure species and liquids.

UNIT – II	**PHASE EQUILIBRIA**	**9**

Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry's law, fugacity, Phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

UNIT – III	**CORRELATION AND PREDICTION OF PHASE EQUILIBRIA**	**9**

Vapor-Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data

UNIT – IV	**CHEMICAL REACTION EQUILIBRIA**	**9**

Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.

UNIT – V	**REFRIGERATION**	**9**

Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, Evaluation and performance of vapor compression and gas refrigeration cycles.

Total:	**45 PERIODS**

Text Books:

1. Smith J.M., Van Ness, H.C., &Abbot M.C," Introduction to Chemical Engineering thermodynamics", McGraw HillVII Edition 2004
2. Kyle B.G.," Chemical and Process Thermodynamics", Pearson International Third Edition 1999.
3. Rao Y.V.C.," Chemical Engineering Thermodynamics" Universities Press,2005

Reference Books:

1. Sandler, S.I.,"Chemical and Engineering Thermodynamics", II Edition,Wiley,1989.
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics "Prentice Hall of India Pvt.Ltd.2001

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1604	**Process Dynamics and Control**	**L**	**T**	**P**	**C**
		2	1	0	3
Objectives					
The course is aimed to ✓ Determine possible control objectives, input variables (manipulated variables and disturbances), model thedynamic behavior of a process, design PID controllers, frequency response and analyze stability of closed loop and open loop systems.					
Course Outcomes (CO)					
CO1	To understand the need to develop mathematical description of a chemical process as a prerequisite to process design and to control the process.				
CO2	To develop transient models for chemical processes using material and/or energy balance equations by incorporating constitutive relationships and seek their solution using Laplace Transforms				
CO3	To convert a process and instrumentation diagram to a control block diagram				
CO4	To understand Frequency response of control systems and tune the PID controllers				
CO5	To appreciate the performance augmentation of PID controllers by using advanced control strategies such as Cascade, Feed forward, Dead time compensation.				
UNIT – I	**INTRODUCTION**				**9**
Introduction to Chemical Process Control, Mathematical description of chemical processes, Formulating Process Models, Laplace Transforms, Properties of Laplace Transforms, Solution of ODE using Laplace Transforms, Standardinput forcing functions, State – Space representation, transform domain models, Impulse response models, Inter relationship between process model forms					
UNIT – II	**FIRST ORDER AND HIGHER ORDER SYSTEMS**				**9**
Open-loop systems, first order systems and their transient response for standard input functions, first order systems in series, linearization and its application in process control, second order systems and their dynamics; transportation lag,FOPDT Model, Skogestaad's rule for FOPDT and SOPDT, Lead- Lag systems					
UNIT – III	**CLOSED LOOP CONTROL SYSTEM**				**9**
Closed loop control systems, development of block diagram for feed-back control systems, servo and regulatoryproblems, transfer function for controllers and final control element, principles of pneumatic and electronic controllers, control valves, transient response of closed-loop control systems and their stability, Root locus diagram.					
UNIT – IV	**FREQUENCY RESPONSE**				**9**
Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, Bode diagram, stability criterion, tuning of controller settings, Nyquist Stability Criterion					

UNIT – V	ADVANCED CONTROL SYSTEMS	9
Introduction to advanced control systems, cascade control, feed forward control, Controllers for Inverse response Smith predictor controller, control of distillation towers and heat exchangers, introduction to computer control ofchemical processes.		
	Total:	**45 PERIODS**

Text Books:

1. Stephanopoulos, G. (1984). Chemical process control (Vol. 2). New Jersey: Prentice hall.
2. Ogunnaike, B. A., & Ray, W. H. (1994). Process dynamics, modeling, and control (Vol. 1). New York: OxfordUniversity Press.
3. Coughanowr, D. R., & Leblanc, S. E. (2008). Introductory concepts. Process Systems Analysis and Control, 3rd Ed, 1-6.

Reference Books:

1. Seborg, D. E., Mellichamp, D. A., Edgar, T. F., & Doyle III, F. J. (2010). Process dynamics and control. John Wiley& Sons.
2. Bequette, B. W. (2003). Process control: modeling, design, and simulation. Prentice Hall Professional.
3. Riggs, J. B., & Karim, M. N. (2006). Chemical and Bio-process Control: James B. Riggs, M. Nazmul Karim.Prentice Hall.
4. Luyben, W. L., Tyréus, B. D., &Luyben, M. L. (1998). Plantwide process control (Vol. 43). New York: McGraw- Hill

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1605	Process Economics and Industrial Management	L	T	P	C
		3	0	0	3

Objectives

The course is aimed to

- ✓ Understand the various concepts of economics, process development, design consideration and cost estimationin chemical industry..

Course Outcomes (CO)

CO1	To understand the concept of economics in a process plant, time value of money and cost indices
CO2	Able to integrate knowledge about financial statements, Depreciation and Accounting
CO3	Able develop economic balance for chemical engineering equipment's and determine the optimum cost for operation
CO4	To understand the basics of principles of management, types of organization and MIS
CO5	To understand the theory behind Work measurement technique, Production planning and elements of production control

UNIT – I	INTEREST AND PLANT COST	9
Economics-Engineering economics-Financial efficiency, human factors, capital, accounting. Time value of money – Interest, present worth, annuities, Depreciation-methods, capital investment, estimation of capital cost, elements of cost, break even analysis (BEA)		
UNIT – II	**PROFITABILITY AND FINANCIAL RATIOS**	**9**
Profitability - methods to estimate profitability, Alternative investments, Balance sheet-Preparation, Income statement (Profit and loss account) and financial ratio analysis.		
UNIT – III	**ECONOMIC BALANCE IN EQUIPMENTS**	**9**
Essentials of economic balance, economic balance in batch operations, cyclic operations, economic balance for insulation, evaporation, heat transfer equipment, plate and frame filter press.		
UNIT – IV	**PRINCIPLES OF MANAGEMENT**	**9**
Principles of management, planning and organizing, staffing, process of directing-communication and types of communication, coordinating and controlling, Types of organizations, Management information systems (MIS).		
UNIT – V	**PRODUCTION PLANNING CONTROL**	**9**
Work measurement techniques, motion study(Work sampling)-procedure and application , time study procedure-performance rating-types of performance rating- learning curve, elements of production control, forecasting, planning, routing, scheduling, dispatching, inventory and control, role of control charts in quality control.		
	Total:	**45 PERIODS**

Text Books:

1. Peters and Timmerhaus, Plant design and Economics for Chemical Engineers, McGraw Hill 5th Edition, 2004.
2. Ahuja K.K, Industrial management, Khanna publishers, New Delhi, 1985.
3. Schweyer. H.E, “Process Engineering Economics”, Mc Graw Hill, 1969

Reference Books:

1. F.C. Jelen and J.H. Black, “Cost and Optimization Engineering”, McGraw Hill, 3rd Edn., 1992

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1	1	2	1	2	1	2	3	2	1	2	1
CO2	1	2	3	2	1	2	1	2	1	2	1	1	2	1
CO3	2	2	1	2	1	2	1	1	1	2	1	2	1	1
CO4	1	1	1	2	1	2	1	1	2	2	1	2	1	1
CO5	1	2	1	2	3	1	2	1	1	2	1	1	2	1

CH1607	Professional Ethical Practice	L	T	P	C
		0	3	3	1

Objectives

- ✓ The course should cover the following topics by way of Seminars, Expert Lecturers and Assignments.

Course Outcomes (CO)

CO1	Distinguish between ethical and non-ethical situations.
CO2	Practice moral judgment in conditions of dilemma.
CO3	Relate the code of ethics to social experimentation

CO4	Develop concepts based on moral issues and enquiry
CO5	Resolve moral responsibilities in complications.

1. Engineering Ethics – Moral Issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer's Responsibility for Safety
4. Responsibilities in Rights
5. Global issues of engineering ethics

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1608	**Chemical Reaction Engineering Laboratory**	**L**	**T**	**P**	**C**
		0	0	3	2

Objectives

The course is aimed to

- ✓ Develop sound practical knowledge for students on different types of reactors.

Course Outcomes (CO)

CO1	Determine the rate constant experimentally in a batch reactor.
CO2	Determine the conversion of a reaction in different reactors (batch, CSTR, PFR)
CO3	Study of temperature dependence of rate constant.
CO4	Determine the non-ideal behaviour and residence time distribution in PFR and CSTR.
CO5	Determine the conversion of reactor arranged in series.

LIST OF EXPERIMENTS

1. Kinetic studies in a Batch reactor
2. Kinetic studies in a Plug flow reactor
3. Kinetic studies in a CSTR
4. Kinetic studies in a Packed bed reactor
5. Kinetic studies in a PFR followed by a CSTR
6. RTD studies in a PFR
7. RTD studies in a Packed bed reactor
8. RTD studies in a CSTR
9. Studies on micellar catalysis
10. Study of temperature dependence of rate constant using CSTR.
11. Kinetic studies in Sono chemical reactor
12. Studies on Cascade CSTR
13. Kinetics of photochemical reaction
14. Demonstration of heterogeneous catalytic reaction
15. Demonstration of gas-liquid reaction
16. Kinetics study in Adiabatic reactor
17. Determination of Activation Energy of a reaction
18. Kinetic study in semi batch reactor

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Batch reactor
2. Plug flow reactor
3. Continuous Stirred Tank Reactor
4. Sono chemical reactor
5. Photo chemical reactor
6. Packed bed reactor

Total Periods:	**60 PERIODS**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

SEMESTER VII

CH1701	**Transport Phenomena**	**L**	**T**	**P**	**C**
		2	1	0	3

Objectives

- ✓ Describe mass, momentum and energy transport at molecular, microscopic and macroscopic level to determinevelocity, temperature and concentration profiles

Course Outcomes (CO)

CO1	To enable the students to understand different types of fluids, rheological models, conservation laws, theories of transport properties of gases and liquids.
CO2	To enable the students to acquire knowledge in the field General method of shell balance approach totransfer problems; Choosing the shape of the shell; most common boundary conditions; momentum flux and velocity distribution for flow of Newtonian and non-Newtonian fluids.
CO3	To enable the students to acquire knowledge in the field of equations of change and their applications
CO4	To enable the students to acquire knowledge in the field General method of shell balance approach to Mass transfer problems.
CO5	To enable the students to acquire knowledge in the field turbulents phenomena; phenomenological relations for transfer fluxes; time smoothed equations of change and their applications for turbulent Flow.

UNIT - I	**MOMENTUM TRANSPORT**	**9**

Viscosity, temperature and pressure effect on viscosity of gases and liquids, Newton’s law, mechanism of momentum transport, shell momentum balance method, Shear stress and velocity distributions in falling film, circular tube, annulus, slit.

UNIT - II	ENERGY TRANSPORT	9
Thermal conductivity, temperature and pressure effect on thermal conductivity of gases and liquids, Fourier's law, mechanism of energy transport, shell energy balance method, Energy flux and temperature distribution in solids andlaminar flow with electrical, nuclear, viscous, chemical heat source, heat conduction through composite walls, fins.		
UNIT - III	**MASS TRANSPORT**	**9**
Diffusivity, temperature and pressure effect on diffusivity, Fick's law, mechanism of mass transport, shell mass balance method, Mass flux and concentration distribution in solids and in laminar flow: stagnant gas film, heterogeneous andhomogeneous chemical reaction systems, falling film, porous catalyst.		
UNIT - IV	**EQUATION OF CHANGE AND THEIR APPLICATIONS**	**9**
Momentum: Equations of continuity, motion and mechanical energy (Isothermal), Energy: Equation of energy (non-isothermal). Mass: Equations of change (multi-component), equations of continuity for each species, equation of energy (multi-component). Solutions of momentum, heat and mass transfer problems discussed under shell balance by applications of equation of change, dimensional analysis of equations of change.		
UNIT - V	**TRANSPORT IN TURBULENT FLOWS AND ANALOGIES**	**9**
Comparison of laminar and turbulent flows, time-smoothed equations of change, empirical expressions. Comparison of laminar and turbulent hydrodynamics, thermal and concentration boundary layer and their thicknesses. Developmentand applications of analogies between momentum, heat and mass transfer.		
	Total:	**45 PERIODS**

Text Books:

1. Bird, R. B., Stewart, W. E. and Lighfoot, E. W., "Transport Phenomena", 2nd Edn., John Wiley, 2002
2. Brodkey, R. S., and Hershey, H. C., "Transport Phenomena", McGraw-Hill, 1988

Reference Books:

1. Welty, J. R., Wilson, R. W., and Wicks, C. W., "Fundamentals of Momentum Heat and Mass Transfer", 3rd Edition. John Wiley, New York, 1984.
2. Slattery, J. S., "Advanced Transport Phenomena", Cambridge University Press, London, 1999.
3. C. J. Geankopolis, "Transport Processes in Chemical Operations", 3rd Edn., Prentice Hall of India, New Delhi, 1996.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	2	1	1	2	1	1	1	1	1	2	1	1
CO2	3	3	3	3	3	3	2	1	1	1	2	3	2	2
CO3	3	3	3	3	3	3	2	1	2	1	2	3	2	3
CO4	3	3	3	3	3	3	2	1	2	1	2	3	2	3
CO5	3	3	3	3	3	3	2	1	2	1	2	3	2	3

CH1702	Chemical Process Equipment Design (Integrated Lab)	L	T	P	C
		2	1	2	4

Objectives

- ✓ Students learn to do in detail process and mechanical design and engineering drawing of different chemicalengineering equipment.

Course Outcomes (CO)

CO1	Apply the skill in thermal design of heat transfer equipment like shell and tube, double pipe heat exchangers and evaporators, and assessing thermal efficiency of the above equipment in practice

CO2	Demonstrate the skills in basic design and drawing of different dryers, cooling towers and cyclone separators.
CO3	Apply the concepts involved in phase separation and design of distillation, Extraction and absorption columns.
CO4	Demonstrate the skills in mechanical design of process equipment, design considerations of pressure vessels and its auxiliary devices design the layout of process industries
CO5	To study the Plant Layout, Pipe Lines and Pipe Layouts, Schematics and Presentation Materials of Construction

UNIT - I		**9+3**

Heat Exchangers, Condensers, Evaporators

Lab Component

- Drawing considerations of Heat Exchangers

UNIT - II		**9+3**

Cooling Tower, Dryers

Lab Component

- Drawing considerations of cooling towers

UNIT - III		**9+3**

Absorption column, Distillation Column, Extraction Column, Adsorption column

Lab Component

- Drawing considerations of Distillation Column and Adsorption column

UNIT - IV		**9+3**

Packed bed Reactors, Pressure Vessel, Storage Vessel

Lab Component

- Drawing consideration of vessels subjected to internal pressure, and external pressure
- Drawing considerations of bolt, nut and screws, welded and riveted joints, flanged joints, nozzles and reinforcements

UNIT - V		**9+3**

Design of Plant Layout, Pipe Lines and Pipe Layouts, Schematics and Presentation Materials of Construction and Selection of process equipment

Lab Component

- Drawing consideration of Plant Layout, Pipe Lines and Pipe Layouts

	Total:	**60 PERIODS**

Text Books:

1. M.V.Joshi and V.V. Mahajan, "Process Equipment Design", MacMillan India Ltd.
2. S.D.Dawande, "Process Design of Equipments", Central Techno Publications, Nagpur, 2000

Reference Books:

1. Indian Standard Specifications IS-803, 1962; IS-4072, 1967; IS-2825, 1969. Indian Standards Institution, NewDelhi.
2. R.H. Perry, "Chemical Engineers' Handbook", McGraw-Hill.
3. W.L.McCabe, J.C.Smith and Harriet, "Unit Operation of Chemical Engineering", McGraw-Hill.
4. Robert Treybal, "Mass Transfer Operations", McGraw-Hill. 66
5. J.M. Coulson and J.Richardson, "Chemical Engineering", vol. 6, Asian Books Printers Ltd.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1

CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1703	**Safety and Hazard analysis**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

To enable the students to

- ✓ Become a skilled person in hazard hazel analysis and finding out the root cause of an accident.
- ✓ Gain knowledge in devising safety policy and procedures to be adopted to implement total safety in a plant

Course Outcomes (CO)

CO1	To understand the need and importance of Industrial safety
CO2	To understand the causes and effects of chemical hazards
CO3	To understand how industries affect the environment
CO4	To familiarize with hazard analysis and assessment procedures
CO5	To understand the concept of Disaster management

UNIT - I **INTRODUCTION TO SAFETY PROGRAMMES** **9**

Safety in industries; need for development; importance safety consciousness in Indian chemical industry; social environmental setup; tolerance limit of the society; psychological attitude towards safety programmes. Elements of safety programme; effective realization; economic and social benefits; effective communication training at various levels of production and operation.

UNIT - II **PLANT SAFETY** **9**

Chemical process industries; potential hazards; chemical and physical job safety analysis; high pressure; high temperature operation; dangerous and toxic chemicals; highly radioactive materials; safe handling and operation of materials and machineries; planning and layout.

UNIT - III **SAFETY PERFORMANCE** **9**

Appraisal; effective steps to implement safety procedures; periodic inspection and study of plant layout and constant maintenance; periodic advice and checking to follow safety procedures; proper selection and replacement of handling equipment's; personal protective equipment's.

UNIT - IV **ACCIDENTS** **9**

Industrial accidents – accident costs – identification of accident spots; remedial measures; identification and analysis of causes of injury to men and machines – accident prevention – accident proneness – vocational guidance, fault free analysis. Fire prevention and fire protection.

UNIT - V **HEALTH HAZARDS AND LEGAL ASPECTS** **9**

Health hazards – occupational – industrial health hazards – health standards, and rules – safe working environments – parliamentary legislations – factories act – labour welfare act – ESI Act – Workmen Compensation Act .Role of Government, safety organizations, management and trade unions in promoting industrial safety.

Total: **45 PERIODS**

Text Books:

1. Ridley Safety at Work, VII Edition, Butterworth Heinman 2007.
2. William Handley, Industrial Safety Hand Book McGraw-Hill Book Company 2nd Edition, 1977.
3. Fawatt, H.H. and Wood, W.S.Safety and Accident Prevention in Chemical Operation, Interscience, 1965

Reference Books:
1. Heinrich, H.W. Dan Peterson, P.E. and Nester Rood. Industrial Accident Prevention, McGraw-Hill Book Co., 1980 2. Blake, R.P., Industrial Safety, Prentice Hall Inc., New Jersy – 3rd Edn. 1963.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1707	Mini Project	L	T	P	C
		0	0	3	2

Objectives

- ✓ The objective of the mini project is to make use of the knowledge gained by the student at early stages of the degree course.

Course Outcomes (CO)

CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation and solution.
CO3	Design engineering solutions to complex problems utilizing a systems approach.
CO4	Conduct an engineering project.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.
Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outside the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

Total Periods:	60 PERIODS

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1708	PROCESS CONTROL AND DYNAMICS LABORATORY	L	T	P	C
		0	0	3	2

Objectives

The course is aimed to

- ✓ Gain the hands-on training about the control systems

Course Outcomes (CO)

CO1	Able to determine the response of a first order and second order system for various input
CO2	Able to determine the response of an interacting and non- interacting system for various input
CO3	Understand the difference between an open loop and closed loop system
CO4	Understand the concept of three classical controller P, PI, PID controller
CO5	Understand the concept of stability and tuning of a system

LIST OF EXPERIMENTS

1. Response of first order system
2. Response of second order system
3. Response of Non-Interacting level System
4. Response of Interacting level System
5. Open loop study on a level system
6. Open loop study on a flow system
7. Open loop study on a thermal system
8. Closed loop study on a level system
9. Closed loop study on a flow system
10. Closed loop study on a thermal system
11. Tuning of a level system
12. Tuning of a flow system
13. Tuning of a thermal system
14. Flow co-efficient of control valves

13. Characteristics of different types of control valves

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Thermometer and Thermo well setup
2. U tube manometer (mercury and water) setup
3. Non- interacting System
4. Interacting System
5. Closed loop Level system
6. Closed loop flow system
7. Closed loop thermal system
8. Control valve setup

Total Periods:	**60 PERIODS**

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1709	Internship	L	T	P	C
		0	0	0	1

Objectives

- ✓ Explore career alternatives prior to graduation.

Course Outcomes (CO)

CO1	Integrate theory and practice.
CO2	Develop work habits and attitudes necessary for job success.
CO3	Build a record of work experience.
CO4	Acquire employment contacts leading directly to a full-time job following graduation from college.
CO5	Develop communication, interpersonal and other critical skills in the job interview process.

Students shall undergo training in R&D institutions / Academics / Industries for a minimum period of 15 days. At the end of internship students must submit a report for internal evaluation.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

CH1807	**Project Work**	L	T	P	C
		0	0	20	12

Objectives

- ✓ The objective of the project is to make use of the knowledge gained by the student at various
- ✓ stages of the degree course.

Course Outcomes (CO)

CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation and solution.
CO3	Design engineering solutions to complex problems utilizing a systems approach.
CO4	Conduct an engineering project.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.

Each student is required to submit a report on the project assigned to him by the department. The report should be basedon the information available in the literature or data obtained in the laboratory/industry.

Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outsidethe department, in industries/Research labs for which proportional weightage will be given in the final assessment.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

PROFESSIONAL ELECTIVE I

CH1509	CHEMICAL WORKS ORGANIZATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed to

- To Introduce the labour welfare act, plant location and layout
- To introduce the multi-dimensional facts of organizational behaviour.
- Effectiveness of the individual dimensions, the group dimensions and its dynamics

Course Outcomes (CO)

CO1	To assess their own entrepreneurial and enterprising potential
CO2	To develop an understanding of the general role of Small Business Enterprises
CO3	To gain knowledge on material and scientific management
CO4	Know the difference between entrepreneurial and managerial type jobs
CO5	Understanding of individual personalities and interpersonal skills needed for effective communications

UNIT – I **9**

Industrial Relations – Introduction. Significance & conditions for good industrial relations Causes of poor industrial relations & suggestions to improve it. Labour disputes in India. Industrial disputes act-1947 (only Salient Points). Types of industrial disputes – strikes – lockouts. Regulation of strikes & Lockouts.

UNIT – II **9**

Business organization - Various forms of private, ownerships, comparison and choice. Industrial Organizations - Plant location - Factors influencing plant location - split and coupled locations- size of industrial units. Plant layout - Choice of equipment various types of layout - guarding of machineries - illumination, heating and ventilation.

UNIT – III **9**

Material management - Organization - Production Planning, purchase, store - inventory control, sales and marketing. Scientific management - Rationalization - time and motion study analysis. Time management.

UNIT – IV **9**

Personality predispositions – personality and personality types, Maddi's models of personality. Perpectual process – development of perpectual skills. Motivation and work performance. Reinforcement theory – Relationship between motivation and performance.

UNIT – V **9**

Dynamics of communication – The communication process, structure of communication, Transactional Analysis, The five common communication networks in an organization. Group Dynamics – Synergy through groups, Group behaviour, group effectiveness, stages of group development. Properties and Characteristics of Highly effective groups

Total Periods: 45

Text Books:

1. Sukla,M.C., Business Organization and Management, 2010.
2. Uma sekaran – "Organisational Behaviour – Text and Cases" 2004, Tata McGrawHill New Delhi.

Reference Books:

1. Tripathi – "Personnel Management & Industrial Relations" 2013, Sultan Chand andSons New Delhi.
2. K.Aswathappa, Organization behavior - Texts and Cases, 1997Himalaya PublishingHouse. Industrial disputes act-1947.
3. Chakraborty S K- Managerial Development & Appraisal –Macmillan India
   Strauss & Sayles – Personnel Management.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1510	**MEMBRANE SCIENCE AND ENGINEERING**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To make students understand the various types of Membrane compositions. To familiarize the studentsof various Membrane Configuration Units.
- To provide knowledge about the various Membrane separations techniques.
- To illustrate the various membrane synthesis techniques and its applications

Course Outcomes (CO)

CO1	To Familiarize main membrane processes, principles, separation mechanisms, and applications
CO2	To Appreciate the selection criteria for different membrane processes
CO3	To Describe the principle of the most common membrane applications
CO4	To Gain knowledge on different modules
CO5	To Understand the application of membrane in various fields.

UNIT – I **9**

Synthetic Membranes - configuration, morphology, principles of permeation and separation, membranematerials.

UNIT – II **9**

Processing: Phase-inversion process, anisotropic membranes, isotropic porous membranes. Polymer blends and alloys, dynamic membranes, liquid membranes, bio mimetic membranes ion exchange membranes, electro dialysis, bipolar membranes, mosaic membranes.

UNIT – III **9**

Separation processes: Electro dialysis, micro filtration, ultra- filtration, reverse osmosis, hemodialysis, hem filtration.

UNIT – IV **9**

Membrane systems: Plate and frame, spiral-wound Unit, hollow fiber Units.

UNIT – V **9**

Membrane Applications: Wastewater treatment, bio separation, biomedical.

Total Periods: 45

Text Books:
1. R.B. Kesting., Synthetic Polymeric Membranes, Second Edn., 1985, Wiley-Interscience, New York. 2. Enrico Drioli, Lidietta Giorno, Enrica Fontananova Comprehensive Membrane Science and Engineering,2013, Elsevier, II Edn.
Reference Books:
1. Mulder, J Basic Principles of Membrane Technology, 1996, Springer. 2. Richard W. Baker, Membrane technology and applications, II Edn., 2004 Wiley Publication.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1511	**POLYMER TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed to

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers.

Course Outcomes (CO)	
CO1	To understand the fundamental concepts of macromolecules
CO2	To understand the addition polymerization
CO3	To understand the condensation polymerization
CO4	To analyse the polymer property relations and their application
CO5	To understand the transition polymers and its properties

UNIT – I	**INTRODUCTION**	**9**

History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

UNIT – II	**ADDITION POLYMERIZATION**	**9**

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals – monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

UNIT – III	**CONDENSATION POLYMERIZATION**	**9**

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT – IV	MOLECULAR WEIGHTS OF POLYMERS	9
Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.		
UNIT – V	**TRANSITIONS IN POLYMERS**	**9**
First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures – crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure.		
	Total Periods:	**45**

Text Books:

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour. R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.

Reference Books:

1. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
2. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor an

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1512	FUNDAMENTALS OF THERMODYNAMICS	L	T	P	C
		2	1	0	3

OBJECTIVE

The course is aimed to

- understand and appreciate thermodynamics as applied to various Chemical Engineering Processes.
- introduce the behavior of components in a mixture or solution.
- impart fundamental concepts of solution thermodynamics involving ideal and non-ideal systems.

Course Outcomes (CO)

CO1	Outline the terminology associated with engineering thermodynamics, apply the concepts of heat, work and energy conversion to calculate heat and work quantities for industrial processes and predict the properties of ideal and real mixtures based on thermodynamic principles
CO2	Apply the basic concepts of first and second laws of thermodynamics for the design and analyse of the open and closed system in chemical process plants
CO3	Predict the changes in the properties of real fluids undergoing changes in process plant equipment.
CO4	Use empirical correlations and experimental date to evaluate thermodynamic quantities that relate to the vapour - liquid or liquid-liquid equilibria of ideal and non-ideal chemical mixtutes.
CO5	Determine equilibrium constants, standard enthalpy, Gibbs free Energy and equilibrium compositions for single and multiple reaction systems.

UNIT – I	BASIC CONCEPTS AND LAWS OF THERMODYNAMICS	9

Terminologies of thermodynamics, categorization of systems and processes, Laws of Thermodynamics. Reversible and Irreversible process. PVT behaviour gases. Equation of state. Entropy change in reversible and irreversible process, Internal energy and entropy as a function of temperature and pressure

UNIT – II	THERMODYNAMIC PROPERTIES	9

Thermodynamics relations, Maxwell relations. Fugacity and fugacity coefficients. Estimation of thermodynamic properties. Types of thermodynamic diagrams.

UNIT – III	PHASE EQUILIBRIA AND VAPOUR LIQUID EQUILIBRIA	9

Phase equilibria - Activity and activity coefficients. Gibbs-Duhem equations. Van laar, Margules equation. Consistency test. Prediction of VLE.

UNIT – IV	CHEMICAL REACTION EQUILIBRIA	9

Criteria of equilibrium. Standard free energy change and equilibrium constants. Effect of temperature. Evaluation of equilibrium constants

UNIT – V	APPLICATION OF LAWS OF THERMODYNAMICS	9

Compression and expansion of fluids. Theory of multistage compression. Refrigeration principles and applications

Total Periods: 45

Text Books:

1. Smith J.M., Van Ness H.C., Abbott M.M., Introduction to Chemical Engineering Thermodynamics, Seventh Edition, Tata McGraw Hill International Student Edition, 2007

Reference Books:

1. Dodge, B.F., Chemical Engineering Thermodynamics, McGraw Hill International Student Edition, 1960.
2. Sandler, S.I., Chemical and Engineering Thermodynamics, Second Edition, John Wiley International Student Edition, 1989. LTPC 22 0 3 38
3. Rao .Y.V.C., Chemical Engineering Thermodynamics, United press (India) ltd.1997.
4. Narayanan K.V., A Text Book of Chemical Engineering Thermodynamics, Prentice- Hall of India Private Limited, New Delhi,2001.
5. Merle Potter , Craig Somerton., Schaum's outline of Thermodynamics for Engineers, Second Edition, McGraw Hill ,2009
6. Hendrick. C. Vanness, Michael M. Abbott., Schaum's outline of Thermodynamics with Chemical Applications, McGraw Hill Professional, 1989.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1513	ESSENTIALS OF THERMODYNAMICS	L	T	P	C
		2	1	0	3

OBJECTIVE

The course is aimed to

- Learn PVT behaviour of fluids, laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

Course Outcomes(CO)

CO1	To understand the fundamental concepts of thermodynamics and its related functions
CO2	To understand and apply the law of thermodynamics in various processes
CO3	To relate PVT behaviour of fluids and understand the real gas behavior
CO4	To apply second law and analyze the feasibility of system
CO5	To solve the thermodynamic problems using MATLAB software

UNIT– I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS **9**

Terminologies of thermodynamics, the variables and quantities of thermodynamics, characteristics of systems and processes, energy classifications, point and path functions, energy in transition work and heat. zeroth law; temperature scales

UNIT– II FIRST LAW OF THERMODYNAMICS **9**

Joule's experiment ,The first law of thermodynamics, statements of first law for the flow and non-flow processes, Heat capacity, energy balance for closed systems, mass and energy balance for open systems Internal Energy

UNIT– III P-V-T BEHAVIOUR AND HEAT EFFECTS **9**

PVT behaviour of fluids; Mathematical representation of PVT behavior; Generalized compressibility factor correlation; Generalized equations of state,

UNIT– IV SECOND LAW OF THERMODYNAMICS **9**

Limitations of the First Law of Thermodynamics, Statements of the second law of thermodynamics, Clausius inequality, heat engine and Carnot cycle and Carnot theorems, Third law of thermodynamics

UNIT– V APPLICATION OF MATLAB IN THERMODYNAMICS **9**

Thermodynamic property relations –Compressibility Factors, cubic equation, generalized equation of state

Total Periods: 45

Text Books:

1. Smith J.M., Van Ness H.C., Abbott M.M., Introduction to Chemical Engineering Thermodynamics, Seventh Edition, Tata McGraw Hill International Student Edition, 2007.
2. Narayanan K.V., A Text Book of Chemical Engineering Thermodynamics, Prentice- Hall of India Private Limited, New Delhi,2001.

Reference Books:

1. Dodge, B.F., Chemical Engineering Thermodynamics, McGraw Hill International Student Edition, 1960.
2. Sandler, S.I., Chemical and Engineering Thermodynamics, Second Edition, John Wiley International Student Edition, 1989. LTPC 22 0 3 38
3. Rao .Y.V.C., Chemical Engineering Thermodynamics, United press (India) ltd.1997.
4. Merle Potter , Craig Somerton., Schaum's outline of Thermodynamics for Engineers, Second Edition, McGraw Hill ,2009
5. Hendrick. C. Vanness, Michael M. Abbott., Schaum's outline of Thermodynamics with Chemical Applications, McGraw Hill Professional, 1989.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	0	1	2	1	2	1	0	2	1	3	1	1
CO2	1	3	1	1	2	1	3	2	1	0	2	1	2	1
CO3	2	1	3	1	1	1	0	0	1	1	1	1	1	2

CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	3	1	0	0	2	1	2	0	1	2	3	1	1	2

PROFESSIONAL ELECTIVE II

CH1609	**INDUSTRIAL AIR POLLUTION**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed to

- To enable the students to learn about Air Pollution, effects of air pollution, Global effects, Sampling of pollutants, Meteorology and air pollution, Atmospheric stability, Plume rise and dispersion and Prediction of air quality.

Course Outcomes (CO)

CO1	To understand Laws and Regulation of air act
CO2	To identify the suitable gaseous pollutants and handling technique.
CO3	To study the particulate matter removal technique.
CO4	To study the types of equipment to remove pollutant.
CO5	To understand the concept of adsorption techniques, various control equipment

UNIT – I INTRODUCTION **9**

Air Pollution Regulatory Framework History – Air Pollution Regulatory Framework - Regulatory System – Laws and Regulations – Clean air Act – Provisions for Recent Developments.

UNIT – II AIR POLLUTION GASES **9**

Measurement fundamentals – chemicals and physical properties – Phase Equelbonemconsecoation laws – Incinerators – Design and Performance – Operation and Maintenance - Absorbers – Design operation and improving performances Absorbers.

UNIT – III PARTICULATE AIR POLLUTION **9**

Particle Collection mechanisms– Fluid particle Dynamics – Particle size Distribution – Efficiency – Gravity Setling chambers Cyclones- Electrostatic preceptors Bannouses

UNIT – IV HYBRID SYSTEM **9**

Heat electrostatic precipitation – Genizing Heat Scrubbers – Dry Scrubbers – Electrostatically Augmented Fabric Fillration

UNIT – V AIR POLLUTION CONTROL EQUIPMENT **9**

Introduction – Installation, Equipment's – Cost Model.

Total Periods: 45

Text Books:

1. Air Pollution Control Equipment Louis Theodore, Burley Intuscence 2008.
2. Air Pollution Control CD Cooper and FC.Alley Wairland Press III Edition 2002.
3. Air Pollution Control Engg, Noel de nevey – Mcgrew Hill.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1610	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed to

- To introduce the measurement techniques of force, torque and speed. To introduce the measurementtechniques of acceleration, Vibration and density

Course Outcomes (CO)

CO1	analyze repeatability, precision and accuracy of the instruments
CO2	understand the measurement techniques for pressure
CO3	understand the measurement techniques for temperature
CO4	understand the measurement techniques for flow and Level
CO5	understand the measurement techniques for composition

UNIT – I **9**

Characteristics of Measurement System -Elements of instruments, static and dynamic characteristics, basicconcepts and qualities of measurement, basic concepts of response of first order type instruments, mercury in glass thermometer

UNIT – II **9**

Pressure measurement: Pressure, Methods of pressure measurement, Manometers, Elastic pressure transducers,Measurement of vacuum, Force-balance pressure gauges, Electrical pressure transducers, Pressure switches, Calibration of pressure measuring instruments, Maintenance and repair of pressure measuring instruments, Troubleshooting

UNIT – III **9**

Temperature measurement: Temperature, Temperature scales, Methods of temperature measurement, Expansion temperature, Filled-system thermometers, Electrical temperature instruments. Pyrometers: Radiationand optical

UNIT – IV **9**

Flow Measurement: Methods of flow measurement, Inferential flow measurement, Quantity flowmeters, Mass flowmeters, Calibration of flowmeters, Selection of flowmeters. Level measurement: Methods of liquid level measurement, Direct methods, level measurement in pressure vessels, measurement of interface level, level of dry materials. Instruments for Analysis - recording instruments, indicating and signaling instruments, instrumentation diagram.

UNIT – V **9**

Methods of composition analysis: Spectroscopic analysis, Absorption spectroscopy, Emission spectroscopy, Mass spectroscopy

Total Periods: 45

Text Books:

1. D. P. Eckman, Industrial Instrumentation, Wiley Eastern Ltd.,2004
2. J. P. Bentley, Principles of Measurement Systems, Longman
3. G. C. Barney, Intelligent Instrumentation, PHI Pvt Ltd.

Reference Books:

1. D. Patranabis, Principles of Industrial Instrumentation, 2nd Edition, Tata McGraw Hill Publishing Company,New Delhi, 1999.
2. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, 1st Edition, Tata McGraw-Hill Education Private Limited, 2009.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1611	ELECTROCHEMICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed to

- Students will gain knowledge about electrochemical process and its application

Course Outcomes (CO)

CO1	To understand the basics of electrochemistry
CO2	To understand the Mass transfer in electrochemical systems
CO3	To understand the corrosion control measures
CO4	To understand the basics of principles of electro refining
CO5	To understand the theory behind different type of electrochemical reactors

UNIT – I **9**

Review basics of electrochemistry: Faraday's law - Nernst potential –Galvanic cells – Polarography, Theelectrical double layer: 94It's role in electrochemical processes –Electrocapillary curve – Helmoltz layer – Guoy–Steven's layer – fields at the interface.

UNIT – II **9**

Mass transfer in electrochemical systems: diffusion controlled electrochemical reaction – the importance of convention and the concept of limiting current over potential, primary-secondary current distribution – rotating disc electrode.

UNIT – III **9**

Introduction to corrosion, series, corrosion theories derivation of potential-current relations of activities controlled and diffusion controlled corrosion process. Potential-pH diagram, Forms of corrosion- definition, factors and control methods of various forms of corrosion-corrosion control measures- industrial boiler water corrosion control – protective coatings –Vapor phase inhibitors – cathodic protection, sacrificial anodes – Paint removers.

UNIT – IV **9**

Electro deposition – electro refining – electroforming – electro polishing – anodizing – Selective solar coatings, Primary and secondary batteries – types of batteries, Fuel cells.

UNIT – V **9**

Electrodes used in different electrochemical industries: Metals-Graphite – Lead dioxide – Titanium substrate insoluble electrodes – Iron oxide – semi conducting type etc. Metal finishing-cell design. types of electrochemicalreactors, batch cell, fluidized bed electrochemical reactor, filter press cell, Swiss roll cell, plug flow cell, design equation, figures of merits of different type of electrochemical reactors.

Total Periods: **45**

Text Books:

1. Picket, " Electrochemical Engineering ", Prentice Hall. 1977.
2. Newman, J. S., " Electrochemical systems ", Prentice Hall, 1973.

Reference Books:

1. 1. Barak, M. and Stevenge, U. K., " Electrochemical Power Sources - Primary and Secondary Batteries"1980
2. Mantell, C., " Electrochemical Engineering ", McGraw Hill, 1972.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1612	**PROCESS PLANT UTILITIES**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To enable the students to understand the process plant utilities and optimization techniques to optimize various parameters in chemical industries.

Course Outcomes (CO)

CO1	To understand the Chemical Softening and Demineralization
CO2	To understand the problems based on Steam, Types of Steam Generator
CO3	To understand the Monochlorodifluro Methane, Chlorofluro Carbons and Brins
CO4	To understand the Air – Water Vapors and use of Humidity Chart and its calculation
CO5	To understand the Natural Gas, Liquid Petroleum Fuels, Coal and Coke

UNIT – I | IMPORTANT OF UTILITIES | 9

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water

UNIT – II | STEAM AND STEAM GENERATION | 9

Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, WasteGas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

UNIT – III | REFRIGERATION | 9

Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluro Methane, Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.

UNIT – IV | COMPRESSED AIR | 9

Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air – Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

UNIT – V | FUEL AND WASTE DISPOSAL | 9

Types of Fuel used in Chemical Process Industries for Power Generation such as Natural Gas, Liquid Petroleum Fuels, Coal and Coke. Internal Combustion Engine, Petrol and Diesel Engine. Waste Disposal.

Total Periods: 45

Text Books:
1. Eckenfelder, W. W, Jr. "Industrial Water Pollution Control" McGraw-Hill: New York, 1966. 2. P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986. 3. Perry R. H. Green D. W. "Perry's chemical Engineer's Handbook", McGraw Hill, New York, 2007.
Reference Books:
1. P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi, 2007.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

PROFESSIONAL ELECTIVE III

CH1710	**MODERN SEPARATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed to

- Students will gain knowledge about recent separation methods

Course Outcomes (CO)

CO1	To understand the basics of separation process
CO2	To understand membrane separations
CO3	To understand the separation by adsorption
CO4	To understand the inorganic separations
CO5	To understand the other pervaporation and permeation techniques

UNIT – I	**BASICS OF SEPARATION PROCESS**	**9**

Review of Conventional Processes, Recent advances in Separation Techniques based on size, surface properties,ionic properties and other special characteristics of substances, Process concept, Theory and Equipment used incross flow Filtration, cross flow Electro Filtration, Surface based solid – liquid separations involving a second liquid.

UNIT – II	**MEMBRANE SEPARATIONS**	**9**

Types and choice of Membranes, Plate and Frame, tubular, spiral wound and hollow fiber Membrane Reactors and their relative merits, commercial, Pilot Plant and Laboratory Membrane permeators involving Dialysis, Reverse Osmosis, Nanofiltration, Ultra filtration and Micro filtration, CeramicHybrid process and Biological Membranes.

UNIT – III	**SEPARATION BY ADSORPTION**	**9**

Types and choice of Adsorbents, Adsorption Techniques, Dehumidification Techniques, Affinity Chromatography and Immuno Chromatography, Recent Trends in Adsorption.

UNIT – IV	**INORGANIC SEPARATIONS**	**9**

Controlling factors, Applications, Types of Equipment employed for Electrophoresis, Dielectrophoresis, Ion Exchange Chromatography and Eletrodialysis, EDR, Bipolar Membranes.

UNIT – V	**OTHER TECHNIQUES**	**9**

Separation involving Lyophilisation, Pervaporation and Permeation Techniques for solids, liquids and gases, zone melting, Adductive Crystallization, other Separation Processes, Supercritical fluid Extraction, Oil spill Management, Industrial Effluent Treatment by Modern Techniques.

	Total Periods:	45

Reference Books:

1. King, C. J., “Separation Processes”, Tata McGraw Hill, 1982.
2. Roussel, R. W., “Handbook of Separation Process Technology”, John Wiley, New York, 1987.
3. Nakagawal, O. V., “Membrane Science and Technology”’ Marcel Dekkar, 1992

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1711	WASTE WATER TREATMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To focus on the wastewater transport system and the theory and design technique for the wastewater treatment process.

Course Outcomes (CO)

CO1	To understand the Regulations – Health and Environment Concerns in waste water.
CO2	To understand the process analysis and selection
CO3	To understand the chemical unit process in water treatment
CO4	To understand the principle of biological treatment.
CO5	To understand the filtration, Membrane and ion exchanger

UNIT – I WASTE WATER TREATMENT AN OVERVIEW **9**

Terminology – Regulations – Health and Environment Concerns in waste water management – Constituents in waste water inorganic – Organic and metallic constituents.

UNIT – II PROCESS ANALYSIS AND SELECTION **9**

Components of waste water flows – Analysis of Data – Reactors used in waste water treatment – Mass Balance Analysis – Modelling of ideal and non ideal flow in Reactors – Process Selection.

UNIT – III CHEMICAL UNIT PROCESSES **9**

Role of unit processes in waste water treatment chemical coagulation – Chemical precipitation for improved plant performance chemical oxidation – Neutralization – Chemical Storage

UNIT – IV BIOLOGICAL TREATMENT **9**

Overview of biological Treatment – Microbial metabolism – Bacterial growth and energatus – Aerobic biological oxidation – Anaerobic fermentation and oxidation – Trickling filters – Rotating biological contractors – Combined aerobic processes – Activated sludge film packing.

UNIT – V ADVANCED WASTE WATER TREATMENT **9**

Technologies used in advanced treatment – Classification of technologies Removal of Colloids and suspended particles – Depth Filtration – Surface Filtration – Membrane Filtration Absorption – Ion Exchange – Advanced oxidation process.

	Total Periods:	45

Text Books:

1. Waste water Engineering Treatment and Reuse: Mc Graw Hill, G. Tchobanoglous, FI Biston, 2002.
2. Industrial Waste Water Management Treatment and Disposal by Waste Water Mc Graw Hill III Edition 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1712	**FLUIDIZATION ENGINEERING**	**L**	**T**	**P**	**C**
		2	1	0	3

OBJECTIVE

The course is aimed

- To enable the students to learn the design aspects of fluidized beds.

Course Outcomes (CO)

CO1	To understand the fundamental concepts of Fluidization
CO2	To understand the Minimum fluidization conditions
CO3	To understand the Bed expansion in liquid – Solid and gas – Solid fluidizations
CO4	To understand the Heat and mass transfer in fluidized bed systems
CO5	To understand the Single stage and multistage fluidization

UNIT – I BASICS OF FLUIDIZATION **9**

Packed bed – Velocity – Pressure drop relations – Correlations of Ergun, Kozneykarman – On set of fluidization – Properties of fluidized beds – Development of fluidization from fixed bed.

UNIT – II FLUIDIZED BED TYPES **9**

Minimum fluidization conditions – Expanded bed – Elutriation – Moving solids and dilute phase – spouted bed.

UNIT – III DESIGN ASPECTS **9**

Channeling – Bed expansion in liquid – Solid and gas – Solid fluidizations. Design aspects of fluidized bed systems.

UNIT – IV HEAT AND MASS TRANSFER IN FLUIDIZED BEDS **9**

Heat and mass transfer in fluidized bed systems – Industrial applications and case studies of fluidized bed systems.

UNIT – V OTHER TYPES OF FLUIDIZATION **9**

Single stage and multistage fluidization – Collection of fines – Use of cyclones.

Total Periods: 45

Text Books:

1. Levenspiel, "Fluidization Engineering", 2nd Edition, Butterworth – Heinmann, 1991.
2. Robert H. Perry and Don W. Green, "Perry's Chemical Engineer's Hand Book", 7th Edition, Mc Graw Hill – International, 1997.

Reference Books:

1. Rowe and Davidson, "Fluidization", Academic Press ,1971.
2. Leva, M., "Fluidization", McGraw Hill Book Co, 1959.
3. Wen-Ching Yang., "Handbook of Fluidization and Fluid-Particle Systems", Marcel Dekker Inc, 2003.

	Course Outcomes	Program Outcomes												Program Specific Outcomes	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
	CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
	CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
	CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
	CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
	CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1713	DISTILLATION	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To provide the basic knowledge on Principles of Distillation Process and Industrial Application.
- To familiarize the students, the functioning of different types of Distillation Processes
- To illustrate the concepts of various types of Distillation Processes and Design

Course Outcomes (CO)

CO1	Understanding of the Basic Principles of Distillation Process
CO2	Distinguish between Different types of Distillation Processes.
CO3	Understanding of Industrial application of Distillation Process.
CO4	Understanding the different types of Distillation Processes
CO5	And the concepts of various types of Distillation Processes and Design

UNIT – I **9**

Gibbs phase rule, phase equilibrium, ideal and non-ideal gas mixtures, Raoult's law, nonideal liquid - liquid mixtures; phase diagrams, effect of pressure on phase equilibria; Vapor Liquid Equilibria: Ideal and non-ideal binary and multi-component systems - Correlation and prediction –consistency tests; VLE of complex system-true boiling point curves-ASTM distillation, equilibrium flash vaporization curves

UNIT – II **9**

Equilibrium and simple distillation: flash vaporization of binary and multi-component systems, differential vaporization and condensation; steam distillation; fractionation of binary systems- analytical and graphical methods of determination of number of equilibrium stages.

UNIT – III **9**

Ternary systems and multi-component systems- Sorel method, Lewis-Matheson method, Thiele-Geddes method, short cut methods, graphical evaluation of number of stages for ternary systems. Complex system fractionation: Pseudo-component design method, fraction with side streams.

UNIT – IV **9**

Azeotropic distillation and extractive distillation: separation of homogeneous azeoptropes, separation of heterogeneous azeotropes, selection of addition agents-design of azeotropic distillation process, design ofextractive distillation process; Reactive Distillation and Case studies.

UNIT – V **9**

Design methods: fractionation devices, bubble cap, sieve and other types of trays-plate and column hydraulics and efficiency- plate fractionation column design methods, packed column design

Total Periods: 45

Text Books:

1. Van Winkle,M., Distillation, 2nd ed. 1967, McGraw Hill publications.
2. Doherty, M.F and Malone, M.F., Conceptual Design of Distillation systems, 2006, McGraw Hill InternationalEdn

Reference Books:
1. Holland, Multi-component Distillation. First Edn., 1963 2 Treybal,R.E.,Mass Transfer Operation, 3rd Edn., 1981, McGraw Hill 3 McCabe,W.L., Smith,J.C. and P.Harriot, Unit Operations in Chemical Engineering, VIIth Edn., 2005, McGrawHill. 4 Sherwood,T.K.,Pigford,R.L and Cr.Wilke., Mass Transfer, McGraw Hill

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

PROFESSIONAL ELECTIVE IV

CH1714	PIPING AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To impart knowledge on piping technology and instrumentation on pipelines.

Course Outcomes (CO)	
CO1	To understand the introduction, applications. Piping
CO2	To understand the Pipe sizing based on velocity and pressure drop
CO3	To understand the Different types of stresses and its impact on piping
CO4	To understand the support based on requirement and its calculation
CO5	To understand the and piping & instrumentation diagram

UNIT – I	FUNDAMENTALS OF PIPING ENGINEERING	9

Definitions, Piping Components their introduction, applications. Piping MOC, Budget Codes and Standards, Fabrication and Installations of piping.

UNIT – II	PIPE HYDRAULICS AND SIZING	9

Pipe sizing based on velocity and pressure drop consideration cost, least annual cost approach, pipe drawing basics, development of piping general arrangement drawing, dimensions and drawing of piping.

UNIT – III	PLOT PLAN	9

Development of plot plan for different types of fluid storage, equipment layout, process piping layout, utility piping layout. Stress analysis -Different types of stresses and its impact on piping, methods of calculation, dynamic analysis, and flexibility analysis.

UNIT – IV	PIPING SUPPORT	9

Different types of support based on requirement and its calculation.

UNIT – V	INSTRUMENTATION	9

Final Control Elements; measuring devices, instrumentation symbols introduction to process flow diagram (PFD)and piping & instrumentation diagram (P&ID)

Total Periods:	**45**

Text Books:
1. Piping Handbook, 6 th edition, M.L. Nayyar, P.E., Mc Graw-Hill, Inc 2. Piping Design Handbook edited by Johan J McKetta, CRC Press, 1992. 3. Luyben, W. L.," Process Modeling Simulation and Control for Chemical Engineers, McGraw Hill, 1990.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**		**5**	**6**	**7**	**8**	**9**	**10**	**1 1**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1715	**FOOD TECHNOLOGY**	**L**	**T**	**P**	**C**

OBJECTIVE

The course is aimed

- To enable the students to learn to design processing equipment's for Food Industries.

Course Outcomes (CO)

CO1	To understand the general aspects of food industry
CO2	To understand the food quality and standards
CO3	To understand the basics process and its application
CO4	To understand the concept and mechanism of preservative methods
CO5	To understand the concept of utilization of food products

UNIT – I	**AN OVERVIEW**	**9**
General aspects of food industry; world food needs and Indian situation.		
UNIT – II	**FOOD CONSTITUENTS, QUALITY AND DERIVATIVE FACTORS**	**9**
Constituents of food; quality and nutritive aspects; food additives; standards; deteriorative factors and their control		
UNIT – III	**GENERAL ENGINEERING ASPECTS AND PROCESSING METHODS**	**9**
Preliminary processing methods; conversion and preservation operations.		
UNIT – IV	**FOOD PRESERVATION METHODS**	**9**
Preservation by heat and cold; dehydration; concentration; drying irradiation; microwave heating; sterilization and pasteurization; fermentation and pickling; packing methods.		
UNIT – V	**PRODUCTION AND UTILISATION OF FOOD PRODUCTS**	**9**
Cereal grains; pulses; vegetables; fruits; spices; fats and oils; bakery; confectionery and chocolate products; soft and alcoholic beverages; dairy products; meat; poultry and fish products.		
	Total Periods:	**45**

Text Books:

1. Heid J.L. Joslyn M.A., Fundamentals of Food Processing Operation, The AVI publishing Co., West port 1967.
2. Potter N.N., Food Science, The AVI publishing Co., Westport, 1963.

Reference Books:

1. Heldman D.R., Food Process Engineering, The AVI publishing co., 1975. 2. Charm S.E., The Fundamentals of Foods Engineering, The AVI Publishing Co., Westport, 1963.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1716	BIOCHEMICAL ENGINEERING	L	T	P	C

OBJECTIVE

The course is aimed

- This course mainly discusses the role of enzymes and microbes in biotechnology sectors.

Course Outcomes (CO)

CO1	To understand the development and scope of biochemical engineering
CO2	To understand the modulation and regulation of enzyme activity
CO3	To understand the models for cellular growth unstructured, structured and cybernetic models
CO4	To understand the determination of oxygen transfer rates, power requirements
CO5	To understand the disruption-mechanical and non-mechanical methods

UNIT – I INTRODUCTION 9

Industrial biochemical processes with typical examples, comparing chemical and biochemical processes, development and scope of biochemical engineering as a discipline. Industrially important microbial strains; their classification; structure; cellular genetics.

UNIT – II KINETICS OF ENZYME ACTION 9

Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, modulation and regulation of enzyme activity, types of inhibition. Immobilized enzyme technology: enzyme immobilization, Immobilized enzyme kinetics: effect of external mass transfer resistance.

UNIT – III KINETICS OF MICROBIAL GROWTH 9

Kinetics of cellular growth in batch and continuous culture, models for cellular growth unstructured, structured and cybernetic models, medium formulation. Thermal death kinetics of cells and spores, stoichiometry of cell growth and product formation, Design and analysis of biological reactors.

UNIT – IV TRANSPORT PHENOMENA 9

Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, power requirements for sparged and agitated vessels, scaling of mass transfer equipment,heat transfer.

UNIT – V DOWN STREAM PROCESSING 9

Down stream processing: Strategies to recover and purify products; separation of insoluble products, filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis),chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification –crystallization and drying.

Total Periods: 45

Text Books:

1. Biochemical engineering fundamentals by J.E.Bailey and D.F.Ollis, 2nd ed, 1986, McGraw Hill.
2. Bioprocess Engineering by Michael L. Shuler and FikretKargi, 2nd edition, Pearson education.

Reference Books:
1. Biochemical engineering by James M.Lee – Prentice-Hall-1992. 2. Bioprocess engineering principles, Pauline M. Doran, Academic Press. 3. Biochemical Engineering, H.W. Blanch and D.S. Clark, Marcel Dekker, 1997.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

GE1003	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, varietyof moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

Course Outcomes (CO)

CO1	Define the dimensions or senses of engineering ethics and describe the various theories of moral development.
CO2	Describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.
CO3	Understand significance of safety and risk assessment when developing engineering products.
CO4	Understand the social responsibilities and intellectual property rights of engineers.
CO5	Understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

UNIT – I	**HUMAN VALUES**	**9**

Morals, values and Ethics; Integrity; Work ethics; Service learning; Civic virtue; Respect for others; Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self- confidence, Character; Spirituality; Introduction to Yoga and meditation for professional excellence and stress management.

UNIT – II	**ENGINEERING ETHICS**	**9**

Senses of 'Engineering Ethics' – Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory; Gilligan's theory; Consensus and Controversy; Models of professional roles; Theories about right action; Self–interest; Customs and Religion; Uses of Ethical Theories.

UNIT – III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**

Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law.

UNIT – IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**

Safety and Risk – Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk; Respect for Authority; Collective Bargaining; Confidentiality; Conflicts of Interest; Occupational Crime; ProfessionalRights; Employee Rights; Intellectual Property Rights (IPR), Discrimination.

UNIT – V	GLOBAL ISSUES	9
Multinational Corporations; Environmental Ethics; Computer Ethics; Weapons Development; Engineers as Managers – Consulting Engineers, Engineers as Expert Witnesses and Advisors; Moral Leadership; Code of Conduct; Corporate Social Responsibility.		
	Total Periods:	**45**

Text Books

1.Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2.Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1.Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2.Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2012.
3.John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
4.Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5.Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd, New Delhi, 2013.
6.World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	3	2	2	3	2	3	2	2	3	2	1	1
CO2	1	2	3	2	2	3	2	3	2	2	3	2	1	1
CO3	1	2	3	2	2	3	2	3	2	2	3	2	1	1
CO4	1	2	3	2	2	3	2	3	2	2	3	2	1	1
CO5	1	2	3	2	2	3	2	3	2	2	3	2	1	1

PROFESSIONAL ELECTIVE V

CH1808	OPTIMIZATION OF CHEMICAL PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- Students will gain knowledge about process modelling and optimization

Course Outcomes (CO)

CO1	To understand the applications of optimization in chemical engineering
CO2	To understand the conditions for optimum; region elimination methods
CO3	To understand the search methods; indirect search methods
CO4	To understand the dynamic and integer programming
CO5	To understand the equipment design, resource allocation and inventory control.

UNIT – I	INTRODUCTION	9
Introduction to optimization; applications of optimization in chemical engineering; classification of optimization problems.		

UNIT – II	SINGLE VARIABLE OPTIMIZATION	9
Necessary and sufficient conditions for optimum; region elimination methods; interpolation methods; direct root methods.		
UNIT – III	**MULTIVARIABLE OPTIMIZATION WITHOUT AND WITH CONSTRAINTS**	**9**
Necessary and sufficient conditions for optimum; direct search methods; indirect search methods.		
UNIT – IV	**OTHER OPTIMIZATION METHODS**	**9**
Introduction to geometric, dynamic and integer programming and genetic algorithms.		
UNIT – V	**APPLICATIONS OF OPTIMIZATION**	**9**
Formulation of objective functions; fitting models to data; applications in fluid mechanics, heat transfer, mass transfer, reaction engineering, equipment design, resource allocation and inventory control.		
	Total Periods:	**45**
Text Books:		
1. Rao, S. S., Engineering Optimization - Theory and Practice, Third Edition, John Wiley & Sons, New York, 1996. 2. Edgar, T.F., Himmelblau, D.M., "Optimisation of Chemical Processes ", McGraw-Hill Book Co., New York, 2003. 3. Reklaitis, G.V., Ravindran, A., Ragsdell, K.M. "Engineering Optimisation ", John Wiley, New York, 1980		

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1809	FERMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To enable the students to understand the role of fermentation microorganisms and (bio) chemical activities and conversions that take place during fermentations, and their impact on quality.

Course Outcomes (CO)	
CO1	To understand the Microbial Enzymes – Microbial metabolites
CO2	To understand the Flow measurement and control
CO3	To understand the Different centrifuge cell description
CO4	To understand the chemical and biological – Aerobic process – Anaerobic treatment
CO5	To understand the Air sterilization – Heating and cooling – Recovery costs..

UNIT – I	INTRODUCTION TO FERMENTATION PROCESSES	9
Microbial biomass – Microbial Enzymes – Microbial metabolites – Recombinant products – Transformation Process – Microbial growth binetus – Isolation and preservation and improvement of industrially important micro organism.		

UNIT – II	INSTRUMENTATION AND CONTROL	9
Measurement of process variables – Temperature and its control – Flow measurement and control – Gases and Liquids – Pressure measurement and control – Cenline analysis – Control System – 93 Combination of Control Systems – Computer application in termentation technology.		
UNIT – III	**RECOVERY AND PURIFICATION OF FERMENTATIONPRODUCTS**	**9**
Removal of Microbial cells – Foam Separation – Precipitation Filtration – Different Filtration process – Centifugation – Different centrifuge cell description – Different methods – Solvent recovery – Superfluid extraction – Chromatography – Membrane processes – Drying – Crystallization – Whole growth processing.		
UNIT – IV	**EFFLUENT TREATMENT**	**9**
Strength of fermentation effluent – Treatment and disposal – Treatment Processes – Physical, chemical and biological – Aerobic process – Anareobic treatment.		
UNIT – V	**FERMENTATION ECONOMICS**	**9**
Introduction – Isolation of micro organisms of industrial interest – Strain improvement – Market potential – Plant and equipment – Media – Air sterilization – Heating and cooling – Recovery costs.		
	Total Periods:	**45**
Text Books:		
1. Principles of fermentation Technology P.Stanbury Buttuworth Hanman – 1999. 2. Fermentation and Biochemical Engineering Handbook – C.C Haber. William Andrew II Edition 2007. 3. Bioprocess Engineering Hydersen B.K Nancy A.delaK.L.Nelsen Wiley Interscience,1994.		

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1810	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactorsand safe disposal of nuclear wastes.

Course Outcomes (CO)

CO1	Ability to understand nuclear reaction process
CO2	Able to gain knowledge on nuclear fuels.
CO3	Gaining knowledge in nuclear fuel reprocessing technology
CO4	Understanding of nuclear power plants
CO5	Acquiring knowledge in safety and disposal of nuclear fuels

UNIT – I	NUCLEAR PHYSICS	9
Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life neutron interactions-cross sections.		
UNIT – II	**NUCLEAR REACTOR**	**9**
Nuclear reactors: types of fast breeding reactors. Design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.		

UNIT – III	NUCLEAR REACTIONS AND REACTION MATERIALS	9
Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification. Zirconium, thorium, beryllium.		
UNIT – IV	**PROPERTIES OF IRRADIATED FUEL - SEPARATION OF REACTOR PRODUCTS**	**9**
Uses of stable isotopes and methods of isotope separation principles of isotope separation - Separation of isotopes of light elements - separation of isotopes of heavy elements.		
UNIT – V	**SAFETY AND DISPOSAL**	**9**
Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety nuclear waste-types of waste and its disposal-radiation hazards and their prevention weapons proliferation.		
	Total Periods:	**45**

Text Books:

1. Thomas J.Cannoly, “Fundamentals of Nuclear Engineering” 1978, John Wiley.
2. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, 1987, Hemisphere publishing, New York.

REFERENCES:

1. Wakil M.M.El., “Power Plant Technology” 1984, Mc Graw

Course Outcomes	Program Outcomes										Program Specific Outcomes	
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1811	ENERGY TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed to

- Students will gain knowledge about different energy sources

Course Outcomes (CO)

CO1	To understand the general classification of energy
CO2	To understand the Thermal, hydel and nuclear reactors
CO3	To understand the solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation
CO4	To understand the hydrolysis & hydrogenation, solvolysis, biocrude
CO5	To understand the Energy management importance, duties and responsibilities.

UNIT – I	ENERGY	9
Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.		
UNIT – II	**CONVENTIONAL ENERGY**	**9**
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.		

UNIT – III	NON-CONVENTIONAL ENERGY	9
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling,solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.		

UNIT – IV	BIOMASS ENERGY	9
Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion,Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.		
UNIT – V	**ENERGY CONSERVATION**	**9**
Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.		
	Total Periods:	**45**

Text Books:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
4. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

Reference Books:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger 100 C.E.M, Faiment Press 2008

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

PROFESSIONAL ELECTIVE VI

CH1812	FERTILIZER TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- Students will gain knowledge about petroleum refining process and production of petrochemical products

Course Outcomes (CO)	
CO1	To understand the Synthetic fertilizers
CO2	To understand the Nitrogenous Fertilizers
CO3	To understand Toyo-Koatsu total recycle process
CO4	To understand the Potassium Fertilizers
CO5	To understand the Miscellaneous Fertilizer and Bio Fertilizers

UNIT – I		9
Introduction to Chemical Fertilizers: Chemical inorganic Fertilizers and Organic manures. Types of fertilizers: Mixed, complex and Granulated, plant nutrients.		
UNIT – II		**9**
Processes for Raw Materials: Processes for manufacture of ammonia, nitric acid, phosphoric acid and sulphuricacid.		
UNIT – III		**9**
Nitrogenous and Potassium Fertilizers: Processes for urea and di-ammonium phosphate. Recovery of Potassium salts, processes for ammonium chloride and ammonium sulphate.		
UNIT – IV		**9**
Complex Fertilizers: Processes for nitro - phosphates and complex NPK fertilizers liquid fertilizers		
UNIT – V		**9**
Phosphatic Fertilizers and Indian Fertilizer Industry: Single and Triple Superphosphate, biofertilizer. Fertilizer Industry in India		
	Total Periods:	**45**

Reference Books:

1. Strelzoff, "Technology and Manufacture of Ammonia", 2nd Edn., Wiley, 1981.
2. L. J. Carpentire, "New Developments in Phosphate Fertilizer Technology", Elsevier, 1971.
3. "Handbook on Fertilizer Technology", Fertilizer Association of India, Near JNU, New Delhi 1992.
4. V. Slack, "Phosphoric Acid", 2nd Edn., Marcell Dekkar , 1968

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1813	PULP AND PAPER TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- Gaining Knowledge of pulp & paper industry, mill Operations, products, process variables, equipment,and terminology.
- Increasing knowledge of how the Pulp &Paper processes affect product properties, in order to improve product quality and troubleshoot variations in quality.

Course Outcomes (CO)	
CO1	Understand the basic concepts of pulp and paper technology to produce paper
CO2	Apply reactions and unit operations steps to manufacture pulp.
CO3	Understand the operation of equipments employed in pulp and paper industry
CO4	Apply waste disposal techniques in pulp and paper industry.
CO5	Perform various chemical tests to monitor quality of raw material, output quality and influent/effluent of pulp and paper industry

UNIT – I	**INTRODUCTION**	**9**
Introduction to pulp and paper technology – Wood haves dry – Wood as a raw material.		
UNIT – II	**WOODYARD OPERATION**	**9**
Woodyard operation - Mechanical pulping – Chemical pulping – Secondary fibre pulp processing.		
UNIT – III	**PAPER MACHINE**	**9**
Paper Machine wet and addition paper machine dry and operation – Paper machine - Wet and operation		
UNIT – IV	**PAPER AND PAPERBOARD**	**9**
Paper and paperboard frames and products – Surface treatments – Finishing operation– End uses.		
UNIT – V	**PROPERTIES AND TESTING OF PULP AND PAPER**	**9**
Properties and Testing of pulp and paper Process control – Quality assurance – Water and air pollution control.		
	Total Periods:	**45**

1. Monica ER Monica, Goran Gellerstcdt Gunnar Hennksson De Gneyter, Pulp and paper chemistry and Technology, 2009.
2. Rao, M.Gopal, Sitting, Marshall, Dryden's outlines of Chemical Technology, 3rd Edition, Affilated East-West Press Pvt. Ltd.

Reference Books:

1. Biermann, Christopher J Handbook of Pulping and Papermaking,.,ISBN-13: 978- 0120973620
2. -Metcalf & Eddy, Wastewater Engineering, Treatment, Dispose and Reuse, Inc. IV EDN, 2002.
3. Austin, George T., Shreves' Chemical Process Industries, 5th Edition, McGraw-Hill Education India Pvt. Ltd - New Delhi.
4. Bhatia, S.C. Environmental Pollution and Control in Chemical Process Industries Second Edition 2011.
5. Trivedi, R.K., Pollution Management in Industries, Environmental Publication, Karad, India

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1814	**MIXING THEORY AND PRACTICE**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To teach the students about the importance of mixing in chemical process industries.
- To teach the students about the heat and mass transfer coefficient and its reaction.
- To provide basic knowledge about the Non Newtonian Liquids.

Course Outcomes (CO)	
CO1	Understand the Basics of Chemical Process Industries.

CO2	Able to select the equipment for mixing
CO3	Able to design the equipment for mixing
CO4	Understand heat and mass transfer aspects in mixing
CO5	Understand mixing in non Newtonian liquids

UNIT – I		**9**
Examples of processes signifying importance of mixing - Goodness of mixing: Qualification - Significance of dimensionless groups - dimensional analysis - power number correlation - Expressions for NRe, NFr, NWe, NPr from their definitions as ratios applied to resisting forces - analogy between drag coefficient and power number		
UNIT – II		**9**
Effect of mixing on chemical reactions - introduction -batch reactor and CSTR comparison - Residence time distribution - mixing concepts and models - RTD functions J(8) and J'(8) - Average residence time from RTD - RTD from response measurements - Interpretation of response data by mixing models - Imperfect mixing in Stirred tanks - transient analysis of chemical reactors in series.		
UNIT – III		**9**
Heat transfer promotion by mixing - mixing and overall heat transfer coefficient - Heat transfer correlation for helical coils and jacketed vessels - transient analysis of heat transfer - isothermal heating or cooling medium - non isothermal cooling medium - external heat exchanger - isothermal/non isothermal heating/cooling medium -Design calculation for heat transfer in mixing vessels - Stirred tank scale-up heat transfer consideration - Scale up of batch and other reactors.		
UNIT – IV		**9**
Mixing and mass transfer - introduction - Liquid liquid extraction - equipments - batch - continuous differential - Triangular representation of concentration - phase equilibrium diagram - Material balance for stage wise contact - counter current continuous and differential contact - problems - Interfacial phenomena - drop size distribution - coalescence - breakage - emulsion - surfactant - Mass transfer coefficient - two film concept - mass transfer modeling - Correlation for mass transfer coefficient - stage efficiency.		
UNIT – V		**9**
Non-Newtonian liquids mixing - introduction, pseudoplastic, dilatant, Bingham plastic liquid, - thixotropic and rheopectic liquids - shear rate - shear stress behaviour - apparent viscosity - Power curve for non-Newtonian liquids - Viscometry - shear in stirred tanks - Shear in stirred tanks related to shear in pipes, apparent viscosity in pipe-line flow and stirred tanks - discussion of experimental work literature - Reynolds number modification - Practical application of Non-Newtonian mixing.		
	Total Periods:	**45**
Text Books:		
1. Holland and Chapman, Liquid Mixing and processing in Stirred Tanks, Reinhold Publishing Co-operation, 1966, New York and London. 2. Uhl and Gray, Mixing theory and practice, Vol.1 and II, 1967, Academic Press, New York and London.		
Reference Books:		
1. Shinji Nagata, Mixing Principles and Applications, 1975, Holted Press , Tokyo		

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

CH1815	PETROLEUM REFINING AND PETROCHEMICALS	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- Students will gain knowledge about petroleum refining process and production of petrochemical products

Course Outcomes (CO)

CO1	To understand the Testing of Petroleum Products
CO2	To understand the Cracking, Thermal Cracking
CO3	To understand the Removal of Sulphur Compounds
CO4	To understand the Catalytic Reforming of Petroleum Feed Stocks
CO5	To understand the Production of Petrochemicals

UNIT – I **9**

Origin, Formation and Evaluation of Crude Oil. Testing of Petroleum Products. Refining of Petroleum – Atmospheric and Vaccum Distillation.

UNIT – II **9**

Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen.

UNIT – III **9**

Treatment Techniques: Removal of Sulphur Compounds in all Petroleum Fractions to improve performance, Solvent Treatment Processes, Dewaxing, Clay Treatment and Hydrofining.

UNIT – IV **9**

Cracking of Naphtha and Feed stock gas for the production of Ethylene, Propylene, Isobutylene and Butadiene. Production of Acetylene from Methane, Catalytic Reforming of Petroleum Feed Stocks and Extraction of Aromatics.

UNIT – V **9**

Production of Petrochemicals like Dimethyl Terephathalate (DMT), Ethylene Glycol, Synthetic Glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol and Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and Production of Carbon Black.

Total Periods: 45

Text Books:

1. Nelson, W. L., “Petroleum Refinery Engineering”, 4th Edn., McGraw Hill, New York, 1985.
2. Bhaskara Rao, B. K., “Modern Petroleum Refining Processes”, 2nd Edn., Oxford and IBH Publishing Company, New Delhi, 1990.
3. Bhaskara Rao, B. K. “A Text on Petrochemicals”, 1st Edn., Khanna Publishers, New Delhi, 1987.
4. Wiseman. P., Petrochemicals, UMIST Series in Science and Technology.
5. H. Steiner, Introduction to petrochemicals Industry’, Pergamon, 1961.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	3	3	1	2	1	2	1	3	2	1	3	1	1
CO2	3	3	1	3	2	1	3	2	1	3	2	1	2	1
CO3	3	1	3	3	1	1	3	2	1	1	1	1	1	2
CO4	1	3	3	2	2	1	2	1	3	3	1	2	1	1
CO5	2	1	3	3	2	1	2	3	1	2	3	3	1	2

OPEN ELECTIVE I

OCE103	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To impart knowledge on Environmental management and Environmental Impact Assessment.

Course Outcomes (CO)

CO1	Carry out scoping and screening of developmental projects for environmental and social assessments
CO2	Explain different methodologies for environmental impact prediction and assessment
CO3	Plan environmental impact assessments and environmental management plans
CO4	Evaluate environmental impact assessment reports
CO5	To understand the Membrane Applications.

UNIT – I INTRODUCTION 9

Impact of development projects–EIA Notifications-Urbanization–Meaning– Activities involved– Effects on environment-Environmental Impact Assessment(EIA)-Environmental Impact Statement(EIS) –

UNIT – II METHODOLOGIES 9

Methods of EIA–Checklists–Matrices–Networks–Cost-benefit analysis–Analysis of alternatives – Uncertaintyin EIA

UNIT – III PREDICTION AND ASSESSMENT 9

Assessment of Impact on land, water, air, social & cultural activities and on flora& Fauna- Mathematical models- Public participation–SIA Judgment authorities-Rapid EIA

UNIT – IV ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on environment–Options for mitigation of impact on water, air, land and on flora& fauna- Addressing the issues related to the Project Affected People.

UNIT – V CASESTUDIES 9

EIA for infrastructure projects–Dams–Highways–Multi-storey Buildings–Water Supply and Drainage Projects–Waste water treatment plants, STP

Total Periods: 45

Text Books:

1. Canter,R.L.,“Environmental Impact Assessment”, McGraw-Hill Inc.,New Delhi,1996.
2. Richard K. Morgan., “Environmental Impact Assessment” Kluwer Academic Publications, London, 2002

Reference Books:

1. John G. Rauand David C Hooten (Ed).,“Environmental Impact Analysis Handbook”, McGraw-Hill BookCompany,1990.
2. “Environmental Assessment Sourcebook”,Vol.I,II&III. The World Bank, Washington, D.C., 1991.
3. Judith Petts,“Handbook of Environmental Impact Assessment Vol.I&II”, Blackwell Science, 1999.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OCS101	INTRODUCTION TO C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To express algorithms and draw flowcharts in a language independent manner.
- To teach how to write modular, efficient and readable C programs
- To impart knowledge in creating and using Arrays of the C data types.
- To describe the techniques for creating program modules in C using functions and recursive functions.

Course Outcomes (CO)

CO1	Write, compile and debug programs in C language.
CO2	Use different data types in a computer program.
CO3	Design programs involving decision structures, loops, arrays and functions
CO4	Identify the difference between call by value and call by reference
CO5	Use pointers to understand the dynamics of memory, Create and perform different file operations

UNIT – I **9**

Introduction to the C Language – Algorithm, Pseudo code, Flow chart, Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output, Operators(Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associatively, Expression Evaluation, Type conversions.

UNIT – II **9**

Statements- Selection Statements (making decisions) – if and switch statements, Repetition statements (loops)- while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Simple C Program examples

UNIT – III **9**

Functions- Introduction to Structured Programming, Functions- basics, user defined functions, inter function communication (call by value, call by reference), Standard functions. Storage classes-auto,

UNIT – IV **9**

Arrays– Basic concepts, one-dimensional arrays, two – dimensional arrays, multidimensional arrays, C programming examples Pointers – Introduction (Basic Concepts), pointers to pointers, compatibility, Pointer Applications, Arrays and Pointers, Pointer Arithmetic, memory allocation functions, array of pointers, pointers to void, pointers to functions, command –line arguments, Introduction to structures and unions.

UNIT – V **9**

Strings – Concepts, C Strings, String Input / Output functions, string manipulation functions, string /data conversion. Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling),Positioning functions.

Total Periods: 45

Text Books:

1. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd edition

Reference Books:

1. Let Us C Yashavant kanetkar BPB.
2. Absolute beginner's guide to C, Greg M. Perry, Edition 2, Publisher: Sams Pub., 1994.
3. Computer Programming and Data Structures by E Balagurusamy, Tata McGraw Hill.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1

CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OEE105	**SOLAR ENERGY UTILIZATION**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To learn the fundamental concepts of solar energy and radiation collecting instruments
- To study about approaches for the storage of solar energy along with solar energy collectors

Course Outcomes (CO)

CO1	To understand the History of solar energy utilization - Solar radiation and modeling
CO2	To understand the Types – Nuclear waste
CO3	To understand the Materials for flat plate collector and their properties
CO4	To understand the solar pond - solar thermal power generation
CO5	To understand the Thermal Storage - Electrical Storage

UNIT – I SOLAR RADIATION **9**

History of solar energy utilization - Solar radiation and modeling - Empirical equations for predicting the availability of solar radiation – Measurement of global, direct and diffuse radiation – Radiation computations on inclined surfaces – Angstrom's turbidity - Solar chart - Standard radiation scale.

UNIT – II SOLAR RADIATION MEASUREMENT AND ESTIMATION **9**

Measurement of solar radiation - Solar energy measuring instruments – Pyranometer – Pyrheliometer – Sunshine recorder - Estimation of average solar radiation - Ratio of beam and total radiation on tilted surface ofthat on horizontal surface.

UNIT – III SOLAR COLLECTORS **9**

Flat plate collector - Materials for flat plate collector and their properties - Thermal Analysis of Flat- plate Collector and Useful Heat Gained by the fluid - fin efficiency - collector efficiency factor - Heat Removal Factor - Focusing collectors - Types and applications of focusing collectors

UNIT – IV SOLAR ENERGY APPLICATIONS **9**

Introduction and principle of operation of solar cooker - solar air heater - solar water heater - solar distillation - solar pond - solar thermal power generation – Greenhouse - Solar PV system.

UNIT – V STORAGE OF SOLAR ENERGY **9**

Types of Energy Storage - Thermal Storage - Electrical Storage - Chemical Storage - hydro-storage

Total Periods: 45

Reference Books:

1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.
2. Sukhatme S.P., Solar Energy, Tata McGraw Hills P Co.,3rd Edition, 2008.
3. Jean Smith Jensen, Applied solar energy research: a directory of world activities and bibliography of significant literature, Volume2, Association for Applied Solar Energy, Stanford Research Institute, 2009.
4. Duffie, J.A., an
5. Jui Sheng Hsieh, Solar Energy Engineering, Prentice- Hall, 2007.
6. Garg, H.P.,Treatise on Solar Energy, John Willey & Sons, 2006.
7. 7. Anna Mani, S Rangarajan: Handbook of Solar Radiation Data for India, Allied Publishers, 2006.

	Course Outcomes	Program Outcomes												Program Specific Outcomes	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
	CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
	CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
	CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
	CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
	CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OBT101	**INDUSTRIAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

Course Outcomes (CO)

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

UNIT – I	**OVERVIEW OF THE CELL**	**9**

Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.

UNIT – II	**MICROBIAL GROWTH: PURE CULTURE TECHNIQUES**	**9**

Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures.

Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.

UNIT – III	**MANAGEMENT OF WASTE**	**9**

Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting

UNIT – IV	Bioremediation	**9**

Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex-situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.

UNIT – V	**BIOENERGY & BIOMINING**	**9**

Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.

Total Periods:	**45**

Text Books:
1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc. 2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,
Reference Books:
1. Environmental Biotechnology - Allan Stagg.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OBT102	**HAZARDOUS WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- Understand the type, nature and treatment of hazardous wastes.

Course Outcomes (CO)		
CO1	To understand Hazardous Solid Waste	
CO2	To introduce students to basic concepts of planning and management of hazardous waste management.	
CO3	The content involves importance of Biomedical waste management	
CO4	To understand Radioactive waste management	
CO5	To understand the E – Waste Management.	
UNIT – I	**INTRODUCTION**	**9**
Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances		
UNIT – II	**HAZARDOUS WASTES MANAGEMENT**	**9**
Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment Technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification- Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste Landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques		
UNIT – III	**BIOMEDICAL WASTE MANAGEMENT**	**9**
Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection - disposal. Infection control Practices.		
UNIT – IV	**RADIOACTIVE WASTE MANAGEMENT**	**9**
Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.		

UNIT – V	E-WASTE MANAGEMENT	9
Regulatory aspects of E-l Waste management, Waste characteristics- Generation–- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management		
	Total Periods:	**45**

Text Books:

1. Hazardous waste management CharlesA.Wentz.Second edition 1995.McGraw Hill international.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.
3. Criteria for hazardous waste landfills–CPCBguidelines2000

Reference Books:

1. Basic Hazardous waste management, "William C.Blackman.Jr", Third Edition, 2001, Lewis Publishers
2. Integrated solidwaste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.
3. Criteria for hazardous waste landfills–CPCB guidelines 2000.
4. Standard handbook of Hazardous waste treatment and disposal by Harry M. Freeman, McGraw Hill 1997.
5. Management of Solid waste in developing countries by Frank Flint off, WH Original publication.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OEE106	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- Understand and analyse the energy data of industries

Course Outcomes (CO)

CO1	the students can able to analyse the energy data of industries
CO2	To understand the energy pricing, energy
CO3	Can carry out energy accounting and balancing
CO4	Conduct energy audit and suggest methodologies for energy savings and Utilize the available resources in optimal ways
CO5	Can suggest methodologies for energy savings

UNIT – I	INTRODUCTION	9
Energy - Power – Past & Present scenario of World; National Energy Consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing		

UNIT – II	ELECTRICAL SYSTEMS	9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		
UNIT – III	**THERMAL SYSTEMS**	**9**
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories		
UNIT – IV	**ENERGY CONSERVATION IN MAJOR UTILITIES**	**9**
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets		
UNIT – V	**ECONOMICS**	**9**
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		
	Total Periods:	**45**

Text Books:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004.

Reference Books:

1. Witte L.C., Schmidt P.S., Brown D.R, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford,1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Murphy. W.R. and G. Mc KAY "Energy Management" Butterworths, London 1987.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OPEN ELECTIVE II

OBT103	FUEL CELL CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To create awareness about alternate clean fuel available.
- To familiarize the students with the concepts and chemistry of fuel cell

Course Outcomes (CO)	
CO1	Students will be aware of alternate energy sources and its importance of it.
CO2	To understand the Fuel cell kinetics
CO3	To understand the Fuel cell characterization techniques
CO4	To understand the principle of renewable sources and its storage.
CO5	To understand the Fuel cell power plants and its portable applications

UNIT – I	INTRODUCTION	9
Overview of fuel cells: Low and high temperature fuel cells; Fuel cell thermodynamics - heat, work potentials, prediction of reversible voltage, fuel cell efficiency.		

UNIT – II	FUEL CELL KINETICS	9
Fuel cell reaction kinetics - electrode kinetics, overvoltage, Tafel equation, charge transfer reaction, exchange currents, electro catalysis - design, activation kinetics, Fuel cell charge and mass transport - flow field, transport in electrode and electrolyte.		
UNIT – III	**CHARACTERIZATION TECHNIQUES**	**9**
Fuel cell characterization - in-situ and ex-situ characterization techniques, i-V curve, frequency response analysis; Fuel cell modeling and system integration: - 1D model – analytical solution and CFD models.		
UNIT – IV	**RENEWABLE SOURCES**	**9**
Balance of plant; Hydrogen production from renewable sources and storage; safety issues, cost expectation andlife cycle analysis of fuel cells.		
UNIT – V	**APPLICATIONS OF FUEL CELL**	**9**
Fuel cell power plants: fuel processor, fuel cell power section (fuel cell stack), power conditioner; automotive applications, portable applications		
	Total Periods:	**45**

Text Books:

1. Gregor Hoogers, "Fuel Cell Technology Handbook", CRC Press, 2003.
2. R.P. O'Hayre,S. Cha, W. Colella, F.B. Prinz, "Fuel Cell Fundamentals", Wiley, 2006.
3. A. J.Bard, L. R. Faulkner, "Electrochemical Methods", Wiley, 2004

REFERENCES

1. S. Basu, "Fuel Cell Science and Technology", Springer, 2007.
2. H. Liu, "Principles of Fuel Cells", Taylor & Francis, 2006.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OEE102	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To explain concept of various forms of renewable energy
- To outline division aspects and utilization of renewable energy sources for both domestics and industrial applications and to analysis the environmental and cost economics of using renewable energy sources compared to fossil fuels.

Course Outcomes (CO)

CO1	Summarize the current energy scenario – Auditing – production – planning and benchmarking
CO2	Analyze the basic concepts, advantages limitations and applications of solar energy utilization
CO3	Analyze the basic concepts, advantages limitations and applications of wind energy utilization

CO4	Analyze the basic concepts, advantages limitations and applications of bio-energy utilization
CO5	Prioritize the options of other energy sources – Ocean energy, geothermal energy, fuel cells

UNIT – I	**INTRODUCTION TO ENERGY**	**9**

Indian Energy Scenario – Types & Forms of Energy - Primary / Secondary Energy Sources – Energy Conservation – Need – EC Act 2003 : Salient Features – Energy Intensive Industries – Barriers -Roles & Responsibility of Energy Managers – Energy Auditing : Preliminary & Detailed - Benchmarking .

UNIT – II	**SOLAR ENERGY**	**9**

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant – Net metering concept.

UNIT – III	**WIND ENERGY**	**9**

Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy – Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.

UNIT – IV	**BIO-ENERGY**	**9**

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction – biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy programme in India.

UNIT – V	**OTHER TYPES OF ENERGY**	**9**

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plants - ocean wave energy conversion - tidal energy conversion – small hydro – geothermal energy - geothermal power plants – hydrogen production and storage - Fuel cell – principle of working - various types - construction and applications.– Energy scenario in India – Growth of energy sector and its planning in India.

Total Periods: 45

Text Books:

1. Sukhatme, S.P., J.K.Nayak, Solar Energy, III Edn. 2008,Tata McGraw Hill,.
2. Twidell, J.W. and Weir, A., Renewable Energy Sources,1986, EFN Spon Ltd..

Reference Books:

1. Kishore VVN, Renewable Energy Engineering and Technology, 2012, Teri Press, New Delhi
2. Peter Gevorkian, Sustainable Energy Systems Engineering, 2007, McGraw Hill
3. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, 1996, Oxford University Press, U.K,
   3. Yogi Goswami, Kreith, F and Kreider, J. F., Principles of Solar Engineering, 2000, McGraw-Hill, IIEdn.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OME102	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed

- To demonstrate knowledge and understanding of Taguchi's approach
- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE) To develop skills to design and conduct experiments using DOE and Taguchi's approach
- To develop competency for analyzing the data to determine the optimal process parameters that optimize the process.

Course Outcomes (CO)

CO1	To understand the fundamental principles of Classical Design of Experiments
CO2	To apply DOE for process understanding and optimization
CO3	To apply Taguchi based approach to evaluate quality
CO4	To describe the Taguchi's approach to experimental design for process performance robustness
CO5	To understand the Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm

UNIT – I **FUNDAMENTALS OF EXPERIMENTAL DESIGNS** **9**

Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principlesof design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT – II **SINGLE FACTOR EXPERIMENTS** **9**

Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT – III **FACTORIAL DESIGNS** **9**

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT – IV **SPECIAL EXPERIMENTAL DESIGNS** **9**

Blocking and Confounding in 2K Designs- blocking in replicated design- 2K Factorial Design in two blocks- Complete and partial confounding- Confounding 2K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2K Design- introduction to response surface methods, central composite design

UNIT – V **TAGUCHI METHODS** **9**

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies

Total Periods: 45

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012
2. Krishnaiah K, and Shahabudeen P, Applied Design of Experiments and Taguchi Methods, PHI, India, 201

Reference Books:

1. 1.Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.
3. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation,and Discovery", 2nd Edition, Wiley, 2005.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OBT104	**BIOSENSORS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- understand protein based biosensors and their enzyme reactivity, stability and their application

Course Outcomes (CO)

CO1	The students will able to understand protein-based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nano chip analyzer
CO5	To understand the Future direction in biosensor research

UNIT – I	**PROTEIN BASED BIOSENSORS**	**9**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nano crystalline Diamond thin film for processing		
UNIT – II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		
UNIT – III	**ELECTRO CHEMICAL APPLICATION**	**9**
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		
UNIT – IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		
UNIT – V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bio nanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		
	Total Periods:	**45**

Text Books:
1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
Reference Books:
1. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007 2. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OME106	**TESTING OF MATERIALS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed

- To understand the various destructive and non-destructive testing methods of materials and its industrial applications

Course Outcomes (CO)

CO1	Ability to use the different technique and know its applications and limitations
CO2	Identify suitable testing technique to inspect industrial component
CO3	To understand the Visual inspection, Liquid penetrant test
CO4	To understand the Differential scanning calorimetry
CO5	To understand the Thermomechanical and Dynamic mechanical analysis

UNIT – I	**INTRODUCTION TO MATERIALS TESTING**	**9**

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT – II	**MECHANICAL TESTING**	**9**

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT – III	**NON DESTRUCTIVE TESTING**	**9**

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT – IV	**MATERIAL CHARACTERIZATION TESTING**	**9**

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT – V	**OTHER TESTING**	**9**

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo- mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

Total Periods:	**45**

Text Books:
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009. 2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000. 3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.
Reference Books:
1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978. 2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA. 3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

OBT105	**INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

The course is aimed to

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

Course Outcomes (CO)

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	develop an ability to critically evaluate the promise of a nanotechnology device.

UNIT – I	**BASICS OF NANOTECHNOLOGY**	**9**

Introduction - Time and length scale in structures -Definition of a Nano system -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress-surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.

UNIT – II	DIFFERENT CLASSES OF NANOMATERIALS	9
Classification based on dimensionality-Quantum Dots, Wells and Wires- Carbon based nano materials (buckyballs, nanotubes, graphene)- Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		
UNIT – III	**SYNTHESIS OF NANOMATERIALS**	**9**
Chemical Methods:Metal Nanocrystals by Reduction -Sol - gel processing -Solvothermal Synthesis- Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods:Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		
UNIT – IV	**CHARACTERIZATION OF NANOSTRUCTURES**	**9**
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)-Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		
UNIT – V	**APPLICATIONS**	**9**
Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices - Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		
	Total Periods:	**45**

Text Books:

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

Reference Books:

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	2	1	2	2	1	2	1	2	3	2	1	2	1
CO2	1	1	2	2	1	2	1	2	1	2	1	1	2	1
CO3	1	3	2	2	1	2	1	1	1	2	1	2	1	1
CO4	2	2	1	2	1	2	1	1	2	2	1	2	1	1
CO5	3	1	2	1	3	1	2	1	1	2	1	1	2	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedomfrom a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

UNIT I: INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of theIndian Constitution-Preamble-Salient Features

UNIT II: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion- Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-FundamentalDuties

UNIT III: ORGANS OF GOVERNANCE **9**

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor- Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV: EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V: LOCAL ADMINISTRATION **9**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL PERIODS: 45

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self-destructive habits with value education
CO5	Interpret social empowerment with value education

UNIT I:	**INTRODUCTION TO VALUE EDUCATION**	**9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral
and non- moral valuation, Standards and principles, Value judgments

UNIT II:	**IMPORTANCE OF VALUES**	**9**

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love fornature, Discipline

UNIT III:	**INFLUENCE OF VALUE EDUCATION**	**9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and
religious tolerance, True friendship Happiness Vs suffering,love for truth.

UNIT IV:	**REINCARNATION THROUGH VALUE EDUCATION**	**9**

Aware of self-destructive habits, Association and Cooperation, doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V:	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**9**

Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL PERIODS: 45

REFERENCE:

Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materialsbest support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developingcountries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidancematerials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

UNIT I:	**INTRODUCTION AND METHODOLOGY**	**9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum,Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II:	**THEMATIC OVERVIEW**	**9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries -Curriculum, Teacher education.

UNIT III:	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**9**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculumand practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV:	**PROFESSIONAL DEVELOPMENT**	**9**

Professional development: alignment with classroom practices and follow up support – Peer support - Support from thehead teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes

UNIT V:	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment -Dissemination and research impact.

TOTAL PERIODS:	**45**

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project(MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and readingin Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do’s and Don’t’s in life through Yam
CO3	Learn Do’s and Don’t’s in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

UNIT I: INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga)

UNIT II: YAM **9**

Do`s and Don’t’s in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III: NIYAM **9**

Do`s and Don’t’s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV: ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V: PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL PERIODS: 45

REFERENCES:

1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department),Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-

AD1005	**PERSONALITY DEVELOPMENT THROUGH LIFEENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

UNIT I:	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II:	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**9**

Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT III:	**ORGANS OF GOVERNANCE**	**9**

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35- Chapter 18-Verses 45, 46, 48

UNIT IV:	**EMERGENCY PROVISIONS**	**9**

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15,16,17, 18

UNIT V:	**LOCAL ADMINISTRATION**	**9**

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 –Verses 37,38,63

TOTAL PERIODS:45

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari’s ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES:

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

UNIT I: QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area.
Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT II: RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market.
Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT III: RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles.
Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT IV: RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.
Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, gve suggestions about improving implementation of the programme for the rural poor

UNIT V:	FIELD WORK	9

Each student selects one programme for field visit Field based practical activities:
• Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
• Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
• Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
• Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
• Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
• Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps
• Participate in Gram Sabha meetings, and study community participation

Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
• Attend Parent Teacher Association meetings, and interview school drop outs
• Visit local Anganwadi Centre and observe the services being provided
• Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
• Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
• Raise understanding of people's impacts of climate change, building up community's disaster preparedness
• Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
• Formation of committees for common property resource management, village pond maintenance and fishing .

TOTAL PERIODS: 45

REFERENCES:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs
4. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
5. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The course will introduce the students to
- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Know the contribution of scientists of different eras.
CO6	Understand education systems in India

UNIT I:	INTRODUCTION TO CULTURE	9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature,Indian Culture, Ancient India, Medieval India, Modern India

UNIT II:	INDIAN LANGUAGES AND LITERATURE	9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languagesand Literature – II:Northern Indian Languages & Literature

UNIT III:	RELIGION AND PHILOSOPHY	9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		
UNIT IV:	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science inancient, medieval and modern India		
UNIT V:	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		
		TOTAL PERIODS: 45

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. 'Agathinai' and 'Purathinai' in Sanga Tamil Literature.
3. 'Attruppadai' in Sanga Tamil Literature.
4. 'Puranaanuru' in Sanga Tamil Literature.
5. 'Pathitrupaththu' in Sanga Tamil Literature.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate 'Agathinai' and 'Purathinai'in their personal and societal life.
CO3	Appreciate and apply the messages in' Attruppadai' in their personal and societal life.
CO4	Appreciate and apply the messages in' Puranaanuru' in their personal and societal life.
CO5	Appreciate and apply the messages in' Pathitrupaththu' in their personal and societal life.

UNIT I:	SANGA TAMIL LITERATURE – AN INTRODUCTION	9
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–SpecialBranches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables.		

UNIT II:	‘AGATHINAI’AND‘PURATHINAI’	9
Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History of Culture from Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		
UNIT III:	**‘ATTRUPPADAI’.**	**9**
AttruppadaiLiterature–Attruppadaiin‘Puranaanuru’-Attruppadaiin‘Pathitrupaththu’-Attruppadaiin ‘Paththupaattu’.		
UNIT IV:	**‘PURANAANURU’**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		
UNIT V:	**‘PATHITRUPATHTHU’**	**9**
Pathitrupaththuin‘Ettuthogai’–Pathitrupaththu’sParables–Tamildynasty:Valor, Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.		
		TOTAL PERIODS: 45

REFERENCES:

1. Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press,2018.
2. Hank Heifetz and GeorgeL. Hart, The Purananuru, Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.
5. Xavier S.Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub. House, 1967.

Course Outcomes	Program Outcomes												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119.

DEPARTMENT OF BIOTECHNOLOGY

REGULATIONS 2021

M. Tech. BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

Vision of the Department

- To provide a world class department to facilitate learning, training and research in Biotechnology by providing infrastructural facilities and competent faculty leading to technological innovations to serve the global society.

Mission of the Department

- The Mission of the Department is to provide quality education to students and to produce competent Biotechnologists to meet the challenges faced by industry and mankind.
- To inculcate high moral, ethical & professional standards among our students.
- To develop overall personality of the students.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. To provide students with solid fundamentals and strong foundation in statistical, scientific and engineering subjects required to create and innovate in the field of biotechnology.
II. To train students with good scientific and technical knowledge so as to comprehend, analyze, design, and create novel products and solutions for developing novel therapeutics and enzymes.
III. To prepare students to excel and succeed in Biotechnology research or industry through the latest state-of-art post graduate education.
IV. To sensitize students about scientific temper and the necessity of bioethics, social responsibility and awareness of the environment.
V. This course enables the student to develop good communication and leadership skills, respect for authority, loyalty and the life-long learning needed for a successful scientific and professional career.

PROGRAMME OUTCOMES (POs):

On successful completion of the Masters in Biotechnology graduates will be able to

1. Acquire in depth knowledge of Biological science and Bioengineering for gaining ability to develop and evaluate new ideas
2. Demonstrate Scientific and technological skills to design and perform research through modern techniques for the development of high throughput process and products.
3. Analyze Biotechnological problems and formulate intellectual and innovative vistas for research and development.
4. Provide potential solutions for solving technological problems in various domains of Biotechnology considering the societal, public health, cultural environmental factors.
5. Examine the outcomes of Biotechnological issues critically and gain knowledge for composing suitable corrective measures.
6. Create and apply modern engineering tools for the prediction and modeling of complex bioengineering activities.
7. Possess self-management and team work skills towards collaborative, multidisciplinary scientific endeavors in order to achieve common goals.
8. Develop entrepreneurial and managerial skills for the implementation of multidisciplinary projects.
9. Demonstrate adherence to accepted standards of professional bioethics and social responsibilities.
10. Possess the attitude necessary for lifelong and acquire communication skills relevant to professional positions

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Our Biotech graduates shall possess strong knowledge in the field of biotechnology and applied sciences.
2. Our Biotech graduates shall be able to design and conduct experiments in biotechnology as well as analyze and interpret data.
3. Our Biotech graduates shall be able to use current techniques, skills and modern tools necessary for modelling and design of bioprocesses.

Mapping of Programme Educational Objectives (PEOs) with Programme Outcomes (POs)and Programme Specific Outcomes (PSOs)

PEOs	POs										PSOs		
	1	2	3	4	5	6	7	8	9	10	1	2	3
I	✓	✓		✓							✓	✓	✓
II			✓		✓	✓	✓				✓	✓	✓
III				✓	✓	✓	✓				✓	✓	✓
IV							✓	✓	✓		✓	✓	✓
V		✓	✓						✓	✓	✓	✓	✓

REGULATIONS 2021

I TO IV SEMESTERS CURRICULUM AND SYLLABUS (FULL TIME)

M.TECH. BIOTECHNOLOGY

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA1155	Applied Statistical Techniques	4	0	0	4
2	BY1101	Advanced Genetic Engineering	3	0	0	3
3	BY1102	Enzyme Technology and Fermentation Technology	3	0	0	3
4	BY1103	Bioinformatics and Applications	3	0	0	3
5		Professional Elective 1	3	0	0	3
6		Professional Elective 2	3	0	0	3
7		Professional Elective 3	3	0	0	3
PRACTICAL						
8	BY1108	Preparative and Analytical Techniques in Biotechnology Lab	0	0	4	2
		TOTAL	**22**	**0**	**4**	**24**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1201	Bioseparation Technology	3	0	0	3
2	BY1202	Bioprocess Engineering	3	0	0	3
3	BY1203	Bioreactor Design and Analysis	3	0	0	3
4	BY1204	Immunotechnology	3	0	0	3
5	BY1205	Advanced Genomics and Proteomics	3	0	0	3
6		Professional Elective 4	3	0	0	3
7		Professional Elective 5	3	0	0	3
PRACTICAL						
8	BY1208	Immunotechnology Lab	0	0	6	3
		TOTAL	**21**	**0**	**6**	**24**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1		Open Elective (OE)*	3	0	0	3
		Online Course (OC)*	0	0	0	
2		Audit Course**	2	0	0	0
PRACTICAL						
3	BY1308	Advanced Molecular Biology and Genetic Engineering Lab	0	0	6	3
4	BY1309	Bioprocess and Downstream Processing Lab	0	0	6	3
PROJECT						
5	BY1310	Project Phase – I	0	0	12	6
		TOTAL	**5**	**0**	**24**	**15**

* Either OE or OC can be opted
** Registration for audit courses is optional

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
PROJECT						
1	BY1410	Project Phase – II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

Total No. of Credits : 75

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVES I

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1001	Molecular concepts in Biotechnology (For Engineering Stream)	3	0	0	3
2	BY1002	Principles of Chemical Engineering (For Science Stream)	3	0	0	3
3	BY1003	Metabolic Process and Engineering (For Biotechnology Stream)	3	0	0	3

PROFESSIONAL ELECTIVES II

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1004	Animal Biotechnology	3	0	0	3
2	BY1005	Computer Aided Learning of Structure and Function of Proteins	2	2	0	3
3	BY1006	Analytical Techniques in Biotechnology	3	0	0	3
4	BY1007	Bio thermodynamics	3	0	0	3
5	BY1008	Plant Biotechnology	3	0	0	3

PROFESSIONAL ELECTIVES III

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1009	Environmental Biotechnology	3	0	0	3
2	BY1010	Cancer Biology	3	0	0	3
3	BY1011	Technology Management	3	0	0	3
4	BY1012	Computational Fluid Dynamics	3	0	0	3
5	BY1013	Biotechnology in Food Processing	3	0	0	3

PROFESSIONAL ELECTIVES IV

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1014	Bio nanotechnology	3	0	0	3
2	BY1015	Phytochemistry	3	0	0	3
3	BY1016	Advances in Molecular Pathogenesis	3	0	0	3
4	BY1017	Spectroscopy for Biotechnologists	3	0	0	3
5	BY1018	IPR and Bio safety	3	0	0	3

PROFESSIONAL ELECTIVES V

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BY1019	Biopharmaceuticals and Bio similars	3	0	0	3
2	BY1020	Bioprocess Modelling and Simulation	3	0	0	3
3	BY1021	Tissue Engineering	3	0	0	3
4	BY1022	Research Methodology in Biotechnology	3	0	0	3
5	BY1023	Bio fuels and Platform Chemicals	3	0	0	3

OPEN ELECTIVES COURSES (OEC)

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	OCP101	Business Data Analytics	3	0	0	3
2	OMF101	Industrial Safety	3	0	0	3
3	OPE101	Renewable Sources of Electrical Energy	3	0	0	3
4	OMB103	Cost Management of Engineering Projects	3	0	0	3
5	OMF102	Composite Materials	3	0	0	3
6	OCH105	Waste to Energy	3	0	0	3

*(Out of six courses, one course can be selected)

ONLINE COURSES (OC)

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BOC131	Drug Delivery Principles and Engineering	0	0	0	3
2	BOC132	Basic Course in Biomedical Research	0	0	0	3
3	BOC133	Experimental Biotechnology	0	0	0	3

*(Any one of the online courses from Swayam platform not less than 12 weeks can be selected)

AUDIT COURSES (AC)

S.No.	COURSE CODE	COURSE TITLE		L	T	P	C
THEORY							
1	AX1001	English for Research Paper Writing		2	0	0	0
2	AX1002	Disaster Management		2	0	0	0
3	AX1003	Value Education		2	0	0	0
4	AX1004	Constitution of India		2	0	0	0
5	AX1005	Pedagogy Studies		2	0	0	0
6	AX1006	Stress Management by Yoga		2	0	0	0
7	AX1007	Personality Development Through Life Enlightenment Skills		2	0	0	0
8	AX1008	Unnat Bharat Abhiyan		2	0	0	0

** Registration for audit courses is optional

SUBJECT AREA WISE DETAILS

FOUNDATION COURSE (FC)

S.No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MA1155	Applied Statistical Techniques	3	2	0	4

PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	BY1101	Advanced Genetic Engineering	3	0	0	3
2	BY1102	Enzyme Technology and Fermentation Technology	3	0	0	3
3	BY1103	Bioinformatics and Applications	3	0	0	3
4	BY1201	Bioseparation Technology	3	0	0	3
5	BY1202	Bioprocess Engineering	3	0	0	3
6	BY1203	Bioreactor Design and Analysis	3	0	0	3
7	BY1204	Immunotechnology	3	0	0	3
8	BY1205	Advanced Genomics and Proteomics	3	0	0	3
9	BY1108	Preparative and Analytical Techniques in Biotechnology Lab	0	0	4	2
10	BY1208	Immunotechnology Lab	0	0	6	3
11	BY1308	Advanced Molecular Biology and Genetic Engineering Lab	0	0	6	3
12	BY1309	Bioprocess and Downstream processing Lab	0	0	6	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	BY1310	Project Phase – I	0	0	12	6
2	BY1410	Project Phase – II	0	0	24	12

SUMMARY OF CREDITS

S. No.	SUBJECT AREA	CREDITS PER SEMESTER				TOTAL CREDITS
		I	II	III	IV	
1	FC	4	-	-	-	04
2	PC	11	18	6	-	35
3	PE	9	6	-	-	15
4	OE/OC	-	-	3	-	03
5	AC	-	-	-	-	-
6	EEC	-	-	6	12	18
Total		**24**	**24**	**15**	**12**	**75**

SEMESTER I

MA1155	APPLIED STATISTICAL TECHNIQUES	L	P	T	C
		4	0	0	4

OBJECTIVES

- This course is designed to provide a solid foundation on topics in statistics that can be useful for the biotechnologists to conduct research on different types of data arising in public health and clinical studies. It is framed to address the issues in biotechnology using the concepts on probability, regression, sampling, testing of hypothesis and design an analysis of experiments.

UNITI RANDOM VARIABLE AND PROBABILITY DISTRIBUTION 12

Discrete random variable– Probability mass function–Properties– Continuous random variable – Probability density function – Properties – Moments : Mean and variance with properties– Special distributions: Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, and Normal–Properties-Simple roblems. **CO1**

UNITII JOINT PROBABILITY DISTRIBUTION 12

Bivariate distribution- conditional and marginal distribution - Correlation coefficient, properties-problems- Regression equations-problems-curve fitting by the method of least squares - fitting curves oftheformax+b,ax^2+bx+c,ab^xandax^b **CO2**

UNIT III TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Tests based on Normal, t,χ^2 and F-distributions for testing of mean, difference between two means, proportion, difference between two proportions, variance, ratio of two variances – Independence of attributes(rxc contingency table)-Goodness of fit. **CO3**

UNITIV NON-PARAMETRIC STATISTICS 12

One sample sign test–Sign test for paired samples–Signed rank test–Rank sum test: The U-test–Rank-sum test: The H-test– Test based on runs. **CO4**

UNITV DESIGN OF EXPERIMENTS 12

Basic principles of experimentation - Analysis of variance - one-way, Two-way classifications - Randomized block design, Latin square design - problems. **CO5**

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Devore, J.L., “Probability and Statistics for Engineering and Sciences”, 8th Edition, Cengage Learning Pvt. Ltd., New Delhi, 2014.
2. Freund, J.E., “Mathematical Statistics”, 5th Edition, Prentice Hall of India, 2001.
3. Gupta, S.C. and Kapoor, V. K, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, 14th Edition, 2016.

4. Johnson, R.A and Gupta C. B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education Int., Asia, 8th Edition, 2011.
5. Libschutz, S. "Probability and Statistics", 4th Edition, McGraw Hill, New Delhi, 2010.
6. Miller, I. and Miller, "Mathematical Statistics", 7th Edition, Pearson Education Inc. (10th impression), 2012.
7. Dr.S.P.Gupta., " Statistical Methods",46th Edition", Sultan Chand and Sons,2021.

COURSEOUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamental concepts of probability and gain knowledge on standard distributions which can describe real life phenomenon.
CO2	Understand the basic concepts of one and two dimensional random variables, curve fitting and apply the techniques in research and on different types of data analysis.
CO3	Apply the concept of testing of hypothesis for small and large samples in real life problems
CO4	Understand the need of non parametric methods and to apply in data analysis without any assumptions about specific population.
CO5	Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	2	1	-	-	3	2	3
CO2	3	2	2	3	2	-	2	-	-	-	3	2	3
CO3	3	2	2	3	3	1	2	-	-	-	3	3	3
CO4	2	2	1	3	3	2	2	-	-	-	3	3	2
CO5	2	2	2	3	3	-	2	1	-	-	3	3	3

BY1101	**ADVANCED GENETIC ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the gene cloning methods, tools and techniques involved in genecloning, genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts, production of recombinant proteins and PCR techniques.
- To understand comparative genomics and proteomics.

UNIT I: CLONING WITH SPECIALIST-PURPOSE VECTORS 9

M13 based vectors, production of RNA probes and interfering RNA - controllable promoters for maximal expression of cloned gene – λPL, trc, T7 and pBAD - factors affecting the expression of cloned genes - purification tags for purification of cloned gene product – vectors for solubilization of expressed proteins

- gateway system of transferring DNA fragments to vectors.

UNIT II: cDNA LIBRARY CONSTRUCTION 9

OligodT priming, self priming and its limitations. Full length cDNA cloning – CAPture method and Oligo capping. Screening strategies – Hybridization, PCR, Immunoscreening, South-western and North-Western. Functional cloning – Functional complementation and gain of function. Difference cloning: Differential screening, Subtracted DNA library, differential display by PCR.

UNIT III: MUTAGENESIS AND ALTERED PROTEIN SYNTHESIS 9

Random mutagenesis - Error-prone PCR, Rolling circle error-prone PCR, use of mutator strains, temporary mutator strains, Insertion mutagenesis, ethyl methanesulfonate, DNA Shuffling, signature tagged mutagenesis and transposon mutagenesis. Incorporation of unnatural amino acids into proteins – Phage and cell-surface display for selection of mutant peptides.

UNIT IV: GENOME ENGINEERING 9

DNA damage – sources and types - DNA double stranded break repair mechanisms - Engineered nucleases in genome engineering - meganucleases, ZFNs, TALEN and CRISPR-Cas system – Mechanisms and applications – Benefits of genome engineering – targeted gene mutation, creating chromosome rearrangement, studying gene function with stem cells, transgenic animals, endogenous gene labelling and targeted transgene addition – genome engineering -prospects and limitations.

UNIT V: GENETIC MANIPULATION OF CELLS AND ANIMALS 9

Overview - principle of gene transfer - methods of gene transfer to animal cell culture - selectable markers for animal cells - Isolation and manipulation of mammalian embryonic stem cells - Using gene transfer to study gene expression and function - creating disease models using gene transfer and gene targeting technology - potential of animal for modelling human disease.

TOTAL PERIODS: 45

TEXT BOOKS:

1.Primrose, S.B., and Twyman., “Principles of Gene Manipulation and Genomics”, 7th Edition,Blackwell Science, 2006.

REFERENCES:

1. Benjamin Lewin, “Gene IX”, Oxford University Press, Cambridge, U.K. 2011.
2. Brown, T.A., “Gene cloning and DNA analysis: An introduction”, 6th Edition, Wiley-Blackwell, 2010.
3. Glick, B.R. and Pasternak J.J., “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, 3rd Edition, ASM Press, 2003.
4. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vol 1-3, CSHL,2001.
5. Winnacker, E.L., “Frome Genes to Clones: Introduction to Gene Technology”, Wiley-Blackwell, 2006.
6. Yamamoto, Takashi (Ed.). “Targeted Genome Editing Using Site-Specific Nucleases”,Springer, Japan, 2015.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Cloning, expression and purification of commercially important genes.
CO2	Library creation and screening techniques involved for recombinant clones
CO3	Mutagenesis and importance of creating altered protein synthesis
CO4	Application of Engineered nucleases in genome engineering
CO5	Gene transfer principles and methods adapted for animal cell culture inorder to create disease models.

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	3	1	-	-	3	-	2	2	3
CO2	3	3	1	1	2	-	-	-	1	-	2	2	2
CO3	3	2	3	1	2	-	-	-	3	-	3	2	2
CO4	0	2	2	1	1	3	-	-	-	-	3	1	2
CO5	3	2	3	1	2	-	-	-	3	-	3	2	2

BY1102	**ENZYME TECHNOLOGY & FERMENTATION TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The course will enable the students

- To gain advanced knowledge about the sterilisation methods, media formulation and use of fermentation processes.
- To have knowledge on operational modes of reactors and selection of process for enzyme production and about immobilisation of enzymes and their applicatons.
- To acquire knowledge involved in the isolation, processing, production and purification of enzymes, organic acids, alcohols and secondary metabolites.
- To understand the theoritical and practical aspects of kinetics and its applicability in research.
- To study the importance of enzymes and its applications in various fields food, pharma and chemical industries etc including research.

UNIT - I FUNDAMENTALS OF FERMENTATION 9

Overview of fermentation – Microbial biomass – Microbial Enzymes – Microbial Metabolites – Types of fermentation – Media for industrial fermentations –– Medium sterilization––Development of inoculum for industrial fermentation -Medium optimization – Oxygen requirements of industrial fermentation – Mass transfer in fermentation – Determination of KLa values – Factors affecting KLavalues in fermentation.

UNIT - II INDUSTRIAL FERMENTATION PROCESSES 9

Aerobic and anaerobic fermentations – Batch culture, continuous culture, fed batch culture –Comparison of batch and continuous culture – Submerged and solid state fermentation for the production of enzymes – Immobilization of enzymes and techniques for enzyme immobilization –Biocatalysis in organic media using enzymes – Biotransformation with crude enzymes and whole cells.

UNIT - III PRODUCTION OF ENZYMES AND METABOLITES 9

Production of Proteases, Cellulases, Lipase, Amylase, Glucose isomerase, Pectinase, Peroxidase, Production of primary metabolites– organic acids (Citric acid, Lactic acid), amino acids (Glutamic acid, Lysine),alcohols (ethanol, butanol). Production of secondary metabolites – aminoacids, (Glutamic acid, Lysine), antibiotics (Penicillin, streptomycin), Vitamins (Vitamin B12, Riboflavin).

UNIT - IV ENZYME KINETICS 9

Overview of enzyme and its action – Time course of enzymatic reactions – Effects of substrate concentration on velocity – Rapid equilibrium model of enzyme kinetics – Steady state model of enzyme kinetics – Significance of *kcat*and *Km* – Experimental Measurement of *kcat*and *Km* – Linear transformations of enzyme kinetic data – Bi Bi reaction mechanisms – Modes of reversible inhibition-Allosteric regulation of enzymes.

UNIT V APPLICATIONS OF ENZYMES 9

Enzymes in organic synthesis – Enzymes as biosensors – Enzymes for food, pharmaceutical, tannery, textile, paper and pulp industries – Enzyme for environmental applications- Enzymes for analytical and diagnostic applications – Enzymes for molecular biology research.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Palmer, T., Bonner, P., “Enzymes Biochemistry, Biotechnology, Clinical chemistry”, 2nd edition, WoodHead Publishing, 2007.
2. Peter Stanbury, Allan Whitaker, Stephen Hall., "Principles of Fermentation Technology", 3rd edition, Elsevier, 2016
3. McNeil, B., Harvey, L., “Practical Fermentation Technology”, John Wiley & Sons, 2008.
4. Buchholz, K., Kasche, V. and Bornscheuer, U., “Biocatalysts and Enzyme Technology”, Completely revised and enlarged edition, WILEY–VCH, 2012.

REFERENCES:

1. Mansi, E.M.T.EL., Bryce, C.F.A., Dahhou, B., Sanchez, S., Demain, A.L. and Allman, A.R., “Fermentation Microbiology and Biotechnology”, 3rd Edition, Taylor and Francis, 2012.
2. Copeland, R. A., “Enzymes- A Practical Introduction to Structure, Mechanism and data analyses” 2nd Edition, WILEY–VCH, 2012.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To design media and choose a suitable fermentation process for the production of a bio product.
CO2	To select an immobilisation method and explore the possibility of choice of a bioreactor for the production of enzyme.
CO3	To apply the various steps involved in the isolation, processing, production and purification of enzymes, organic acids, alcohols and secondary metabolites.
CO4	To apply the knowledge gained on the theoretical and practical aspects of kinetics for the economical production of the enzyme.
CO5	To understand the importance of enzymes and its applications in various fields like including research.

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	1	1	1	-	-	-	1	1	2	1
CO2	1	3	2	1	2	2	1	1	1	2	1	3	2
CO3	-	3	3	2	2	3	1	1	1	2	1	2	2
CO4	1	2	2	2	1	3	1	-	1	1	1	2	2
CO5	1	1	2	2	1	-	1	-	2	1	-	1	3

BY1103	**BIOINFORMATICS AND APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To improve the programming skills of the student in the field of Biological research
- To let the students know the recent evolution in biological databank usage
- To train the students to analyse the genome of an organism
- To equip the students in protein modelling and visualization
- To familiarise the students in the drug designing domain using in-silico tools

UNIT I: LINUX OS AND PERL 9+3

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Programming in PERL: Name conventions – Variables – Operators – Functions – Control structures – File input and output.

UNIT II: BIOLOGICAL SEQUENCES AND DATABANKS 9+3

Introduction to Biological sequences and methods of sequencing, Biological databases: Primary, Secondary and Composite databanks - Scoring matrices: PAM, BLOSUM - Data lifecycle.

UNIT III: SEQUENCE ANALYSIS 9+3

Pairwise Sequence alignment: Dynamic Programming Algorithms, Needleman-Wunch Algorithm, Smith-Waterman Algorithm, FASTA, BLAST – Multiple sequence alignment: Progressive methods, Iterative methods, Applications – Motif representation- PSSM - Gene finding-Artificial Neural Network – Hidden Markov Model

UNIT IV: DATA ANALYSIS AND PHYLOGENETIC METHODS 9+3

Analysis of gene expression, Analysis of mutations in cancer using High-throughput techniques - Microarray analysis, High volume scatter plots and Heat maps. Structural genomics - Plotting along genomic coordinates and Mapping analysis. Introduction to phylogenetics - Distance based and character based trees, tree evaluation.

UNIT V: PROTEIN STRUCTURE ANALYSIS AND DRUG DESIGNING 9+3

Protein structure prediction methods - Homology modeling, abinitio approaches. Protein structure visualization: Pymol, Rasmol. Threading, Critical Assessment of Structure Prediction and RNA structure prediction. Introduction to Systems Biology and Synthetic Biology, DNA computing, Bioinformatics approaches for drug discovery- Rosetta, protein-ligand docking – QSAR analysis, protein-protein interaction, Peptide mass fingerprinting.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by DanGusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCES:

1. 1. Baldi, P. and Brunak, S., "Bioinformatics: The Machine Learning Approach" 2nd Edition, MIT Press, 2001.
2. Gentleman, R., "Bioinformatics and Computational Biology Solutions using R and Bioconductor", Springer Science and Business media Inc., 2005.
3. Lesk, A. K., "Introduction to Bioinformatics", 4th Edition, Oxford University Press, 2013 13
4. Liebler, "Introduction to Proteomics" Humana Press, 2002.
5. Mount, D.W., "Bioinformatics Sequence and Genome Analysis" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
6. Rastogi, S.C., "Bioinformatics Concepts, Skills & Applications", 2nd Edition, CBS Publishers, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Understand the fundamentals of operating system and gain knowledge in programming language and to develop bioinformatics related tools with programming skils.
CO2	Gain knowledge about the biological sequences and sequence databases.
CO3	Understand the sequence alignment programs and its importance in Bioinformatics.
CO4	Modelling the structure of proteins.
CO5	Screen drug likeliness of molecules using in-silico techniques.

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	3	2	2	1	1	2	2	2
CO2	3	3	2	2	2	1	1	1	2	1	2	2	2
CO3	2	1	2	1	2	2	1	2	2	2	2	2	2
CO4	2	2	2	3	3	2	2	2	2	2	2	3	2
CO5	3	3	2	2	3	3	2	2	2	2	3	3	3

BY1108	**PREPARATIVE AND ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

· To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules and laboratory analysis of the same in the body fluids
· To have a practical hands on experience on Absorption Spectroscopic methods and to validate spectrometric and microscopic techniques
· To acquire experience in the purification by performing chromatography
· To design processes for the recovery and subsequent purification of target biological products.

LIST OF EXPERIMENTS

1. Estimation of amino acids by ninhydrin method
2. Estimation of total sugars by phenol sulphuric acid method
3. Estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose.
4. Estimation of protein concentration using Lowry's and Bradford method.
5. DNA determination by UV-visible spectrophotometer – hyperchromic effect.
6. Separation of amino acids and lipids by TLC.
7. Enzyme kinetics: Determination of Km, Vmax and Kcat, Kcat/ Km.
8. Restriction enzyme – Enrichment and unit calculation.

9. Ion-exchange chromatography – Purification of IgG and Albumin.
10. Gel filtration – Size based separation of proteins.
11. Affinity chromatography – IMAC purification of His-tagged recombinant protein.
12. Extraction and characterization of photochemical using UV-visible spectrophotometer.
13. Separation of compounds using Column chromatography.

Requirements:

UV-visible spectrophotometer, Hot air oven, Incubator, Chromatography column, required glasswares, chemicals & kits

TOTAL PERIODS: 60

REFERENCES:

1. Pingoud, A., Urbanke, C., Hoggett, J. and Jeltsch, A., “Biochemical Methods: A ConciseGuide for Students and Researchers”, Wiley-VCH, 2002.
2. Segel, I.H., “Biochemical Calculations: How to Solve Mathematical Problems in GeneralBiochemistry”, 2nd Edition, John Wiley & Sons, 2004.
3. Wilson, K. and Walker, J., “Principles and Techniques of Biochemistry and MolecularBiology”, 7th Edition, Cambridge University Press, 2010.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules and laboratory analysis of the same in the body fluids.

CO2 To have a practical hands on experience on Absorption Spectroscopic methods and to validate spectrometric and microscopic techniques.

CO3 To acquire experience in the purification by performing chromatography.

CO4 To have hands-on experience on the study of enzyme kinetics.

CO5 To design processes for the recovery and subsequent purification of target biological. products.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	-	1	-	-	1	-	-	-	1	1	2	1	1
CO2	1	2	-	-	1	-	-	-	1	1	2	2	1
CO3	1	2	1	2	2	-	-	-	1	1	2	2	2
CO4	1	2	-	1	1	-	-	-	1	1	2	2	1
CO5	1	2	1	2	2	-	-	-	1	1	2	2	2

SEMESTER II

BY1201	BIOSEPARATION TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to

- Understand the methods to obtain pure proteins, enzymes and bioproducts in general.
- Have depth knowledge on downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I: DOWNSTREAM PROCESSING IN BIOTECHNOLOGY 9

Role and importance of downstream processing in biotechnological processes – Problems and requirements of bioproduct purification – Economics of downstream processing in Biotechnology, cost-cutting strategies – Separation characteristics of proteins and enzymes – size, stability, properties – Flocculation and conditioning of broth – Process design criteria for various classes of bioproducts (high volume, low value products and low volume, high value products) – Upstream production methods affect downstream purification strategies. Purification of inclusion bodies.

UNIT II: PHYSICO-CHEMICAL BASIS OF BIO-SEPARATION PROCESSES 9

Cell disruption methods for intracellular products – Physical, chemical, mechanical – Removal of insoluble, biomass and particulate debris separation techniques – Filtration at constant pressure and at constant rate – Empirical equations for batch and continuous filtration – Types of filtration - Centrifugal and cross – flow filtration – Types of filtration equipments – Centrifugation – Basic principles, design characteristics – Types of centrifuges and applications.

UNIT III: MEMBRANE SEPARATIONS AND ENRICHMENT OPERATIONS 9

Theory, Design consideration and configuration of membrane separation processes – Types membrane separation processes - Reverse osmosis, microfiltration, ultrafiltration, dialysis – Membrane modules – Enrichment Operations – Extraction–equipment for extraction – Aqueous two-phase extraction process –Adsorption isotherms and techniques – Protein precipitation – Methods of precipitation.

UNIT IV: MECHANISM AND MODES OF CHROMATOGRAPHIC SEPARATION 9

Chromatography – Classification of chromatographic techniques – General description of column chromatography – Chromatographic terms and parameters – Practice of chromatography – adsorption, Partition, normal-phase, reversed-phase, size exclusion, ion exchange, hydrophobic, affinity chromatography – Scale-up of chromatography.

UNIT V: FINISHING OPERATIONS AND FORMULATIONS 9

Drying – Mechanism, methods and applications, Types of dryers – Tray, spray, rotary, belt – Crystallization – Nucleation , growth – Types of crystallizers – Tank, Oslo, Circulating-magma evaporator – Freeze drying – Principle, process, applications – Case studies - Purification of Citric acid, Penicillin, Cephalosporin, Recombinant Streptokinase, and Interferon.

TOTAL PERIODS: 60PERIODS

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988.
2. Sivasankar, B. “Bioseparations: Principles and Techniques”. PHI, 2005.
3. Asenjo, Juan A. “Separation Processes in Biotechnology”. CRC / Taylor & Francis, 1990.

REFERENCE BOOKS:

1. Forciniti, D., “Industrial Bioseparation: Principles & Practice”, Blackwell, 2008.
2. Ghosh, R., “Principles of Bioseparations Engineering”, World Scientific Publishers, 2006.
3. Ladisch, M.R., “Bioseparations Engineering: Principles, Practice, and Economics”, John Wiley & Sons, 2001.4. Roger, H., “Bioseparations Science and Engineering”, Oxford University Press, 2006.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The product recovery, unit operations involved and factors affecting bioseparation of bioproducts and recombinant products.
CO2	Selection and design of cell disruption methods, filtration and centrifugation operation for bioseparation.
CO3	To identify a suitable unit operation for isolation and concentration for the given bioproduct.
CO4	To select a suitable chromatographic operation for purification of given bioproducts.
CO5	Design various bioproducts polishing methods and purification of various bioproducts/recombinant products.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	3	2	1	2	1	-	-	2	2	3
CO2	3	2	2	3	2	-	2	-	-	-	2	2	3
CO3	3	2	2	3	3	1	2	-	-	-	2	2	3
CO4	2	2	1	3	3	2	2	-	-	-	3	2	3
CO5	2	2	2	3	3	-	2	1	-	-	3	2	3

BY1202	BIOPROCESS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites
- To endow the students with the basics of microbial kinetics, metabolic stoichiometry and energetics
- To develop bioengineering skills for the production of biochemical products using integrated biochemical processes.

UNIT I: METABOLIC STOICHIOMETRY AND ENERGETICS 9

Outline of Stoichiometry and energetics – Growth yields, Growth yields based on total energy andATP generation – Conservation of mass principles - Carbon and oxygen balances, ATP generation during growth – Relationship between substrate consumption, growth, respiration and noncellular products – Growth energetics of aerobic and anaerobic process – Case studies on mass and energy balance for Embden–Meyerhoff–Parnas pathway, continuous ethanol fermentation,penicillin production.

UNIT II: MICROBIAL GROWTH, KINETICS, MAINTENANCE AND PRODUCT FORMATION 9

Establishment of growth kinetic equations for batch, fed batch and continuous culture – Basic unstructured kinetic models of growth and product substrate utilization – Negative biokinetic rates– Multisubstrate kinetics – Mixed population kinetics - Kinetic models for microbial product formation - Kinetic model equations for inhibition by substrates and products.

UNIT III: STRUCTURED MODELS 9

Structured models for growth and product formation – Compartmental and metabolic models – Mechanistic models - Product formation kinetics – Gaden's and Deindoerfer's classifications – Chemically and genetically structured models – Kinetics models of heterogeneous bioprocesses – Biofilm kinetics, Unstructured models of pellet growth – Considerations for the production of r-DNA products.

UNIT IV: MASS TRANSFER IN BIOLOGICAL SYSTEMS 9

Interphase Gas-Liquid mass transfer – General oxygen balances for Gas-Liquid transfer – Models for oxygen transfer in large scale bioreactors – Case studies for large scale bioreactors – Model for oxygen gradients in a bubble column bioreactor, air lift bioreactor – Model for a multiple impeller fermenter – Gas-liquid mass transfer of components other than oxygen.

UNIT V: DIFFUSION AND BIOLOGICAL REACTION IN IMMOBILIZED BIOCATALYST 9

External mass transfer – Internal diffusion and reaction within biocatalysts – Derivation of finite difference model for diffusion – Reaction systems – Dimensionless parameters from diffusion – Reaction models – Effectiveness factor concept – Case study for diffusion with biological reaction– Estimation of oxygen diffusion effects in a biofilm.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Moser, Anton., "Bioprocess technology: kinetics and reactors", Springer Science & BusinessMedia, 2012.

REFERENCES:
1. Blakebrough, N., T. K. Ghose, and A. Fiechter, eds. “Advances in biochemical engineering”.Springer-Verlag, volume 3, 2013.
2. Dunn, I.J., Heinzle, E., Ingham, J. and Prenosil, J.E., “Biological Reaction Engineering:Dynamic Modelling Fundamentals with simulation examples”, 3rd Revised Edition, WILEYVCHpublications, 2016.
3. Najafpour, G.D., “Biochemical Engineering & Biotechnology”, 2 nd Edition, Elsevier, 2015.
4. Truskey, G.A., Yuan, F. and Katz, D.F., “Transport Phenomena in Biological Systems”,Pearson Prentice Hall, 2007.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The principles behind the metabolic stoichiometry and its importance in the designing of engineered microorganisms.
CO2	The kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes.
CO3	The develop new biochemical models in optimizing the production of biochemical products
CO4	The models derived for external factors supporting fermentation process (Mass transfer - internal & external)
CO5	The engineering principles to systems containing biological catalysts to meet the needs of the society.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	-	-	3	3	3
CO2	3	3	2	2	2	1	-	-	-	-	3	3	3
CO3	3	3	2	2	3	1	-	-	-	-	3	3	3
CO4	3	3	3	2	3	1	-	-	-	-	3	3	3
CO5	3	3	3	2	3	1	-	-	-	-	3	3	3

BY1203	BIOREACTOR DESIGN & ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course will enable the students

- To understand and develop mathematical models for batch, fedbatch and Continuous reactors.
- To apply the transport phenomena principles to bioreactoR
- To frame the requirements for the design of a reactor.
- To apply the sterilisation principles, the techniques in scale up and scale down of a process.
- To understand the importance of instrumentation, measure and control of process variables involved in the process.

UNIT - I BASIC BIOREACTOR CONCEPTS 12

Bioreactor Operation – Batch operation, semi-continuous and fed-batch operation, Continuous Operation – Chemostat, turbidostat – Microbiological reactors, enzyme reactors – Tank-type, Column-type biological reactors – Case studies – Continuous Fermentation with Biomass Recycle, residence time distribution, Tanks-in-series, Tubular plug flow bioreactors.

UNIT - II AERATION & AGITATION IN BIOPROCESS SYSTEMS 12

Mass transfer in agitated tanks – Effect of agitation on dissolved oxygen - Correlations with kLa in Newtonian and non Newtonian liquid – Power number, Power requirement for mixing in aerated and non aerated tanks for Newtonian and non Newtonian liquids – Agitation rate studies - Mixing time in agitated reactor,– Shear damage, bubble damage, Methods of minimizing cell damage – Laminar and Turbulent flow in stirred tank bioreactors.

UNIT - III SELECTION & DESIGN OF BIOPROCESS EQUIPMENT 12

Materials of construction for bioprocess plants – Design considerations for maintaining sterility of process streams processing equipments, selection, specification – Design of heat and mass transfer equipment used in bioprocess industries – Requirements, design and operation of bioreactor for microbial, plant cell and animal cell.

UNIT - IV SCALE UP AND SCALE DOWN ISSUES 12

Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculum development,nutrient availability and supply – Bioreactor scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear), mass transfer co-efficients – Scale up of downstream processes – Adsorption (LUB method), Chromatography (constant resolution etc.), Filtration (constant resistance etc.), Centrifugation (equivalent times etc.), Extractors (geometry based rules) – Scale–down related aspects.

UNIT V BIOREACTOR INSTRUMENTATION AND CONTROL 12

Bioreactor controlling probes – Characteristics of bioreactor sensors - Methods of measuring process variables –Temperature – Flow measurement and control – Pressure measurement and control – Agitation – shaft power, rate of stirring – Detection and prevention of foam –
Measurement of Microbial biomass – Measurement and control of Dissolved oxygen – Inlet and outlet gas analysis – pH measurement and control - Biosensors.

TOTAL PERIODS: 60

TEXT BOOKS:

1. Mann, U., “Principles of Chemical Reactors Analysis & Design: New tools for Industrial Chemical Reactor Operations”, Willey–VCH, 2009.
2. Mansi, E.M.T.EL., Bryce, C.F.A., Demain, A.L. and Allman, A.R., “Fermentation Microbiology and Biotechnology”, 3 rd edition Taylor and Francis, 2012.

REFERENCES:

1. Impre, J.F.M.V., Vanrolleghem, P.A. and Iserentant, D.M., “Advanced Instrumentation, Data Interpretation and Control of Biotechnological Processes”, Kluwer Academic Publishers, 2010.
2. Towler, G. and Sinnott, R., “Chemical Engineering Design: Principles, Practice, Economics of Plant and Process Design”, 2 nd edition, Butterworth – Heinemann ltd., Elsevier, 2012.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To select appropriate bioreactor configuration and operation mode based on the nature of bioproduct and cell lines and other process criteria.
CO2	To apply the knowledge of transport phenomena in the design of reactors.
CO3	To frame the requirements for the design of a reactor.
CO4	To analyse the techniques involved in the scale up and scale down of a process.
CO5	Integrate research lab and Industry; identify problems and seek practical solutions for large scale implementation of Biotechnology.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	-	1	-	-	3	2	2
CO2	2	2	1	-	1	1	1	-	-	-	2	3	2
CO3	3	2	2	1	1	1	1	-	-	-	3	2	2
CO4	1	2	1	-	-	-	1	-	-	1	1	2	2
CO5	2	2	2	1	-	1	1	1	-	1	2	2	2

BY1204	IMMUNOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions that offers defence mechanism
- To explain various techniques of therapeutically significant monoclonal and engineered antibodies production

UNIT I: IMMUNE SYSTEM AND ITS RESPONSE 9

Cells of the immune system and their development – Primary and secondary lymphoid organs – Humoral immune response – Cell mediated immune responses – T lymphocyte and B lymphocyteTolerance – Homeostasis in immune system – Complement.

UNIT II: ANTIGEN AND ANTIBODY 9

Production of antibodies – Polyclonal, monoclonal – Hybridoma technology – Antibody – Isolationand identification – Validation and their use – Agglutination and precipitation tests – Coomb's test– ELISA types – ELISPOT– Plaque forming cell assay, Epitope mapping, Antigen detection assay,SDS-PAGE-immunoblotting and immunoprecipitation – Immunofluorescence andimmunohistochemistry – Measurement of Ag-Ab interaction.

UNIT III: CELLULAR IMMUNOLOGICAL TECHNIQUES 9

PBMC separation from the blood – Ficoll-hypaque method – Identification of lymphocytes basedon CD markers – FACS – Lymphoproliferation assay – Cr5I release assay – Macrophage culturesdetection assays – Rosette assay – Cytokine bioassays: IL2, IFNγ, TNFα – Mixed lymphocytereaction – HLA typing.

UNIT IV: VACCINE TECHNOLOGY 9

Principles in vaccine development – Adjuvant, Immunization (Active and Passive immunization) – Vaccine validation – Protein based vaccines – DNA vaccines – Plant based vaccines – Ediblevaccine – Recombinant antigens as vaccines – Multivalent subunit vaccine – Reverse vaccinology– New Types of Replicating vaccines.

UNIT V: IMMUNOTHERAPEUTICS 9

Engineered antibodies – Catalytic antibodies, idiotypic antibodies, plantibodies – Combinatoriallibraries for antibody isolation. Cancer immunotheraphy and Immunosuprressive therapy –Cytokine therapy – Immunoglobulin therapy: Replacement and immunomodulators – Genetransfer techniques for immunological diseases.

TOTAL PERIODS: 45

REFERENCE:

1. Emily P. Wen, Ronald Ellis and Narahari S. Pujar, "Vaccine Development andManufacturing" Wiley, 1st Edition, 2014.
2. Gerd-Rudiger Burmester, Antonio Pezzutto and Jurgen Wirth, "Color Atlas of Immunology",Thieme Medical Publishers, 1st Edition, 2003.
3. Judith A. Owen, Jenni Punt and Sharon Stranford, "Kuby Immunology", W.H. Freeman andCompany, 7th Edition, 2013.
4. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Roitt, "Roitt's EssentialImmunology" Wiley-Blackwell Publication, 12th Edition, 2011.
5. Robert R. Rich, Thomas A Fleisher, William T. Shearer, Harry Schroeder, Anthony J. Frewand Cornelia M. Weyand, "Clinical Immunology-Principles and Practice" Elsevier, 4th Edition, 2013.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students would have a fundamental knowledge about the various organs involving in immune response, immune resopones and complement systems.
CO2	Students would have developed knowledge about the production and application of producing monoclonal antibodies and will have knowledge in various immunological techniques.
CO3	Students would have gained knowledge in the separation and identification of lymphocytes and various CD markers. They also gain knowledge in cytokine assay.
CO4	After completing this course, students get familiar about the basic principles and application of various vaccine development
CO5	At the end of the course the student would acquire knowledge on development aspects in engineering antibodies and gain knowledge in combinational libraries for antibody isolation.

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	-	-	-	-	-	-	-	-	2	1	-
CO2	1	1	1	-	-	-	-	-	-	-	1	3	3
CO3	1	2	1	1	-	1	-	-	-	-	1	2	3
CO4	1	2	2	1	1	2	1	-	1	-	1	2	1
CO5	1	2	2	1	1	3	1	-	1	-	1	1	3

BY1205	**ADVANCED GENOMICS AND PROTEOMICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the gene cloning methods, tools and techniques involved in gene cloning, genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts, production of recombinant proteins and PCR techniques.
- To identify the importance of protein bio molecules and the structure-function relationships in proteins.
- To understand comparative genomics and proteomics

UNIT I: GENE AND GENOME ANALYSIS 9

Gene prediction in prokaryotes and eukaryotes - Genome-wide association (GWA) analysis - Massively parallel Signature sequencing (MPSS), Whole genome Shotgun sequencing, Next Generation Sequencing (NGS) - Cytogenetic and physical mapping - GDB, NCBI, OMIM, NGI/MGD - Structural annotation - Functional annotation - Limitation of genomics

UNIT II: GENOME INFORMATICS 9

Functional genomics: Developmental biology and Differential gene expression, Microarray analysis - Epigenomics: Histone modification assays-ChIP-Chip and ChIP-Seq, DNA Methylation assays-DNA hybridization technique - Metagenomics: *de novo* transcriptome assembly

UNIT III: GENOMIC DIVERSITY 9

Study systems: Cyanobacteria, Plasmodium, Yeast, Virus, *Arabidopsis thaliana*, *Homo sapiens*, Worm, Zebra fish - Comparative databases: COG, KEGG, MBGD, PEDANT, Organism Specific databases

UNIT IV: PROTEOME INFORMATICS 9

2D Electrophoresis - Spot visualization and picking - Database for 2D gel - Tryptic digestion of protein - Peptide fingerprinting - Data analysis: Mass spectrometry; ion source (MALDI, spray sources); analyzer (ToF, quadrupole, quadrupole ion trap) and detectors - Ramachandran plot - Post-translational modifications of proteins - Limitation of proteomics

UNIT V: APPLICATIONS OF GENOMICS AND PROTEOMICS 9

Genomic Medicine - Synthetic biology and bioengineering - Conservation genomics - Interaction proteomics - Protein networks - Expression proteomics – Biomarkers - Proteogenomics.

TOTAL PERIODS: 45

REFERENCES:

1. Benjamin Lewin, “Gene IX”, Oxford University Press, Cambridge, U.K. 2011.
2. Brown, T.A., “Gene cloning and DNA analysis: An introduction”, 6th Edition, Wiley-Blackwell, 2010.
3. Glick, B.R. and Pasternak J.J., “Molecular Biotechnology: Principles and Applications of Recombinant DNA”, 3rd Edition, ASM Press, 2003.
4. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vol 1-3, CSHL,2001.
5. Winnacker, E.L., “Frome Genes to Clones: Introduction to Gene Technology”, Wiley-Blackwell, 2006.
6. Yamamoto, Takashi (Ed.). “Targeted Genome Editing Using Site-Specific Nucleases”,Springer, Japan, 2015.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Genome sequencing techniques currently used for gene and genome analysis.

CO2 Microarrays, Analysis of Gene expression and proteomics.

CO3 Genomic diversity and organism specific databases

CO4 2D Gel electrophoresis and Mass spectrometry analysis for any proteome

CO5 Applications of Genomics and proteomics in Biomedicine

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1	3	1	-	-	-	-	2	2	3
CO2	3	3	1	1	2	-	-	-	-	-	2	2	2
CO3	3	2	3	1	2	-	-	-	-	-	3	2	2
CO4	3	2	2	1	1	3	-	-	-	-	3	1	2
CO5	3	2	3	1	2	-	-	-	-	-	3	2	2

BY1208	IMMUNOTECHNOLOGY LABORATORY	L	T	P	C
		0	0	6	3

OBJECTIVES:

- To give practical exposure in the clinical diagnosis.
- To give laboratory training in different immunotechnological techniques.

EXPERIMENTS

1. Preparation of antigen and Routes of immunization (Intra-peritonial, Sub-cutaneous,Intramuscular, Intra- nasal, Oral)
2. Methods of bleeding (Eg. Tail bleeding, Intravenous, intraorbital)
3. Collection of serum, storage and purification of total IgG (salt precipitation).
4. Evaluation of Antibody titre by direct ELISA
5. Evaluation of Antigen by Sandwich ELISA
6. Characterization of antigens by native and SDS-PAGE
7. Characterizations of antigens by Western blot analysis – Wet and semi dry transfer
8. Conjugation of Immunoglobins (Streptavidin, colloidal gold)
9. Methods for prototype development of Immunodiagnostics (ICT card)
10. Blood smear identification of leucocytes by Giemsa stain
11. Separation of mononuclear cells by Ficoll-Hypaque
12. Separation of spleenocytes and proliferation against mitogens

TOTAL PERIODS: 90

Equipment Needed

Microscopes, restainer (mouse, rat, rabbit), Restrainers, purification columns, microplate reader, UV spectrometer, PAGE apparatus, Western blot apparatus (dry/semi-dry/wet), centrifuge, Haemocytometer, required strains & consumables

REFERENCE:

1.Antibodies: A Laboratory Manual, Edward A. Greenfield, Cold Spring Harbor Laboratory Press, 2nd Edition, 2014
2.Current protocols in immunology / editorial board John E. Coligan.et al,. 2003, New York :Wiley Interscience, 2003.
3.Practical Immunology Frank C. Hay and Olwyn M.R. Westwood, Blackwell Science Ltd., 4th ed, 2002

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Handle animals for immunological experiments, prepare and isolate antigens from animals.

CO2 Prepare, quantify and purify antibodies.

CO3 Evaluate antigens and antibodies using ELISA, Blotting and characterise protein by SDS-PAGE.

CO4 Perform experiments to identify and isolate different cells in a blood sample.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	2	2	3	1	1	2	2
CO2	2	2	2	2	2	2	2	2	2	1	2	2	2
CO3	2	2	2	2	3	2	2	2	2	1	2	2	3
CO4	2	1	2	2	2	2	2	2	2	1	2	2	2

SEMESTER III

BY1308	**ADVANCED MOLECULAR BIOLOGY AND GENETIC ENGINEERING LAB**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

OBJECTIVES:

- Provide hands-on experience in performing basic recombinant DNA techniques
- To understand the principle behind each techniques and applications of each methodology in applied biological research.

LIST OF EXPERIMENTS

1.Isolation of DNA
2. Electroporation to Yeast
3. Isolation of RNA
4. cDNA synthesis
5. Primer designing
6. Real-time PCR
7. Plasmid isolation and confirming recombinant by PCR and RE digestion.
8. Confirmation of the presence of insert by colony PCR
9. Induction and expression of recombinant protein
10. Western blot with ECL detection
11. Site directed mutagenesis
12. Southern blot (Non-radioactive)
13. RFLP analysis of the recombinant DNA

Required Equipments:

PCR, purification columns, micro plate reader, UV spectrometer, SDS- PAGE apparatus, Western blot apparatus (dry/semi-dry/wet), Southern blot apparatus, Cooling centrifuge, Haemocytometer, Gel Documentation, Gel rocker

TOTAL PERIODS: 90

REFERENCES:

1.Sambrook, J. and Russsel, D.W., “Molecular cloning – A laboratory manual”, Third edition, Cold Spring Harbor Laboratory Press, Cold Spring harbor, New York, USA, 2001.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Describe the main principles, methods for preparation and cloning of DNA in various organisms.
CO2	Express clearly about the gene amplification and methods for analysis of DNA such as hybridization, restriction analysis and gene expressions.
CO3	Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1	3	1	-	-	3	-	2	2	3
CO2	3	3	1	1	2	-	-	-	-	-	2	2	2
CO3	3	2	3	1	2	-	-	-	3	-	3	2	3

BY1309	**BIOPROCESS AND DOWNSTREAM PROCESSING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

OBJECTIVES:

The course applies earlier learned knowledge on bioreactors and sterilization kinetics.

- To provide hands-on training in downstream processing through simple experimentation in the laboratory.
- To understand the nature of the end product, its concentration, stability and degree of purification required for targeted biological products.
- Skills and knowledge gained are useful by analogy when solving problems typical for the bioindustry or for research.

LIST OF EXPERIMENTS:

1. Enzyme immobilization studies – Gel entrapment, adsorption and cross linking immobilisation.
2. Batch cultivation – *E.coli*– growth rate, substrate utilization kinetics, product analysis.
3. Fed batch cultivation - *E.coli*- growth rate, substrate utilization kinetics, product analysis.
4. Continuous cultivation – x - D construction, kinetic parameter evaluation, gas analysis, carbon balancing.
5. Optimization techniques – PlackettBurman, Response surface methodology.
6. Bioreactor studies: Sterilization kinetics, kLa determination, residence time distribution.
7. Cell separation methods-Centrifugation and microfiltration
8. Cell disruption methods- ultrasonicator, homogeniser.
9. Aqueous two phase extraction of biologicals.

10. Protein precipitation by salting-out method (ammonium sulphate).
11. Protein purification method- Column chromatography.
12. Product polishing- dryers, crystallizers.

TOTAL PERIODS: 90

REQUIRED EQUIPMENTS:

Centrifuge, Column for purification, Ultrasonicator, Homogeniser, Microfiltration,Hot air oven, Incubator, Laminar air flow chamber, freeze dryer, required chemicals & strains

REFERENCES:

1. J.C. Janson – Protein Purification – Principles, High Resolution Methods And Applications, 3rd Edition, Wiley, 2011.
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications
3. Shuler and Kargi, “Bioprocess Engineering “, 3rd Edition, Prentice Hall, 2017.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Describe the main principles, methods for preparation and cloning of DNA in various organisms.
CO2	Express clearly about the gene amplification and methods for analysis of DNA such as hybridization, restriction analysis and gene expressions.
CO3	Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	-	-	-	-	2	3	3
CO2	2	3	3	3	3	2	-	-	-	-	2	3	3
CO3	2	3	3	3	3	2	-	-	-	-	2	3	3

PROFESSIONAL ELECTIVES I

BY1001	**MOLECULAR CONCEPTS IN BIOTECHNOLOGY (FOR ENGINEERING STREAM)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

1. Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes
2. By doing this course students wil lacquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity of the cells.
3. This course will emphasize the molecular mechanism of DNA replication, repair, transcription, protein synthesis and gene regulation in various organisms.

UNIT I DNA, RNA AND PROTEIN SYNTHESIS 9

Concept and organization of genetic materials – Types of DNA & RNA – DNA replication, Decoding genetic information – Regulation of gene expression – Protein synthesis, Transcription and translation. Regulation of transcription in bacteria and eukaryotes – Non-coding RNAs – DNA repair mechanism

UNIT II MANIPULATION OF GENE EXPRESSION IN PROKARYOTE 9

Prokaryotic genome organization - Regulatable promoters, fusion proteins – Construction, cleavage and use of fusion proteins – Unidirectional tandem gene arrays and translation expression vectors – Protein stability – Oxygen limitation, protease deficient host strains, bacterial hemoglobin *Vitreoscill* sp. – Increased protein secretion – Factor Xa and bacteriocin

UNIT III DIRECTED MUTAGENESIS AND PROTEIN ENGINEERING 9

Directed mutagenesis – Oligonucleotide-directed mutagenesis with M13 virus and plasmid DNA – PCR amplified oligonucleotide directed mutagenesis – Protein thermostability – Addition of disulfide bonds, reduction in free sulfhydryl residues – Increasing enzyme activity – Modifying the substrate binding specificity, modifying metal cofactor requirements – Restriction modification enzymes – Zinc finger proteins.

UNIT IV TRANSGENIC ANIMALS 9

Concept of genetic engineering – Techniques in genetic engineering - Transgenic animals – Gene transfer methods – Retroviral vector method, DNA microinjection, engineered embryonic stem cell, nuclear transfer, YAC –Applications of transgenic animals – Transgenic livestock – Production of donor organs, pharmaceuticals, disease resistant livestock – Improving milk quality and animal production traits

UNIT V HUMAN MOLECULAR GENETICS 9

Genetic linkage and gene mapping – Genetic polymorphism, RFLP, SNP, STRP – Physical mapping of the human genome – Sequence tagged site (STS) for constructing physical maps from YAC, BAC or PAC – Genomic libraries – Transcriptional mapping – Cloning human disease genes and methods – Human Genome Project.

Total Periods 45

REFERENCES

1. Glick, B.R., Pasternak, J.J. and Cheryl L. Patten., “Molecular Biotechnology – Principles and Applications of Recombinant DNA”, 4^{th} Edition, ASM Press, 2009.
2. Wink, M., “An Introduction to Molecular Biotechnology – Molecular Fundamentals, Methods and Applications in Modern Biotechnology”, Wiley-VCH Verlag, 2006.
1. Clark, D.P. and Pazdernik, N.J., “Biotechnology – Applying the Genetic Revolution”, Elsevier Inc., 2009.
4. Kun, L.U., “Microbial Biotechnology – Principles and Applications”, 2^{nd} Edition, World Scientific Publishing Co. Pte. Ltd., 2006.
2. Walker, J.M. and Rapley, R., “Molecular Biology and Biotechnology”, 5^{th} Edition, RSC publishing, 2009.
3. Ajoy Paul: Cell and Molecular Biology, 4^{th} Ed., Books and Allied (P) Ltd., Kolkata, 2015.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Describe the Molecular mechanism of DNA Replication,Repair,Transcription, Protein synthesis and gene regulation in various organisms

CO2 Understand and Manipulation of Gene Expression in Prokaryote

CO3 Understand and Perform Directed Mutagenesis and Protein Engineering

CO4 Get Detailed Knowledge on Transgenic Animals and Its Applications

CO5 Understand The Overall View on Human Molecular Genetics

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	1	1	2	1	1
CO2	3	2	-	-	-	-	-	-	1	1	2	1	1
CO3	3	2	-	-	-	-	-	-	1	1	2	1	1
CO4	3	2	-	-	-	1	-	-	2	1	2	1	1
CO5	3	2	-	2	-	1	-	-	3	1	2	1	1

BY1002	PRINCIPLES OF CHEMICAL ENGINEERING (for Science Stream)	L	T	P	C
OBJECTIVES:		3	0	0	3

The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics. The objectives are to enable the students

- To perform calculations pertaining to processes and operations.
- To apply fluid mechanics principles to applied problems

UNIT I FUNDAMENTALS OF CHEMICAL ENGINEERING 9

Concepts of unit operation and unit process with examples – Units and dimensions, conversion factors, dimensional analysis – Presentation and analysis of data – Mole, density, Specific gravity – Mass fraction, Mole fraction – Analysis of multicomponent system – Concentration.

UNIT II MATERIAL AND ENERGY BALANCES 9

Overall and component material balances – Material balances without chemical reactions – Chemical reactions, stoichiometry, conversion and yield – Material balance calculations with chemical reactions – Combustion calculations – Recycle operations – Energy balances – Entropy, latent heat – Concepts of chemical thermodynamics – Relation to VLE, solution thermodynamics and reaction thermodynamics.

UNIT III FLUID MECHANICS 9

Laminar and turbulent flow – Basic equations of fluid flow, continuity equations and Bernoulli's equation – Shear – Stress relationships – Non-Newtonian fluids, friction factor and its calculation in laminar and turbulent flow – Operational principles of different types of pumps, compressors and valves – Measurement of fluid flow using venturimeters, orifice meters – Rotameters, pivot tube.

UNIT IV MASS TRANSFER 9

Fick's law of diffusion – Analogy with momentum and heat transfer, diffusivities of gases and liquids, diffusion in binary mixtures, Interphase mass transfer – Film theory of mass transfer, determination of volumetric mass transfer coefficient – Overview of separation operations with examples, ideal stage concept – Mass transfer equipment – Distillation, liquid extraction, gas absorption, drying

Total periods 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Solve problems related to units and conversions and fit the given data using the methodologies
CO2	Solve problems related to material and energy balance concepts and design reactors for biochemical processes
CO3	Understand Fluid Mechanics principles in biotechnology
CO4	Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics.
CO5	Apply their knowledge in the field of biochemical engineering from the principles of conservation of mass

COs	PROGRAM OUTCOMES (POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	-	-	2	-	1	-	1	3	1	1
CO2	3	3	1	-	-	2	-	1	-	1	3	1	1
CO3	3	3	1	-	-	2	-	1	-	1	3	1	1
CO4	3	3	1	-	-	2	-	1	-	1	3	1	1
CO5	3	3	1	-	-	2	-	1	-	1	3	1	1

BY1003 METABOLIC PROCESS AND ENGINEERING (for Biotechnology Stream)

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a quantitative basis, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level
- To enable the students to use organisms to produce valuable substances on an industrial scale in cost effective manner

UNIT I: CELLULAR METABOLISM 9

Transport Processes – Fueling reactions – Glycolysis, fermentative pathways – TCA cycle and oxidative phosphorylation, anaplerotic pathways –Catabolism of fats, organic acids, and amino acids - Biosynthesis of amino acids, nucleic acids, and fatty acids – Polymerization – Growth Energetics.

UNIT II: REGULATION, MANIPULATION AND SYNTHESIS OF METABOLIC PATHWAY 9

Regulation of enzyme activity – Regulation of enzyme concentration – Regulation of metabolic networks – Regulation at the whole cell level – Metabolic pathway manipulations – Enhancement of Product yield and productivity – Extension of substrate range, product spectrum and novel products (Antibiotics, Polyketides, Vitamins) – Improvement of cellular properties – Metabolicpathway synthesis algorithm – Lysine biosynthesis.

UNIT III: ANALYSIS AND METHODS FOR THE METABOLIC FLUX 9

Metabolic flux map – Fluxes through the catabolic pathways in microbes– Metabolic flux analysis for determined, overdetermined and under-determined systems –Sensitivity analysis – Direct flux determination from fractional label enrichment – Applications involving complete enumeration of metabolite isotopomers – Carbon metabolite balances.

UNIT IV: APPLICATION OF METABOLIC FLUX ANALYSIS 9

Amino acid production – Biochemistry and regulation– Metabolic flux analysis of lysine biosynthetic network and specific deletion mutants – Metabolic fluxes in mammalian cell cultures –Intracellular fluxes, validation of flux estimates by ^{13}C labeling studies – Design of cell culture media.

UNIT V: ANALYSIS OF METABOLIC CONTROL AND INDUSTRIAL CASE STUDIES 9

Fundamental of Metabolic Control Analysis (MCA), MFA, and MPA and their application, relating system variables to enzyme kinetics, Multi-substrate enzyme kinetics, Metabolic engineering examples for bio-fuel, bio-plastic and green chemical synthesis and industrial case studies.

TOTAL PERIODS: 45

REFERENCES:

1. Christiana D. Smolke, “The Metabolic Pathway Engineering Handbook Fundamentals”,CRC Press Taylor & Francis Group, 2010.
2. Cortossa, S., Aon, M.A., Iglesias, A.A. and Lloyd.D., “An Introduction to Metabolic and CellularEngineering'', 2nd Edition,World Scientific Publishing Co, 2011
3. Curran, C.P., “Metabolic Processes and Energy Transfers - An Anthology of CurrentThought”, The Rosen Publishing group, Inc., 2006.
4. Nielsen, J., Villadsen, J. and Liden, G., “Bioreaction Engineering Principles”,3rd Edition,Springer, 2011
5. Stephanopoulos, G.N., Aristidou, A.A. and Nielsen.J., “Metabolic Engineering – Principles And Methodologies”, Elsevier Science, 2001.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students would have a fundamental knowledge about the cellular metabolism and biosynthesis and catabolism of various biomolecules.
CO2	Students would have gained knowledge on regulation, manipulation and synthesis of metabolic pathways
CO3	Students would have developed knowledge about analysis and methods for the metabolic flux
CO4	After completing this course, students get familiar with the application of metabolic flux analysis.
CO5	At the end of the course the student would acquire knowledge in analysis of metabolic control and industrial case studies

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	1	-	2	-	-	-	-	2	2	1
CO2	1	1	2	2	2	2	-	-	-	-	2	2	1
CO3	2	1	3	2	2	1	-	-	-	-	2	2	1
CO4	2	1	3	2	2	2	-	-	-	-	2	2	1
CO5	2	1	2	2	2	1	-	-	-	-	2	-	1

PROFESSIONAL ELECTIVES II

BY1004	ANIMAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the fundamentals of animal cell culture,diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I INTRODUCTION 4

cope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins – Significance of animal based products.

UNIT II MOLECULAR BIOLOGY 9

Biology of animal viral vectors- SV40, adeno virus, retrovirus, vaccinia virus, herpes virus, adeno associated virus and baculo virus.

UNIT III CELL CULTURE TECHNOLOGY 11

Culturing of cells, primary and secondary cell lines, Analysis of cell energitics - Cell culture - Scaling up of animal cell culture-monolayer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, Chemostat/Turbidostat; High technology vaccines: Hybridoma technology; Cell lines and their applications

UNIT IV GENETIC ENGINEERING 11

Gene therapy-prospects and problems; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications.

UNIT V APPLICATIONS 10

Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming - Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.

TOTAL PERIODS: 45

REFERENCES:

1. Watson, J.D., Gilman, M., Witowski J.and Zoller, M. Recombinant DNA, 2nd ed., Scientific American Books, 1983
2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3rd ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004
4. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 1998 5. Freshney R.I. Animal Cell Culture- a practical approach, 1987.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Fundamentals And Applications Of To Animal Biotechnology

CO2 Molecular Biology Aspects Of Animal Biotechnological Operations

CO3 Various Techniques To Be Adopted In Cell Culture

CO4 Concepts Of Micromanipulation Technology And Transgenic Animal technology

CO5 Applications In Transgenic Animal Breeding

COs	PROGRAM OUTCOMES(POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	2	1	2	1	2
CO2	3	2	2	-	-	-	-	-	2	1	2	1	2
CO3	3	2	3	-	-	-	-	-	2	1	2	1	2
CO4	3	2	2	1	-	-	-	-	2	1	2	1	2
CO5	3	2	3	1	2	-	-	-	2	1	2	1	2

BY1005	COMPUTER AIDED LEARNING OF STRUCTURE AND FUNCTION OF PROTEINS	L	T	P	C
		2	2	0	3

OBJECTIVES:

To enable the students

- To identify the importance of protein biomolecules.
- To realize the structure-function relationships in proteins

UNIT I AMINO ACIDS AND 3D STRUCTURE 9

Amino acids – Acid-base properties – Stereo chemical representations – Chemical and Physical properties – Primary structure – Secondary structure and motifs – Tertiary structures and domains – Quaternary structures – Classifications – CATH, SCOP – Protein Data Base analysis.

UNIT II FIBROUS AND MEMBRANE PROTEINS 9

Amino acid composition and organization of fibrous proteins – Keratins – Fibroin – Collagen – Molecular organization of membranes – Bacteriorhodopsin – Structure of the Bacterial reaction centre – Oxygenic photosynthesis – Membrane proteins based on transmembrane beta barrels – Structure of ATP synthetase.

UNIT III FUNCTION AND CONTROL OF FUNCTION 9

Protein flexibility – Hydrogen exchange – Rotations of side chains – Enzyme Catalysis – Steady state kinetics – Transition state stabilization – Allostery – Multiple binding sites and interactions – Allosteric properties of Hemoglobin – Negative Cooperativity.

UNIT IV BIOSYNTHESIS AND DEGRADATION 9

Post translational covalent modifications – Proteolytic processing – Alteration of the chain Termini – Glycosylation – Lipid attachment – Hydroxylation – Phosporylation – Disulphide bond formation – Chemical aging – Factors determine the rate of degradation – Proteases – Lysosomes – Ubiquitin mediated pathway.

UNIT V DETERMINATION AND PREDICTION OF 3D STRUCTURE 9

Experimental physical methods – X-Ray crystallography, NMR, Cryo-EM, Neutron diffraction – Vibrational spectroscopy – Raman spectroscopy – Computational methods – Homology modeling – Fold recognition and Threading.

TOTAL PERIODS: 45

TEXT BOOKS

1. Whitford, D.,"Proteins: Structure and Function", John Wiley & Sons Ltd., 2005.
2. Creighton. TE., "Proteins: Structures and Molecular Properties", 2nd Edition, W. H. Freeman and Company, New York, 1993.

REFERENCES:

1. Rastogi, S.C., "Bioinformatics Concepts, Skills & Applications", 2nd Edition, CBS publishers, 2009.
2. Petsko, G.A. and Ringe, D., "Protein Structure and Function", 2004.
3. Bujnicki, J.M., "Prediction of Protein Structures, Functions, and Interactions", John Wiley & Sons Ltd., 2009.

COURSE OUTCOMES

Upon completion of the course, the students will be able to gain knowledge on

CO1 Various Interactions In Protein Makeup.

CO2 Different Levels Of Protein Structure.

CO3 Role Of Functional Proteins In Various Field Of Study.

CO4 Biosynthesis And Degradation of Proteolytic Process

CO5 Latest Application Of Protein Science In Their Research

COs	PROGRAM OUTCOMES(POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1	-	1	-	1	-	-	1	1	2	1	1
CO2	2	1	-	1	-	1	-	-	1	1	2	1	1
CO3	2	1	1	1	-	1	-	-	1	1	2	1	1
CO4	2	1	-	1	-	-	-	1	1	1	2	1	1
CO5	2	1	1	1	-	-	-	1	1	1	2	1	1

BY1006	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.
- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D

UNIT I: PROTEIN CRYSTALLOGRAPHY 9

Biological macromolecules – Principle of protein crystallization – Method – Testing – Cryotechniques – Influence of heterogeneity on crystallization – Progress in structural genomics – Micro crystallization – Utility of micro fluidics for crystallization.

UNIT II: PROTEIN AND PEPTIDE PURIFICATION 9

Chromatographic methods for protein and peptide purification – Multidimensional chromatography – High throughput screening of soluble recombinant proteins – Immunoprecipitation – Affinity chromatography for antibody purification – Role of reverse phase HPLC in proteomic research.

UNIT III: ELECTROPHORETIC TECHNIQUES 9

Strategies – Separation of proteins using 2D gel electrophoresis – Electrophoresis method for purifying proteins – *in situ* enzyme detection – Staining method – Separation of peptide mixture – Pulse field gel electrophoresis – Denaturing gradient gel electrophoresis.

UNIT IV: MICROSCOPY 9

Microscopy with light and electrons – Electrons and their interaction with the specimen – Electron diffraction – Instrument, specimen preparation and application of TEM and SEM – Fluorescence microscopy – Laser confocal microscopy – Phase contrast – Video microscopy – Scanning probe microscopy.

UNIT V: SPECTROSCOPY 9

Methods for characterizing purified proteins – IR absorption process, IR spectrometer and sample preparation – Instrumentation and applications of UV – Overview of mass spectrometry, ionization methods, mass analysis, detection and quantitation – Circular dichroism (CD) spectroscopy – NMR – Fourier transform infrared spectroscopy (FTIR).

TOTAL PERIODS: 45

REFERENCES:

1. Babine, R.E. and Abdel-Meguid, S.S., “Protein Crystallography in Drug Discovery”, Willy-VCH Verlag GmbH& Co., 2004.
2. Bhowmik, G. and Bose, S., “Analytical Techniques in Biotechnology”, Tata McGraw-Hill Publishers, 2011.
3. Chandler, D. and Roberso, R.W., “Bioimaging: Current Techniques in Light & Electron Microscopy”, Jones and Bartlett publishers, 2008.
4. Pavia, D.L., Lampman, G.M., Kriz, G.S. and Vyvyan, J.R., “Introduction to Spectroscopy”, 4th Edition, Brooks/Cole Cengage Learning, 2008.
5. Simpson, R.J., “Purifying Proteins for Proteomics”, Cold Spring Harbor Lab Press, 2004.

COURSE OUTCOMES

Upon completion of the course,

CO1 Students would have a fundamental knowledge about the various methods to obtain pure proteins and protein crystallization.

CO2 Students would have gained knowledge on the different chromatographic methods for separation of biological products.

CO3 Students would have developed knowledge about electrophoretic techniques for the separation of proteins.

CO4 Students get familiar with the Microscopic techniques.

CO5 Students would have acquired knowledge about the light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	-	1	-	-	-	-	-	-	2	2	1
CO2	2	1	-	2	2	-	-	-	-	-	2	2	1
CO3	2	1	-	2	2	-	-	-	-	-	2	2	1
CO4	2	1	-	2	2	-	-	-	-	-	2	2	1
CO5	2	1	-	2	2	-	-	-	-	-	2	-	1

BY1007	BIOTHERMODYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to learn about basic concepts of classical and statistical thermodynamics
- To demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.

UNIT I CONCEPTS AND LAWS OF THERMODYNAMICS 9

Basic concepts of thermodynamics – First Law of Thermodynamics – Second law of thermodynamics – Zeroth Law and Third Law of thermodynamics – Laws of thermodynamics and biology – Thermodynamics of equilibrium – Behavior of systems far from equilibrium – Dissipative structures in non-equilibrium systems – Thermodynamic features of small systems – Thermodynamics of macromolecular processes in cells – Thermodynamics of energy interactions in ecosystems – Conservation of energy.

UNIT II ENERGY TRANSFORMATION AND BIOENERGETICS 9

Distribution of energy – Carbon, energy and life – Molecular level energy storage – Biothermodynamics of energy use by plant and animals – Methods for measuring the thermodynamic stability of membrane proteins – Protein folding – Modeling the native state ensemble of proteins using statistical thermodynamics – Energetic profiles of proteins derived from thermodynamics of the native state ensemble – Principle of components analysis of energetic profile space – Energetic profiles are conserved between homologus proteins

UNIT II GIBB'S FREE ENERGY AND ITS APPLICATIONS 9

Theory and derivation of Gibbs free energy – Free energy of reactions –Lipid membrane phase transitions – Thermodynamics of cellular metabolism – Sugar metabolism – Energy transport in ATP and NAD – Substrate recycling – Donnan Equilibrium – Enzyme-substrate interaction – Free energy of transfer of amino acids – Differences between heat engines and biological energy processes – Temperature regulation in organisms – Humidity and temperature effects on organisms – Non-equilibrium thermodynamics and life.

UNIT IV STASTICAL THERMODYNAMICS AND BINDING EQUILIBRIA 9

Diffusion – Boltzman distribution – Partition function – Analysis of thermodynamic data – Multi-state equlibria – Protein heat capacity functions – Cooperative transitions – Interaction free energy – Helix coil transition theory – Binding equlibria – Single site model – Multiple independent sites – Oxygen transport – Scatchard plots and Hill plots – Ligand binding in macromolecules.

UNIT V REACTION KINETICS TO BIOLOGICAL SYSTEM 9

Free energy analysis of chemical reactions – Chemical coupling to drive reactions in biological systems – First order and second order reactions – Collision theory – Transition state theory – Free energy of activation – Arrhenius rate constant equation – Applications – Temperature and concentration effects on enzyme kinetics – Reaction mechanism of lysozyme – Kinetic identification of reaction intermediates – Sequential enzyme reactions in metabolism and analysis.

TOTAL PERIODS: 60

Text Books

1. Haynie, D.T., "Biological Thermodynamics", Second Edition, Cambridge University Press, 2008.
2. Hammes, G.G., "Thermodynamics and Kinetics for the Biological Sciences for Biological System", Wiley, 2000.

REFERENCES:

1. Cengel, Y.A. and Boles, M.A., "Thermodynamics, an Engineering Approach", McGraw Hill, Sixth Edition, 2006.
Timasheff, S.N., "Protein Hydration, Thermodynamic Binding, and Preferential Hydration, Biochemistry", 13473-13482, 2002.
Johnson, M.L., Holt, J.M. and Ackers, G.K., "Biothermodynamics", Part 1, Academic Press, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Explain the theoretical concepts of thermodynamics and how it applies to energy

CO2 Understand Conversion in technological applications and biological systems.

CO3 Design and carryout bioprocess engineering experiments, and analyze and Interpret fundamental data to do the design and operationof bioprocesses.

CO4 Describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations, microbial growth and productformation.

CO5 Gain knowledge on Chemical reaction kinetics to biological system

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	-	-	1	2	2	1	2
CO2	3	2	2	1	1	2	-	-	1	2	2	1	2
CO3	3	2	2	1	1	2	-	-	1	2	2	1	2
CO4	3	2	2	1	1	2	-	-	1	2	2	1	2
CO5	3	2	2	1	1	2	-	-	1	2	2	1	2

BY1008	PLANT BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give the details of plant cells and its functions
- To provide the basics of agro bacterium and applications of plant biotechnology

UNIT I PLANT TISSUE CULTURE 9

Concept of cellular totipotency– Cytodifferentiation– Organogenic differentiation – Nutritional requirements – Seed culture, embryo culture, Protoplast culture, Micropropagation, Cell suspension –*Invitro* production of haploids–Somaclonal variation –Germplasm storage and cryopreservation.

UNIT II CHLOROPLAST AND MITOCHONDRIA 9

Structure, function –Light and dark reaction and genetic material –Rubisco synthesis and assembly, coordination, regulation and transport of proteins– Mitochondria: Genome – Cytoplasmic male sterility and import of proteins – Comparison and differences between mitochondrial and chloroplast genome – Chloroplast transformation.

UNIT III **PLANT METABOLISM AND METABOLIC ENGINEERING** **9**

Nitrogen fixation – Nitrogenase activity – Nod genes, nif genes, bacteroids – Plant nodulins. Production of secondary metabolites – Flavanoid synthesis and metabolic engineering.

UNIT IV **GENE TRANSFER IN PLANTS** **9**

Tranisent and stable gene expression –Marker genes –Vector mediated gene transfer, *Agrobacterium* mediated DNA transformation–Tumor inducing principle, Ti plasmid – TDNA transfer – Transformation techniques using *Agrobacterium,*importance in genetic engineering–Agrobacterium vectors – Viruses mediated gene transfer, status and expression of transferred genes.

UNIT V **TRANSGENICS IN CROP IMPROVEMENT** **9**

Resistance to biotic stresses and abiotic stresses – Herbicide resistance –Transgenics for quality – Transgenics plants as bioreactors – commercial transgenic crops and impact of recombinant DNA technology–Molecular Pharming – Therapeutic products –Transgene silencing and ethical issues.

TOTAL PERIODS: 45

REFERENCES:

1. Adrian, Scott, Nigel W., Fowler, Mark R.Plant Biotechnology: The Genetic Manipulation of Plants by Slater 2nd Edition Oxford University Press, 2008
2. Chawla, H.S, Introduction to Plant Biotechnology, 2nd edition, 2007
3. Gamburg ,O.L., and Philips G.C. Plant Tissue & Organ Culture: Fundamental Methods. Narosa Publishing House,2005
4. Grierson D. and Covey, S.N. Plant Molecular Biology, 2nd Edition, Blackie,1988
5. Heldt, Hans-Walter, Plant Biochemistry & Molecular Biology, 1stEditionOxford University Press,1997

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 The fundamentals of plant cells, structure and functions.

CO2 The regulation and transport of proteins.

CO3 The Nitrogen fixation mechanism and significance of viral vectors.

CO4 Plant tissue culture and transgenic plants

CO5 Transgenic crops and development of therapeutic products.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	2	2	3	1	1
CO2	3	2	1	2	1	-	-	-	2	2	3	1	1
CO3	3	2	1	2	1	-	-	-	2	2	3	1	1
CO4	3	2	1	2	1	-	-	-	2	2	3	1	1
CO5	3	2	1	2	1	-	-	-	2	2	3	1	1

PROFESSIONAL ELECTIVES III

BY1009	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The proposed course is designed

- To understand the scientific and engineering principles of microbiological treatment technologies to clean up contaminated environments
- To replace of conventional treatment methodologies by molecular biology and genetic engineering strategies
- To seek the way for the alternate sources of energy to avoid environmental issues

UNIT I: BIODEGRADATION AND BIOREMEDIATION 9

Bioremediation technologies – Biostimulation, Bioaugmentation, Bioventing, biosparging and Phytoremediation – Bioleaching, bioprecipitation, bioaccumulation and biosorption of heavy metals. Aerobic and Anaerobic degradation of aliphatic and aromatic compounds – Biodegradation of herbicides and pesticides.

UNIT II: MICROBIAL METABOLISM IN WASTEWATER TREATMENT 9

Decomposition of organic compounds in natural ecosystems – Co-metabolic degradation of organo-pollutants - Hydrolysis of biopolymers by aerobic and anaerobic microorganisms – Anaerobic degradation of carbohydrates, proteins, lipids – Nitrogen removal – Ammonification, nitrification, denitrification

UNIT III: BIOLOGICAL TREATMENT OF WASTEWATER 9

Physico-chemical characteristics of wastewater – Overview of aerobic and anaerobic treatment processes, Process design of aerobic and anaerobic system – Activated sludge process – Trickling filter – Rotating biological contactors – Fluidized bed reactor – Upflow anaerobic sludge blanket reactor (UASB) – Membrane bioreactors – Algal photosynthesis in wastewater treatment.

UNIT IV: BIOTECHNOLOGY FOR AIR POLLUTION AND WASTE MANAGEMENT 9

Biotechnology for treating Air pollutants – Biofilters and Bioscrubbers – Biotechnology for the management of agricultural, plastic, dairy, paper and pulp, textile, leather, hospital and pharmaceutical industrial wastes.

UNIT V: BIOPRODUCTS FROM RENEWABLE SOURCES 9

Overview of renewable sources, Production of vermicompost, Production of biofertilizers and biopesticides, Production of biomethane, bioethanol, biohydrogen, biodiesel – Production of bioplastics and biopolymers – Bioelectricity generation and value added products from renewable sources

TOTAL PERIODS: 45

TEXT BOOKS:

1. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series , Vol.1, Gulf Publications Co., London, 1989.
2. Evans, G.G. and Furlong, J., Environmental Biotechnology: Theory and Application, 2nd Edition, John Wiley & Sons, 2011.

REFERENCES:

1. Henze, M., Harremoes, P., Jansen, J.C. and Arvin, E., “Wastewater Treatment: Biological and

Chemical Processes", 2nd Edition, Springer, 2013.
2. Jordening, H.J. and Winter, J., "Environmental Biotechnology: Concepts and Application", Wiley-VCH Verlag GmbH & Co., 2005.
3. Wong J.W-C., Tyagi R.D., and Pandey. A., "Current Developments in Biotechnology and Bioengineering Solid waste" Elsevier, 2016.
4. Zarook, S. and Ajay,S., Biotechnology for Odor and Air Pollution Control, Springer, 2005.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Understand the scientific & engineering principles of microbial technologies to clean up polluted ecosystems
CO2	Replace of conventional treatment methodologies by molecular biology and genetic engineering strategies
CO3	Improve the sources of energy for aerobic and anaerobic treatment methods
CO4	Design Scientific solutions and participation can be served for the environmental Protection.
CO5	Seek the way for alternate sources of energy to avoid environmental issues.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	-	-	-	-	3	2	1
CO2	1	2	2	2	1	-	-	1	-	-	2	3	-
CO3	-	-	1	3	-	1	-	-	3	-	1	2	1
CO4	-	-	-	-	1	2	-	2	3	-	-	1	2
CO5	-	-	-	-	-	-	-	1	2	3	-	1	3

BY1010	CANCER BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students to understand

- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
- Enhanced immunology based detection methods and imaging techniques
- Development of cell based and cytokine based immunotherapy against cancer

UNIT I PRINCIPLES OF CANCER BIOLOGY 9

Cancer: Definition, causes, properties, classification, clonal nature – Cell Cycle: Regulation of cell cycle, cell proliferation and apoptosis – Signal transduction pathways – Apoptosis: apoptotic pathways, signal molecules, effects on receptor, signal switches – Modulation of cell cycle in cancer – Mechanism of spread.

UNIT II PRINCIPLES OF CARCINOGENESIS 9

Cancer risk factors – Theory of carcinogenesis – Chemical carcinogenesis – Physical carcinogenesis: x-ray radiation – mechanisms of radiation carcinogenesis – Stages of cancer: initiation, promotion, progression.

UNIT III MOLECULAR BIOLOGY OF CANCER 9

Signal targets and cancer – Growth factors – Transformation – Activation of kinases – Oncogenes: c-Myc, Ras, Bcl-2 family – Mechanism of oncogene activation – Retroviruses and oncogenes – Detection of oncogenes – Oncogenes/proto oncogene activity – Tumor suppressor genes: Rb, p53, APC, BRCA paradigms – Telomerases

UNIT IV CANCER METASTASIS 9

Clinical significances of invasion – Heterogeneity of metastatic phenotype – Metastatic cascade: basement membrane disruption, invasion – Recent approach to identify key factors controlling metastasis – Angiogenesis

UNIT V CANCER THERAPY 9

Therapy forms – Surgery, chemotherapy, radiation therapy - Detection of cancers – Prediction of aggressiveness of cancer – Advances in cancer detection – Tumor markers; New approaches of cancer therapy – mAbs, vaccines, gene therapy, stem cell therapy.

TOTAL PERIODS: 45

Text Books

1. Ruddon, R.W., "Cancer Biology", 2nd Edition, Oxford University Press, 2007
2. Weinberg, R.A., "The Biology of Cancer", Taylor & Francis, Garland Science, 2007

REFERENCES:

1. Schulz, W.S., "Molecular Biology of Human Cancers – An Advanced Students Text Book", Springer, 2005.
2. Pelengaris, S. and Khan, M., "The Molecular Biology of Cancer", Blackwell Publishing, 2006.
3. Fialho, A. and Chakrabarty, A., "Emerging Cancer Therapy: Microbial Approaches and Biotechnological Tools" 1st Edition, Wiley, 2010.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Concepts of cell cycle, cell regulation, proliferation & apoptosis.

CO2 Principles of carcinogenesis and stages of cancer.

CO3 Signal targets, growth factors & Mechanism of oncogene activation and detection.

CO4 Cancer metastatis, clinical significances and factors that can control metastatis.

CO5 Detection of cancer & Advancements in cancer detection.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	-	2	2	3	1	1
CO2	3	3	3	2	2	1	1	-	2	2	3	1	1
CO3	3	3	3	2	2	1	1	-	2	2	3	1	1
CO4	3	3	3	2	2	1	1	-	2	2	3	1	1
CO5	3	3	3	2	2	1	1	-	2	2	3	1	1

BY1011	TECHNOLOGY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

UNIT I TECHNOLOGY MANAGEMENT 9

Concept and meaning of technology – Evolution and growth of technology – Role and significance of management of technology – Impact of technology on society and business – Process and product technology. Competitive advantages through new technologies: product development from scientific breakthrough to marketable product – Role of Government in Technology Development – Managing Intellectual Property

UNIT II TECHNOLOGICAL FORECASTING & ASSESSMENT 9

Intuitive – Extrapolation – Growth Curves – Technology Monitoring. Normative: Relevance Tree – Morphological Analysis – Mission Flow Diagram - Technology Choice –Technological Leadership and Followership – Technology Acquisition. Meaning of Innovation and creativity – Innovation management

UNIT III TECHNOLOGY STRATEGY 9

Strategy concept – Types – Key principles – Framework for formulating technology strategy - Technology forecasting: techniques and application – Technology diffusion and absorption: Rate of Diffusion – Innovation Time and Innovation Cost – Speed of Diffusion – Project management in adoption and implementation of new technologies

UNIT IV TECHNOLOGY TRANSFER MANAGEMENT 9

Technology transfer process – Outsourcing strategic issues – Joint ventures – Technology sourcing. Integration of People and Technology – Organizational and Psychological Factors –Organizational Structure – Social Issues in Technology Management: Technological Change and Industrial Relations – Technology Assessment – Environmental Impact Analysis.

UNIT V TECHNOLOGY TRANSFER AND ACQUISITION 9

Import regulations – Implications of "Uruguay Round" and WTO – Bargaining process –Transfer option – MOU. Adopting technology – Human interactions – Organizational redesign and re-engineering – Technology productivity. Technology Absorption and Innovation: present status in India – Need for new outlook – Absorption strategies for acquired technology – Creating new/improved technologies – Innovations – Technology Measurement – Technology Audit

TOTAL PERIODS: 45

Text Books

1. Khalli,T., “Management of Technology”, McGraw-Hill, 2009.
2. Schilling, M.A., “Strategic Management of Technological Innovation”, McGraw-Hill, 2008.

REFERENCES:

1. Narayanan,V.K., “Managing Technology and Innovation for Competitive Advantage” Pearson Education, 2007.
2. Sullivan, N., “Technology Transfer”, Cambridge University, 1995.
3. Thamhain, H.J., “Management of Technology: Managing Effectively in Technology-Intensive Organizations”, 2nd Edition, Wiley, 2005

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Evolution , significance & impact of technology on society & business.

CO2 Morphological analysis, mission flow diagram leading to innovation & creativity.

CO3 Principles, framework in formulating a strategy- its adoption & implementation

CO4 Technology assessment & environment impact analysis.

CO5 Human interaction, organisational design leading to productivity.

COs	PROGRAM OUTCOMES(POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	3	1	1	2	1	1	1	1
CO2	1	2	2	2	1	3	1	1	2	1	1	1	1
CO3	1	2	2	2	1	3	1	1	2	1	1	1	1
CO4	1	2	2	2	1	3	1	1	2	1	1	1	1
CO5	1	2	2	2	1	3	1	1	2	1	1	1	1

BY1012	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics. The objectives are to enable the students

- To perform calculations pertaining to processes and operations.
- To apply fluid mechanics principles to applied problems

UNIT I GOVERNING EQUATIONS 9

Fluid flow and its mathematical descriptions; conservation laws – Continuity equations – Momentum equation, energy equation – Navier-Stokes equations – Boundary conditions, Solutions of Governing Equations – Finite difference method, Finite element method, Finite Volume Method, Euler's Equations – Non-Newtonian Constitutive Equations – Curvilinear coordinates and Transformed equations – CFD as Research tool and Design tool – Validation Strategies.

UNIT II NUMERICAL ANALYSIS 9

Solving System of Algebraic equations – Gauss Elimination, Gauss-Seidel – LU-Decomposition – Jacobi – Simpson Rule – Laplace solution – Euler's method – R-K method – Fourier analysis of first and second upwind

UNIT III COMPRESSIBLE FLOW COMPUTATION 9

Euler equations – Conservative and non-conservative from thermodynamics of compressible flow – Scalar conservations laws – Conservation – Weak solutions – Non-uniqueness – Entropy conditions – Godunov methods – Flux vector splitting Method – Reconstruction of dependent variables – Fluxes – Preconditioning of low speed Flows – Projection methods

UNIT IV TURBULENT FLOW COMPUTATION 9

Physical Considerations – Survey of theory and models – Relation of High – Resolution Methods and Flow Physics – Large Eddy Simulation – Standard and Implicit – Numerical Analysis of Sub grid Models – ILES Analysis – Explicit Modeling – Implicit Modeling – Limiters – Energy Analysis – Computational Examples – Burgers' Turbulence – Convective Planetary Boundary Layer.

UNIT V FINITE ELEMENT METHOD 9

Finite Element formulation – Errors, Solutions of Finite difference equations – Elliptic equations – Parabolic Equations – Hyperbolic Equations – Burger's Equations – Nonlinear Wave equation (Convection Equation) – Primitive Variable method for Incompressible viscous flows; Taylor-Galerkin Method and Pertov-Galerkin Method for Compressible Flows.

TOTAL PERIODS: 45

Text Books

1. Drikakis, D. and Rider, W.J., "High - Resolution Methods for Incompressible and Low-Speed Flows", Springer-Verlag Berlin Heidelberg, 2005.
2. Blazek, J., "Computational Fluid Dynamics: Principles and Applications", Elsevier Publications, 2005.

REFERENCES:

1. Knight, D.D., "Elements of Numerical Methods for Compressible Flows Cambridge" University Press, 2006.
2. Cebeci, T., Shao, J.P., Kafyeke, F. and Laurendeau, E., "Computational Fluid Dynamics for Engineers", Springer - Horizons Publishing Inc., 2005.
3. Warsi, Z.U.A., "Fluid dynamics: Theoretical and Computational approaches", CRC Press, 1999.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Solving problems related to units and conversions and fit the given data using the methodologies

CO2 Solving problems related to material & energy balance, application of algebraic expressions, Laplace & Fourier analysis

CO3 Application of knowledge from the principles of thermodynamics to biochemical engg.

CO4 Computational modelling methods and its application in fluid dynamics.

CO5 Fluid statics & dynamics and the application of finite element methods.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	3	-	-	1	2	2	2	1
CO2	2	2	1	1	1	3	-	-	1	2	2	2	1
CO3	2	2	1	1	1	3	-	-	1	2	2	2	1
CO4	2	2	1	1	1	3	-	-	1	2	2	2	1
CO5	2	2	1	1	1	3	-	-	1	2	2	2	1

BY1013	BIOTECHNOLOGY IN FOOD PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms,foodspoilage diseases.
- To know different techniques used for the preservation of foods.

UNIT I FOOD PROCESSING 9

Heat Processing using steam or water (Blanching, Pasteurization) – Heat sterilization (Evaporation and distillation) – Heat processing using hot air (Dehydration, baking and roasting) – Heat processing using hot oils – Processing by the removal of heat (chilling , Freezing) – High pressure processing of foods – Pulsed electric field processing of liquids and beverages – Non-thermal processing by radiofrequency electric fields

UNIT II FOOD FERMENTATION 9

Fermentative production of foods – Single cell protein (yeast, mushroom) – Microorganisms responsible for production of fermented foods – Enzyme in bakery and cereal products – Enzymes in fat/oil industries – Protease in cheese making and beverage production – Production of Pectinases and Utilization in Food Processing – Food Flavour Production – Utilization of food waste for production of valuables.

UNIT III FERMENTED FOODS 9

Overview of fermented foods – Bean-based – Grain-based – Vegetable-based – Fruit-based – Honey-based – Dairy-based – Fish-based – Meat-based – Tea-based – Advantages of fermented foods Health benefits of fermented foods – Nutritive value of fermented food – Biotechnological approaches to improve nutritional quality – Microbial changes in fermented food.

UNIT IV FOOD PRESERVATION TECHNIQUES 9

Spoilage of food - Microbiology of water, meat, milk, vegetables – Food poisoning – Cold preservation – Heat conservation – Ionizing radiation – High pressure – Electric field – Chemical food preservation – Combination of techniques for food preservation – Natural antioxidants – Antimicrobial enzymes – Edible coatings – Control of pH and water activity.

UNIT V FOOD QUALITY AND CONTROL 9

Analysis of food – Major ingredients present in different product – Food additives, vitamins – Analysis of heavy metal, fungal toxins, pesticide and herbicide contamination in food – Microbial safety of food products – Chemical safety of food products – Good manufacturing practice

TOTAL PERIODS: 45

Text Books

1. Fellows, P.J., "Food Processing Technology: Principles and Practice", 3rd Edition, CRC Press, 2009.
2. Pometto A, Shetty K, Paliyath G and Levin R. E., "Food Biotechnology", 2nd Edition , CRC press, 2005.

REFERENCES:

1. Hutkins R. W., "Microbiology and Technology of Fermented Foods", IFT Press series, Volume 32 of Institute of Food Technologists Series, Wiley-Blackwell, 2006.
2. Zeuthen P. and Bogh-Sorensen, L., "Food Preservation Techniques", 1st Edition, CRC Press, 2003.
3. Adams M., Adams M. R. and Robert Nout M. J., "Fermentation and food safety", Springer, 2001.
4. Da-Wen S., "Emerging Technologies for Food Processing", Academic Press, 2005.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Sterilisation methods and processing methods of foods & beverages.

CO2 Production of fermented foods and use of food waste for production of value added products

CO3 Nutritive & health benefits of fermented foods.

CO4 Food preservation techniques and edible coatings

CO5 Analysis of contaminants in food, safety and GMP.

COs	PROGRAM OUTCOMES(POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	-	2	2	3	3	2
CO2	3	3	2	2	2	2	1	-	2	2	3	3	2
CO3	3	3	2	2	2	2	1	-	2	2	3	3	2
CO4	3	3	2	2	2	2	1	-	2	2	3	3	2
CO5	3	3	2	2	2	2	1	-	2	2	3	3	2

PROFESSIONAL ELECTIVES IV

BY1014	BIO NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to learn about basis of nanomaterial science
- To make them ready to prepare nanoparticles in different routes
  - Capable of characterising nano-scale materials
  - Apply nano materials in nano device fabrications
- To equip them in targeted drug design area

UNIT I: NANOSCALE PROCESSES AND NANOMATERIALS 9

Overview of nanoscale processes of nanomaterials – Physicochemical properties of nanomaterials – Concepts in nanotechnology – Natural nanomaterials –Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Polymeric nanoparticles, Buckyballs, Nanotubes) – Interaction between biomolecules and nanoparticle surface –Synthesis and assembly of nanoparticles and nanostructures using bio-derived templates.

UNIT II: STRUCTURAL AND FUNCTIONAL PRINCIPLES OF BIONANOTECHNOLOGY AND CHARACTERISATION 9

Biomolecular structure and stability – Biomolecular Self-assembly – Self-organization – Molecular recognition –Chemical transformation – Regulation – Biomaterials –– Traffic across membranes – Biomolecular sensing – Self-replication – Characterisation techniques - X-ray diffraction technique, Scanning Electron Microscopy, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques AFM, SPM, STM, and VSM.

UNIT III: PROTEIN-BASED NANOTECHNOLOGY 9

Overview of protein nanotechnology – Nanotechnology with S-Layer protein – Engineered nanopores – Bacteriorhodopsin and its potential – Protein assisted synthesis of metal nanoparticles – Synthesis of protein-based nanoparticles – Protein nanopaticle-hybrids – Biomolecular motors and motor proteins - Covalent and non-covalent protein nanoparticle conjugates – Protein-carbon nanotube conjugates.

UNIT IV: DNA-BASED NANOTECHNOLOGY 9

DNA-based nanostructures – Biomimetic fabrication of DNA based metallic nanowires and networks – Self assembling DNA structures – DNA-nanoparticle conjugates – DNA-carbon nanotube conjugates – DNA templated electronics – DNA nanostructures for mechanics and computing – DNA nanomachine.

UNIT V: NANOMEDICINE AND NANOSENSING 9

Promising nanobiotechnologies for applications in medicine – Role of nanotechnology in methods of treatment – Liposomes in nanomedicine – Therapeutic applications of nanomedicine – NanoSized carriers for drug delivery and drug carrier systems – Protein and peptide nanoparticles, DNA based nanoparticles, Lipid matrix nanoparticles for drug delivery – Design and development of bionanosensors using DNA, enzymes – Nanobiosensors for imaging and diagnosis.

TOTAL PERIODS: 45

Text Books

1. Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.
2. Singh BD. Text Book of Biotechnology, Kalyani Publishers. 1998

REFERENCES:

1. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
2. Ignacimuthu .S, Applied Plant Biotechnology, Tata McGraw Hill. 1996.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Understand the fundamental concepts, physiochemical properties and the types of nanoscale materials.
CO2	Gain knowledge about the structure and function of different types of nanomaterials and the machines used in bionanotechnology.
CO3	Understand the involvement of protein in bionanotechnology and its role.
CO4	Gain knowledge about the DNA based nano structures and its application various areas of nanobiotechnology.
CO5	Understand the principle behind targeted drug delivery and the usage of nano carriers in nanomedicine.

COs	**PROGRAM OUTCOMES(POs)**										**PROGRAMSPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	2	2	1	1	1	-	-	-	1	1
CO2	1	2	2	2	2	1	2	1	1	-	1	1	2
CO3	2	2	2	2	2	1	2	1	1	-	2	2	3
CO4	2	2	2	2	3	2	2	2	1	1	3	2	3
CO5	2	2	3	3	3	3	2	2	2	2	2	3	3

BY1015	**PHYTOCHEMISTRY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give the details of plant derived value added compounds and its functions
- To provide knowledge on biotech based production of agro medicines

UNIT I INTRODUCTION OF PHYTOCHEMICALS 9

Categories of phytochemicals and their classification (carbohydrates, tannins, alkaloids, glycosides, steroids, saponins, terpenoids, flavonoids, coumarins, mucilage's xanthine) – Phytochemical screening: Physiochemical tests – Moisture content, total ash, water-soluble ash, acid-insoluble ash, sulphate ash, alcohol and water-soluble extractive values – Heavy metal detection by atomic spectroscopy. Macroscopic studies –Shape, apex, base, margin, taste and odour Microscopic-stomatal number, stomatal index, vein islet number and vein termination number.

UNIT II THERAPEUTIC EFFECT OF PLANT PRODUCTS 9

Anti-tumor activity – Anti-coagulation – Anti-bacterial – Anti-inflammatory– Anti-MRSA and Anti-VRE activities of Phytoalexins and Phytoncides. Screening of Plant extracts for antiparasitic activity.

UNIT III BIOACTIVITY STUDIES 9

Screening of drugs for biological activity – Antidiabetic, antinflammatory, antihepatotoxic, antifertility, diuretic, anticancer, antihepatotoxic, antimalarial, antihypertensive and hypolipedemic and adoplogenic agents

UNIT IV SEPARATION TECHNIQUES AND STRUCTURE ELUCIDATION 9

Thin layer chromatography – HPTLC – Column chromatography – GC-MS – LC-MS – HPLC – Partition chromatography – Gas chromatography – FT-IR – UV- NMR (1D&2D) – X-ray diffraction.

UNIT V LARGE SCALE PRODUCTION OF BIOACTIVE PRODUCTS 9

Secondary metabolite production through cell culture system – Hairy root induction –Methods of gene transfer – Chemical methods – PEG – dextran – Physical method – Electroporation – Microinjection – Lipofection agrobacterium based vector mediated gene transfer – Particle bombardment.

TOTAL PERIODS: 45

TEXT BOOKS

Ahamed, I., Aqil, F. and Owais, M., “Modern Phytomedicine”, WILEY VCH, Verlag GmbH & Co, KGaA, Weinheim. 2006.
Chawla, H.S., “Introduction to Plant Biotechnology”, Science Publishers, 2004.

REFERENCES:

Meskin, M.S., Bidlack, W.R., Davies, A.J. and Omaye, S.T., “Phytochemicals in Nutrition and Health”, CRC Press, 2002.
Arnason, J.T., Arnason, J.E. and Arnason, J.T., “Phytochemistry of Medicinal Plants”, Kluwer Academic Publishers, 1995.
Bidlack, W.R., Omaye, S.T., Meskin, M.S. and Topham, D.K.W.,” Phytochemicals as Bioactive Agents”, 1St Edition, CRC Press, 2000.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Category and classification of phytochemicals
CO2 Therapeutic effect of plant products.
CO3 The screening of drugs for biological activity.
CO4 The separation techniques that can be used for plant derived products
CO5 The production of various bioactive products

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	-	-	-	2	2	3	1	1
CO2	3	1	2	3	2	-	-	-	2	2	3	1	1
CO3	3	1	2	3	2	-	-	-	2	2	3	1	1
CO4	3	1	2	3	2	-	-	-	2	2	3	1	1
CO5	3	1	2	3	2	-	-	-	2	2	3	1	1

		L	T	P	C
BY1016	**ADVANCES IN MOLECULAR PATHOGENESIS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To enable the students

- To understand about the microbial toxins and modern molecular pathogenesis
- To know about the host pathogen interaction and identifying virulence factors
- To control pathogens by modern approaches.

UNIT I VIRAL PATHOGENESIS 9

Various pathogen types and modes of entry – Viral dissemination in the host – Viral virulence – Injury induced by virus – Host susceptibility of viral disease – Pattern of infection - Acute infection – Persistant infection – Latent infection – Slow infection – Methods for the study of pathogenesis – Foot and mouth disease virus, Pestiviruses, Arteriviruses, Blue tongue virus and Animal herpesviruses

UNIT II FUNGAL PATHOGENESIS 9

Innate humoral immunity to fungi – Acquired cellular immunity – Mucosal immunity – Intracellular pathogenesis of *Histoplasma capsulatum* – Facultative intracellular pathogen of *Cryptococcus neoformans* – Fungal interaction with leukocytes – Fungal vaccine development – Host defence against chronic disseminated *Candidiasis* – Study fungal virulence by using Genomics – Functional genomic approaches to fungal pathogenesis.

UNIT III BACTERIAL PATHOGENESIS 9

Epidemology and Clinical disease – Clinical course and basic immunology – *In vitro* models of *Salmonella* virulence – Antibiotic resistant *Salmonella* – *Salmonella* based vaccines – *Shigella* cellular models of infection – Influenza virus – Pathogenic *Escherichia coli* – *Vibrio cholerae* – Streptococcal disease – *Haemophilus influenzae* infection

UNIT IV MANIPULATION OF HOST CELLS AND IMMUNE FUNCTION BY VIRAL PROTEINS 9

Clinical importance of understanding host defence – Interference with cytokine and Chemokine function – impairment of host mediated killing of infected cells – inhibition of apoptosis – Immunological structure of proteins – Class I and II MHC mediated antigen – Evasion from natural killer cells.

UNIT V MOLECULAR APPROACHES TO CONTROL 9

Classical approaches based on serotyping – Modern diagnosis based on highly conserved virulence factors, immune and DNA based techniques – New therapeutic strategies based on recent findings on molecular pathogenesis – Viral Vaccines – Immune modulators – New vaccine technology

TOTAL PERIODS: 45

Text Books

1. Groismen, E.A., "Principles of Bacterial Pathogenesis", Academic Press, 2001.
2. Norkin, L.C., "Virology: Molecular Biology and Pathogenesis", ASM Press, 2009.

REFERENCES:

1. Gyles, C.L., Prescott, J.F., Songer, J.G. and Thoen C.O., "Pathogenesis of Bacterial Infections in Animals", 3rd Edition, Wiley-Blackwell, 2004.
2. Flint, J., Enquist, L.W., Krug, R.M., Racaniello, V.R. and Skalka, A.M., "Principles of Virology: Molecular Biology, Pathogenesis and Control", American Society of Microbiology, 2003.
3. Mettenleitter, T.C. and Sobrino, F.,"Animal Viruses: Molecular Biology", Caister Academic Press, 2008.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Fundamentals of modern molecular pathogenesis of Virus

CO2 Fundamentals of modern molecular pathogenesis of Fungus

CO3 Fundamentals of modern molecular pathogenesis of Bacteria

CO4 Host pathogen interaction and identifying virulence factors

CO5 Control of pathogens by modern approaches

COs	PROGRAM OUTCOMES(POs)										PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	-	-	3	2	3	2	1
CO2	3	2	2	2	1	1	-	-	3	2	3	2	1
CO3	3	2	2	2	1	1	-	-	3	2	3	2	1
CO4	3	2	2	2	1	1	-	-	3	2	3	2	1
CO5	3	2	2	2	1	1	-	-	3	2	3	2	1

BY1017	SPECTROSCOPY FOR BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To have a fundamental knowledge about the Light spectrum, Absoprtion, Fluorescence,NMR, Mass spectroscopy

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

UNIT I ELECTRONIC SPECTRA 9

Overview of electronic spectra – Absorption spectra – Ultraviolet spectra of proteins – Nucleic acid spectra – Prosthetic groups – Difference spectroscopy – X-ray absorption spectroscopy – Fluorescence and phosphorescence – Helicase activity monitored by fluorescence – Fluorescence energy transfer – Molecular ruler-application of energy transfer to biological systems.

UNIT II CIRCULAR DICHROISM, OPTICAL ROTARY DISPERSION AND FLUORESCENCE POLARIZATION 9

Optical rotary dispersion – Circular dichroism – Optical rotary dispersion and circular dichroism of proteins – Optical rotation and circular dichroism of nucleic acids – Small molecule binding to DNA – Protein folding – Interaction of DNA with zinc finger proteins – Fluorescence polarization – Integration of HIV genome into host genome and alpha – Ketoglutarate.

UNIT III IR AND RAMAN SPECTROSCOPY 9

Infrared spectroscopy – Raman spectroscopy – IR and Raman spectroscopy of biological materials – Structure determination with vibrational spectroscopy – Structure of enzyme-substrate complexes – Biological vibrational spectroscopic imaging – FT-IR and FT-Raman in biomedical research.

UNIT IV NUCLEAR MAGNETIC RESONANCE AND ELECTRON SPIN RESONANCE 9

NMR spectrometers – Chemical shifts – Spin-spin splitting – Relaxation times –Multidimensional NMR – Magnetic resonance imaging – Electron spin resonance – Regulation of DNA transcription – Protein – DNA interactions – Dynamics of protein folding – RNA folding – Lactose permease.

UNIT V MASS SPECTROMETRY 9

Mass analysis – Tandem Mass Spectrometry – Ion detectors – Ionization of the sample – Sample preparation/analysis – Proteins and peptides – Protein folding – Mass spectrometry of biomolecules

TOTAL PERIODS: 45

TEXT BOOKS

1. Hammes, G.G., “Spectroscopy for the Biological Sciences”, 1st Edition, Wiley-Inter Science, 2005.
2. Ramamoorthy, A., “NMR Spectroscopy of Biological Solids”, CRC Press, 2005

REFERENCES:

1. Pretsch, E., Bühlmann, P. and Badertscher, M., “Structure Determination of Organic compounds: Tables of Spectral Data”, 4th Edition, Springer, 2009.
2. Gremlich, H. and Yan, B., “Infrared and Raman Spectroscopy of Biological Materials”, CRC Press, 2000.
3. Greve, J., Puppels, G.J. and Otto, C., “Spectroscopy of Biological Molecules: New Directions 1st Edition, Springer”, 1999.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Basics of Electronic spectra and its various biological applications

CO2	Basics of Circular Dichroism, Optical Rotary Dispersion And Fluorescence Polarization and its various biological applications
CO3	Basics of IR And Raman Spectroscopy and its various biological applications
CO4	Basics of NMR and Electron Spin Resonance and its various biological applications
CO5	Basics of Mass Spectrometry and its various biological applications

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	3	1	1	1	-	-	-	1	1	2	1
CO2	1	3	3	1	1	1	-	-	-	1	1	2	1
CO3	1	3	3	1	1	1	-	-	-	1	1	2	1
CO4	1	3	3	1	1	1	-	-	-	1	1	2	1
CO5	1	3	3	1	1	1	-	-	-	1	1	2	1

BY1018	IPR AND BIOSAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To create awareness about IPR and engineering ethics
- To follow professional ethics and practices in their careers
- To create awareness and responsibilities about the environment and society

UNIT I AGREEMENTS, TREATIES AND CONCEPT OF PRIOR ACT 9

History of GATT Agreement – Madrid Agreement – Hague Agreement – WIPO Treaties –Budapest Treaty – PCT – Indian Patent Act 1970 & recent amendments Ordinary – PCT – Conventional – Divisional and Patent of Addition – Specifications – Provisional and complete – Forms and fees Invention in context of "prior art" – Patent databases – Searching International Databases – Country-wise patent searches (USPTO,esp@cenet(EPO) – PATENT Scope (WIPO) – IPO, etc.

UNIT II IPR 9

Intellectual property rights – Origin of the patent regime – Early patents act & Indian pharmaceutical industry – Types of patents – Patent Requirements – Application preparation filing and prosecution – Patentable subject matter – Industrial design, Protection of GMO's IP as a factor in R&D,IP's of relevance to biotechnology and few case studies.

UNIT III PATENT FILING PROCEDURES 9

National & PCT filing procedure – Time frame and cost – Status of the patent applications filed – Precautions while patenting – disclosure/non-disclosure – Financial assistance for patenting – Introduction to existing schemes. Patent licensing and agreement Patent infringement – Meaning, scope, litigation, case studies

UNIT IV BIOSAFETY 9

Introduction – Historical Backround – Introduction to Biological Safety Cabinets – Primary Containment for Biohazards – Biosafety Levels – Biosafety Levels of Specific Microorganisms – Recommended

Biosafety Levels for Infectious Agents and Infected Animals – Biosafety guidelines – Government of India.

UNIT V GENETICALLY MODIFIED ORGANISMS 9

Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol

TOTAL PERIODS: 45

TEXT BOOKS

1. Irish, V., "Intellectual Property Rights for Engineers", 2nd Edition, The Institution of Engineering and Technology, 2005.
2. Fleming, D.O. and Hunt, D.L., "Biological Safety: Principles and Practices", 4th Edition, American Society for Microbiology, 2006.
3. BAREACT.IndianPatentAct1970Acts&Rules,UniversalLawPublishingCo.Pvt.Ltd., 2007.
4. Kankanala, C. Genetic Patent Law &Strategy, 1stEd., ManupatraInformation SolutionPvt.Ltd.,2007
5. Kanka, S.S.EntrepreneurshipDevelopment, 1st Ed., S. ChandandCo,1997.

REFERENCES:

1. Bouchoux, D.E., "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets for the Paralegal", 3rd Edition, Delmar Cengage Learning, 2008.
2. Young, T., "Genetically Modified Organisms and Biosafety: A Background Paper for Decision-Makers and Others to Assist in Consideration of GMO Issues" 1st Edition, World Conservation Union, 2004.
3. Mueller, M.J., "Patent Law", 3rd Edition, Wolters Kluwer Law & Business, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Various Laws, Rules and Regulations of Patents
CO2 Various forms of Intellectual Property Rights
CO3 Patent filing procedures and types of infringement
CO4 Different Biosafety Levels and its Guidelines
CO5 Fundamentals of GMO, its regulations and agreements

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	3	3	1	1	-	2	2	1	1	3
CO2	1	2	2	3	3	1	1	-	2	2	1	1	3
CO3	1	2	2	3	3	1	1	-	2	2	1	1	3
CO4	1	2	2	3	3	1	1	-	2	2	1	1	3
CO5	1	2	2	3	3	1	1	-	2	2	1	1	3

PROFESSIONAL ELECTIVE V

BY1019	BIOPHARMACEUTICALS AND BIOSIMILARS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The aim of the course is to give strong foundation and advanced information on

- Core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the no the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I: INTRODUCTION 9

Drug sources – Discovery and Development phases – Drugs and Cosmetics Act and regulatory aspects – Role of patents in the drug industry – Biopharmaceutical classification system – Drug Target – Drug metabolism – Pharmacokinetics – Pharmacodynamics – Bioavailability – Bioequivalence – Toxicity studies – Pharmacogenomics.

UNIT II: DOSAGE FORMS 9

Classification of dosage forms – Excipients – Formulation – Tablets, Capsules, Emulsion, Suspension, Lotion, Liniments, Ointments, Cream, Paste, Suppositories, Parenterals – Pressurized dosage forms – Packaging techniques.

UNIT III: ADVANCED DRUG DELIVERY SYSTEMS 9

Controlled release dosage forms – Rationale – Principle and factor influencing – Design and Fabrication – Microencapsulation – Liposomes – Niosomes – Transdermal drug delivery – Ocular, Vaginal and Uterine controlled release.

UNIT IV: BIOSIMILARS 9

Biosimilar medicine – Importance – INN nomenclature system – Key trends in biosimilar product development – Production of biosimilar products – Difficulties with biosimilar drugs – Non clinical and clinical study – Regulation and approval process – Future prospects.

UNIT V: CASE STUDIES ON BIOPHARMACEUTICALS 9

Erythropoietin – Insulin – Somatotropin – Interleukin – Interferon – GM-CSF – Blood clotting factors – Tissue plasminogen activator – Monoclonal antibodies and engineered antibodies.

TOTAL PERIODS: 45

REFERENCES:

1. Crommelin Dwan J.A., Robert D. Sindelar and Bernd Meibohm, “Pharmaceutical Biotechnology: Fundamentals and application”, Springer, 4th Edition, 2013.
2. Gary Walsh, “Pharmaceutical Biotechnology-Concepts and Application”, John Wiley and Sons Publishers, 1st Edition, 2007.
3. James Swarbrick, “Encyclopedia of Pharmaceutical Technology”, CRC Press, 4th Edition, 2013.
4. Shayne Cox Gad, “Pharmaceutical Manufacturing Handbook: Production and Processes”, Wiley, 2nd Edition, 2011.
5. Shein-Chung Chow, “Biosimilars: Design and Analysis of Follow-on Biologics”, CRC Press, 3rd Edition, 2013.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students would have a fundamental knowledge about the various phases and the regulatory aspects involved in the drug development and on pharmacokinetics & dynamics.
CO2	Students will get familiar with the preparation of various dosage forms of drug and its quality control.
CO3	Students would have developed knowledge about advanced drug delivery systems.
CO4	Students would have gained knowledge about biosimilars and its regulation and approval process.
CO5	At the end of the course the student would acquire knowledge on different types of biopharmaceuticals.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	2	-	3	-	-	-	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	2	-	-	2	-	-
CO4	1	-	-	2	-	-	2	2	1	-	-	2	2
CO5	2	-	2	-	-	-	-	-	-	-	2	-	-

BY1020	**BIOPROCESS MODELING AND SIMULATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- Provide the students with the basics of bioreactor engineering.
- To develop bioengineering skills for the production of biochemical product using integrated biochemical processes.

UNIT I CONCEPTS AND PRINCIPLES 9

Introduction to modelling – Systematic approach to model building – Material and energy balance – Classification of models – General form of dynamic models dimensionless models – General form of linear systems of equations nonlinear function – Conservation principles thermodynamic principles of process systems

UNIT II MODELS 9

Structured kinetic models – Compartmental models (two and three) – Product formation Unstructured models – Genetically structured models – Stochastic model for thermal sterilization of the medium –

Modelling for activated sludge process – Model for anaerobic digestion – Models for lactic fermentation and antibiotic production

UNIT III MODELLING OF BIOREACTORS 9

Modelling of non-ideal behaviour in Bioreactors – Tanks-in-series and Dispersion models – Modelling of
PFR and other first order processes – Analysis of packed bed and membrane bioreactors
Recombinant Cell Culture Processes – Plasmid stability in recombinant Cell Culture limits to over-expression

UNIT IV MONITORING OF BIOPROCESSES 9

On-line data analysis for measurement of important physico-chemical and biochemical parameters – State and parameter estimation techniques for biochemical processes – Biochemical reactors-model equations – Steady-state function – Dynamic behaviour – Linearization – Phase plane analysis – Multiple steady state – Bifurcation behaviour

UNIT V SOLUTION STRATEGIES 9

Solution strategies for lumped parameter models – Stiff differential equations – Solution methods for initial value and boundary value problems – Euler's method – R-K method – shooting method – Finite difference methods – Solving the problems using MATLAB/SCILAB –ISIM-Simulation of bioprocesses using models from literature sources.

TOTAL PERIODS: 45

TEXT BOOKS

1. Hangos, K.M. and Cameron, I.T., "Process Modelling and Simulation", 2001.
2. Heinzle, E., Biwer, A.P. and Cooney, C.A.L., "Development of Sustainable Bioprocess: Modeling", Wiley, 2007.

REFERENCES:

1. Boudreau, M.A. and McMillan, G.K.," New Directions in Bioprocess Modelling and Control", ISA, 2006.
2. Bequette, B.W., "Process Control:Modeling, Design & Stimulating", Prentice Hall, 2003.
3. Bailey, J.A. and Ollis, D. F., Fundamentals of Biochemical Engineering", McGraw Hill –1986

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Systematic approach to model building & thermodynamic principles of model systems
CO2	Various types of models and its application in bioprocess
CO3	Modelling of non ideal behaviour in reactors
CO4	Measurement of important parameters in bioprocessing operation
CO5	Simulation of bioprocess using various models.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	3	1	1	3	-	-	-	1	1	2	1
CO2	2	3	3	1	1	3	-	-	-	1	1	2	1
CO3	2	3	3	1	1	3	-	-	-	1	1	2	1
CO4	2	3	3	1	1	3	-	-	-	1	1	2	1
CO5	2	3	3	1	1	3	-	-	-	1	1	2	1

BY1021	TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stemcells, biomaterials and its applications

UNIT I FUNDAMENTAL OF TISSUE ENGINEERING 9

Cells and tissue grade organization in living system - Cell cycle – Stem cells – Types, factors influencing stem cells – Mechanical properties of cells and tissues, cell adhesion – Extracellular matrix – Glycans, laminin, fibronectin, collagen, elastin, extracellular matrix functions – Signalling – Mechanics and receptors – Ligand diffusion and binding, trafficking and signal transduction – *In vitro* cell proliferation – Scope of tissue engineering

UNIT II BIOMATERIALS FOR TISSUE ENGINEERING 9

Preparation of biomaterials and their types - Measurement of protein adsorption – Direct and indirect methods, fibrinogen adsorption –Displaceable and non-displaceable – Changes in protein conformation upon adsorption – Vroman effect principle to maximize the amount of fibrinogen adsorption – Devices for tissue engineering transplant cells.

UNIT III DELIVERY OF MOLECULAR AGENTS AND CELL INTERACTIONS WITH POLYMERS 9

Molecular agents in tissue engineering – Controlled released of agents – Methods, in time and space – Future applications of controlled delivery – Microfluidic systems – Microfluidics and microfluidic devices – Cell interactions – Factors influencing cell interactions – Cell interactions with polymer surfaces and suspension – Cell interactions with three-dimensional polymer

UNIT IV POLYMERS AND CONTROLLED DRUG DELIVERY 9

Natural and synthetic biodegradable Polymers – Engineered tissues – Skin regeneration – Nerve regeneration – Liver, cartilage, bone – Biodegradable polymers in drug delivery –Polymeric drug delivery systems – Applications of biodegradable polymers.

UNIT V BIOPOLYMER-BASED BIOMATERIALS AS SCAFFOLDS AND STEM CELLS

Synthesis of bio polymer - Natural polymers – Structural and chemical properties, scaffold processing, mechanical properties and biodegradability – Biocompatibility and host response – Application of scaffolds in tissue engineering. Use of stem cells in tissue engineering – Embryonic stem cells, mesenchymal stem cells (MSC), adult stem cells, markers for detection of stem cells – Risks with the use of stem cells – Application of stem cells in tissue engineering.

TOTAL PERIODS: 45

TEXT BOOKS

1. Pallua, N. and Suscheck, C.V., "Tissue Engineering: From Lab to Clinic" Springer, 2010
2. Saltzman, W.M., "Tissue Engineering", Oxford University Press, 2004.

REFERENCES:

1. Palsson, B., Hubbell, J.A., Plonsey, R. and Bronzino, J.D., "Tissue Engineering", CRC Press, 2003.
2. Palsson, B.O. and Bhatia, S., "Tissue Engineering", Pearson Prentice Hall, 2004.
3. Scheper, T., Lee, K. and Kaplan, D., "Advances in Biochemical Engineering / Biotechnology – Tissue Engineering I", Volume 102, Springer-Verlag Berlin Heidelberg, 2006.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Components of tissue architecture
CO2 Preparation of various types of biomaterials
CO3 Delivery of molecular agents and cell interactions with polymers
CO4 Different types of polymers and their role in Drug delivery
CO5 Biopolymer-based biomaterials as scaffolds and Stem cells in organogenesis

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	-	-	2	2	3	2	2
CO2	3	3	2	2	2	1	-	-	2	2	3	2	2
CO3	3	3	2	2	2	1	-	-	2	2	3	2	2
CO4	3	3	2	2	2	1	-	-	2	2	3	2	2
CO5	3	3	2	2	2	1	-	-	2	2	3	2	2

BY1022 RESEARCH METHODOLOGY IN BIOTECHNOLOGY

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To impart the knowledge of various methods of research strategy
- To understand Biotech research constraints and its analysis
- To emphasise the Creativity, Innovation and New Product Development

UNIT I RESEARCH AND ITS METHODOLOGIES 9

Motivation – Objective and significance of research – Research process – Observation – Axiom – Theory – Experimentation – Types of research (basic, applied, qualitative, quantitative, analytical etc). Features of translational research – Concept of laboratory to market (bench to public) – Industrial R&D.

UNIT II RESEARCH IN BIOTECHNOLOGY 9

Laboratory policy and procedure of academic research – Types of expertise and facilities required. Technology and product transfer research – Grant funding – Sources of literature – Interdisciplinary nature – Collaboration based research.

UNIT III EXPERIMENTAL RESEARCH 9

Research direction – Understanding biotechnology research by experimentation – Strategies for experimentation – Selecting an experimental design – Sample size – Enzymes and enzymatic analysis – Antibodies and immunoassays – Instrumental methods – Bioinformatics and computation

UNIT IV RESULTS AND ANALYSIS 9

Scientific methodology in recording results – Importance of negative results – Ways of recording – Industrial requirement – Artifacts versus true results – Types of analysis (analytical, objective, subjective) and cross verification – Correlation with published results – Discussion – Hypothesis – Concept – Theory and model.

UNIT V PUBLISHING SCIENTIFIC AND TECHNICAL PAPERS 9

Guide to publishing scientific papers – Types of scientific and technical publications in biotechnology – Specifications – Ways to protect intellectual property – Patents – Technical writing skills – Importance of impact factor and citation index.

TOTAL PERIODS: 45

TEXT BOOKS

1. Marczyk, G.R., DeMatteo, D. & Festinger, D. Essentials of Research Design and Methodology, John Wiley & Sons Publishers Inc, 2005.
2. Segel, I.H. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Ed., John Wiley & Sons Publishers Inc, 1976.
3. Korner, A.M. Guide to Publishing a Scientific paper, Bioscript Press, 2004.
4. Marczyk,G.R., DeMatteo, D. and Festinger, D., “Essentials of Research Design and Methodology”, John Wiley & Sons Publishers, Inc., 2005.
5. Korner, A.M., “Guide to Publishing a Scientific paper”, Taylor & Francis group, 2008.

REFERENCES:

1. Kothari, C.R., “Research Methodology: Methods and Techniques”, New Age Publications, 2008.
2. Malinowski, M.J. and Arnold, B.E., “Biotechnology: Law, Business and Regulation”, Aspen Publishers, 2004.
3. Haaland, P.D., “Experimental Design in Biotechnology”, Marcel Dekker, 1989.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Types of research and research process

CO2 Biotechnology research planning and execution and result analysis

CO3 Design and Experimentation of Biochemical assays

CO4 Ways of recording, interpreting and analysing results

CO5 Fundamentals of writing and publishing scientific and technical papers

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	1	-	-	3	1	3	3	1	2	1
CO2	1	2	2	1	-	-	3	1	3	3	1	2	1
CO3	1	2	2	1	-	-	3	1	3	3	1	2	1
CO4	1	2	2	1	-	-	3	1	3	3	1	2	1
CO5	1	2	2	1	-	-	3	1	3	3	1	2	1

BY1023	BIOFUELS AND PLATFORM CHEMICALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the knowledge of Bioconversion of renewable lignocelluloses biomass to biofuel and value added products
- To demonstrate a drive towards products benign to natural environment increasing the importance of renewable materials
- To emphasise the development of Biomass an inexpensive feedstock considered sustainable and renewable to replace a wide diversity of fossil based products

UNIT I INTRODUCTION 9

Cellulosic Biomass availability and its contents. Lignocellulose as a chemical resource. Physical and chemical pretreatment of lignocellulosic biomass. Cellulases and lignin degrading enzymes.

UNIT II ETHANOL 9

Ethanol as transportation fuel and additive; bioethanol production from carbohydrates; engineering strains for ethanol production from variety of carbon sources to improved productivity.

UNIT III BIODIESEL 9

Chemistry and Production Processes; Vegetable oils and chemically processed biofuels; Biodiesel composition and production processes; Biodiesel economics; Energetics of biodiesel production and effects on greenhouse gas emissions. Issues of ecotoxicity and sustainability with ; expanding biodiesel production

UNIT IV OTHER BIOFUELS 9

Biodiesel from microalgae and microbes; biohydrogen production; biorefinery concepts

UNIT V PLATFORM CHEMICALS 9

Case studies on production of C3 to C6 chemicals such as Hydroxy propionic acid, 1,3 propanediol, propionic acid, succinic acid, glucaric acid, cis-cis muconic acid.

TOTAL PERIODS: 45

REFERENCES:

1. Lee, Sunggyu; Shah, Y.T. “Biofuels and Bioenergy”. CRC / Taylor & Francis, 2013

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Bioconversion of renewable lignocelluloses biomass to biofuel and value added products

CO2 Production of Biothanol as sustainable and renewable energy

CO3 Production of Biodiesel and its economics

CO4 Other alternate energy sources such as biohydrogen and bio refinery

CO5 Synthesis of various Platform chemicals

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	2	-	-	2	2	3	3	1
CO2	3	3	2	3	2	2	-	-	2	2	3	3	1
CO3	3	3	2	3	2	2	-	-	2	2	3	3	1
CO4	3	3	2	3	2	2	-	-	2	2	3	3	1
CO5	3	3	2	3	2	2	-	-	2	2	3	3	1

OPEN ELECTIVES COURSES (OEC)

OCP101	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT - I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real–time decision–making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT - II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, Z–Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.
-

UNIT - III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and

- Hypothesis testing.
- Converting real–time decision–making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT - IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map–Reduce: Matrix–Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web–based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT - V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map–Reduce Tasks and Result Projection

TOTAL PERIODS: 45

REFERENCES:

1. Vignesh Prajapati, ‘Big Data Analytics with R and Hadoop’, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, ‘Business Analytics Using R – A Practical Approach’, A press, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, ‘Mining of Massive Datasets’, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, ‘Essentials of Business Analytics’, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, ‘Business Analytics: The Science of Data–Driven Decision Making’, Wiley, 2017.
6. A. Ohri, ‘R for Business Analytics’, Springer, 2012
7. Rui Miguel Forte, ‘Mastering Predictive Analytics with R’, Packt Publication, 2015.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Identify the real–world business problems and model with analytical solutions.
CO2	Solve analytical problem with relevant mathematics background knowledge.
CO3	Convert any real–world decision–making problem to hypothesis and apply suitable statistical testing.
CO4	Write and demonstrate simple applications involving analytics using Hadoop and MapReduce
CO5	Use open–source frameworks for modeling and storing data and apply suitable visualization technique using R for visualizing voluminous data

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	-	1	1	-	2	2	1	1	1	1	2
CO2	1	2	-	1	1	-	2	2	1	1	1	1	2
CO3	1	2	-	1	1	-	2	2	1	1	1	1	2
CO4	1	2	-	1	1	-	2	2	1	1	1	1	2
CO5	1	2	-	1	1	-	2	2	1	1	1	1	2

OMF101	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT - I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

UNIT - III **WEAR AND CORROSION AND THEIR PREVENTION** **9**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV **FAULT TRACING** **9**

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V **PERIODIC AND PREVENTIVE MAINTENANCE** **9**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL PERIODS: 45

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgraw Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn , Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition, 2008

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Basics of industrial safety

CO2 Fundamentals of maintenance engineering and its tools and applications

CO3 Wear and corrosion, its types and preventive methods

CO4 Illustration of fault tracing and its concepts

CO5 Identification of preventive and periodic maintenance of various equipments

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	1	2	-	-	2	2	2	1	1	1	2
CO2	1	2	1	2	-	-	2	2	2	1	1	1	2
CO3	1	2	1	2	-	-	2	2	2	1	1	1	2
CO4	1	2	1	2	-	-	2	2	2	1	1	1	2
CO5	1	2	1	2	-	-	2	2	2	1	1	1	2

OPE101	RENEWABLE SOURCES OF ELECTRICAL ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the energy scenario and various energy sources.
- To learn the solar photovoltaic and solar thermal systems.
- To impart knowledge on wind energy and bio-mass energy conversion systems.
- To provide knowledge about the Geothermal and Ocean energy conversion system.
- To design and implement hybrid energy conversion system.

UNIT I INTRODUCTION 9

Renewable energy sources and its energy scenario - global and Indian; Environmental aspects and impacts of renewable energy generation on environment; Types of Renewable energy sources: solar - wind - Biomass - Ocean - Tidal - Geothermal and Fuel cell.

UNIT II SOLAR ENERGY SYSTEMS 9

Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - Introduction to Solar photo-voltaic (PV) system and Solar - thermal system; Equivalent circuit of a solar cell, solar array and its sizing. Solar thermal collectors: flat plate collectors - concentrating collectors; solar thermal applications - heating, cooling, desalination, drying, cooking - solar thermal electric power plant.

UNIT III WIND ENERGY AND BIO-MASS ENERGY 9

Wind Sources: horizontal and vertical axis wind turbine - performance characteristics - types of wind turbine generators - Betz criteria; Bio-mass: Principles of Bio-Conversion - Anaerobic/aerobic digestion - types of Bio-gas digesters - gas yield - combustion characteristics of bio-gas - utilization for cooking.

UNIT IV GEOTHERMAL AND OCEAN ENERGY 9

Geothermal: Resources - types of wells - methods of harnessing the energy. Ocean Energy: OTEC-Principles, utilization - setting of OTEC plants - thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques - mini-hydro power plants and their economics.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems - Types of Hybrid systems - Case studies of solar and Wind.

TOTAL PERIODS: 45

TEXT BOOKS

1. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage‟, Tata McGraw Hill, 1990.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 2011.

REFERENCES:

1. G. L. Johnson, Wind energy systems, Prentice Hall Inc. New Jersey.
2. J. M. Kriender, Principles of Solar Engineering‟, McGraw Hill, 1987.
3. Twidell&Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011
4. V. S. Mangal, Solar Engineering‟, Tata McGraw Hill, 1992.
5. N. K. Bansal, Renewable Energy Source and Conversion Technology‟, Tata McGraw Hill, 1989.
6. P. J. Lunde, Solar Thermal Engineering‟, John Willey & Sons, New York, 1988.
7. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes‟, Wiley & Sons, 1990

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Understand the energy scenario and the various sources of non-conventional energy sources.
CO2	Learn the physics of solar energy and to understand the solar photovoltaic, solar-thermal energy conversion system.
CO3	Acquire knowledge in wind and bio-mass energy conversion system.
CO4	Acquire knowledge in Geothermal and Ocean energy conversion system.
CO5	Design and implement hybrid energy systems.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	2	1	-	1	2	2	2	1
CO2	2	2	2	2	2	2	1	-	1	2	2	2	1
CO3	2	2	2	2	2	2	1	-	1	2	2	2	1
CO4	2	2	2	2	2	2	1	-	1	2	2	2	1
CO5	2	2	2	2	2	2	1	-	1	2	2	2	1

OMB103 COST MANAGEMENT OF ENGINEERING PROJECTS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT - I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT - II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT - III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT - IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity- Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT - V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory

TOTAL PERIODS: 45

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003

5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Understand the costing concepts and their role in decision making
CO2	Understand the project management concepts and their various aspects in selection
CO3	Interpret costing concepts with project execution
CO4	Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5	Become familiar with quantitative techniques in cost management

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	-	1	-	1	1	1	1	1	1	1	2
CO2	1	2	-	1	-	1	1	1	1	1	1	1	2
CO3	1	2	-	1	-	1	1	1	1	1	1	1	2
CO4	1	2	-	1	-	1	1	1	1	1	1	1	2
CO5	1	2	-	1	-	1	1	1	1	1	1	1	2

OMF102	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials

UNIT - I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT - II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT - III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications

UNIT - IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method –Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications

UNIT – V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

TOTAL PERIODS: 45

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2010.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2	Know the various reinforcements used in composite materials.
CO3	Understand the manufacturing processes of metal matrix composites.
CO4	Understand the manufacturing processes of polymer matrix composites.
CO5	Analyze the strength of composite materials.

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	1	-	-	1	1	1	2
CO2	2	2	2	2	1	1	1	-	-	1	1	1	2
CO3	2	2	2	2	1	1	1	-	-	1	1	1	2
CO4	2	2	2	2	1	1	1	-	-	1	1	1	2
CO5	2	2	2	2	1	1	1	-	-	1	1	1	2

OCH105 **WASTE TO ENERGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT - I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III BIOMASS GASIFICATION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors

UNIT - IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT - V BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL PERIODS: 45

TEXT BOOKS

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

REFERENCES:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the various types of wastes from which energy can be generated

CO2 To gain knowledge on biomass pyrolysis process and its applications

CO3 To develop knowledge on various types of biomass gasifiers and their operations

CO4 To gain knowledge on biomass combustors and its applications on generating energy

CO5 To understand the principles of bio-energy systems and their features

COs	PROGRAM OUTCOMES(POs)										PROGRAMSPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	3	-	1	-	-	2	1	2	2	1
CO2	3	2	1	3	-	1	-	-	2	1	2	2	1
CO3	3	2	1	3	-	1	-	-	2	1	2	2	1
CO4	3	2	1	3	-	1	-	-	2	1	2	2	1
CO5	3	2	1	3	-	1	-	-	2	1	2	2	1

AUDIT COURSES

AX1001	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission.

UNIT I: INTRODUCTION TO RESEARCH PAPER WRITING 6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II: PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT III: TITLE WRITING SKILLS 6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV: RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT V: VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.

TOTAL PERIODS: 30

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books)2006.
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book1998.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Understand that how to improve your writing skills and level of readability

CO2 Learn about what to write in each section

CO3 Understand the skills needed when writing a Title

CO4 Understand the skills needed when writing the Conclusion

CO5 Ensure the good quality of paper at very first-time submission

AX1002	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflictsituations.
- Develop the strengths and weaknesses of disaster managementapproaches

UNIT I: INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II: REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III: DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV: DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V: RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

TOTAL PERIODS: 30

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

COURSE OUTCOMES

Upon completion of the course, the students will have an

CO1	Ability to summarize basics of disaster
CO2	Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5	Ability to develop the strengths and weaknesses of disaster management approaches

AX1003	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I:

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III:

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV:

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL PERIODS: 30

REFERENCES:

1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, NewDelhI

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Knowledge of self-development.

CO2 Learn the importance of Human values.

CO3 Developing the overall personality

AX1004	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik revolution in 1917and its impact on the initial drafting of the Indian Constitution.

UNIT I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working).

UNIT II: PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features.

UNIT III: CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties

UNIT IV: ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V: LOCAL ADMINISTRATION

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI: ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and ElectionCommissioners - Institute and Bodies for the welfare of SC/ST/OBC and women

TOTAL PERIODS 30

REFERENCES:

1. The Constitution of India,1950(Bare Act),GovernmentPublication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition,2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., LexisNexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualizationof social reforms leading to revolution in India..
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

AX1005 **PEDAGOGY STUDIES**

	L	T	P	C
	2	0	0	0

OBJECTIVES:

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development

UNIT I: INTRODUCTION AND METHODOLOGY **9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching.

UNIT II: THEMATIC OVERVIEW **9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III: EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **9**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV: PROFESSIONAL DEVELOPMENT **9**

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.

UNIT V: RESEARCH GAPS AND FUTURE DIRECTIONS **9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL PERIODS: 30

REFERENCES:

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245- 261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies,36(3):361-379.

3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population oflearners?
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effectivepedagogy?

AX1006	**STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- To achieve overall health of body and mind
- To overcome stress

UNIT I: 10

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II: 10

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III: 10

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL PERIODS: 30

REFERENCES:

1. Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Develop healthy mind in a healthy body thus improving social health
CO2	Also Improve efficiency.

AX1007	**PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENT SKILLS**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- To learn to achieve the highest goalhappily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom instudents

UNIT I: 10

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT II: 10

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III: 10

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17,Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63.

TOTAL PERIODS: 30

REFERENCES:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

AX1008 **UNNAT BHARAT ABHIYAN**

L	T	P	C
2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN 9

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area.

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II RURAL ECONOMY AND LIVELIHOOD 9

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market .

Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT - III RURAL INSTITUTIONS 9

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles.

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES 9

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.

UNIT - V FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings, and interview school drop outs
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing.

Total Periods: 45

TEXT BOOKS:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand of rural life, culture and social realities

CO2 Understand the concept of measurement by comparison or balance of parameters.

CO3 Develop a sense of empathy and bonds of mutuality with local community

CO4 Appreciate significant contributions of local communities to Indian society and economy

CO5 Value the local knowledge and wisdom of the community

CO6 Understand of rural life, culture and social realities

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DEPARTMENT OF BIOTECHNOLOGY

REGULATIONS 2021

(Approved for the students admitted in the Batch 2021 – 2025)

B.TECH BIOTECHNOLOGY

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

Vision of the Department

- To provide a world class department to facilitate learning, training, and research in Biotechnology by providing infrastructural facilities and competent faculty leading to technological innovations to serve the global society.

Mission of the Department

- The Mission of the Department is to provide quality education to students and to produce competent Biotechnologists to meet the challenges faced by industry and mankind.
- To inculcate high moral, ethical & professional standards among our students.
- To develop the overall personality of the students.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The primary objective of the Bachelor of Biotechnology program is to prepare professionals with the skills required to work in the Biotechnology industry with particular emphasis on the engineering aspects of manufacturing and design.

Biotech Graduates are trained to

I. To provide the necessary background in basic sciences like physics, chemistry, Computers, and advanced mathematics and to provide opportunities for students to gain knowledge in multidisciplinary subjects and labs.

II. To provide training to design and solve problems relevant to the general practice of Biotechnological process development, product optimization, commercialization, and social application taking into account their impacts on the environment.

III. To impart job-related skills in the field of biotechnology with an awareness of professional codes and bioethical practices.

IV. To promote a life-long learning process for a successful professional career in industries and research organizations leading to successful employability.

The Overall objective of the Program is to promote education and research in biotechnology and provide academic and professional excellence for immediate productivity in industrial, governmental, or clinical settings for an ultimate benefit of society and environment.

PROGRAM OUTCOMES(POs)

As a result of this program, the student will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to proceed to valid conclusions.

5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Our Biotech graduates shall possess strong knowledge in the field of biotechnology and applied sciences.

2. Our Biotech graduates shall be able to design and conduct experiments in biotechnology as well as analyze and interpret data.

3. Our Biotech graduates shall be able to use current techniques, skills and modern tools necessary for modelling and design of bioprocesses.

Mapping of Programme Educational Objectives (PEOs)with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

PEOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I		✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓
II	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	
III		✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
IV	✓			✓	✓	✓	✓		✓	✓		✓		✓	✓

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 1	SEM 1	Communicative English	-	✓	✓	✓	✓	-	✓	-	✓	✓	-	-
		Engineering Mathematics – I	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓
		Engineering Physics	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
		Engineering Chemistry	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Problem Solving and Python Programming	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
		Engineering Graphics	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓
		Python Programming Laboratory	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓
		Physics and Chemistry Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEM 2	Professional English	-	-	-	✓	-	-	✓	-	✓	✓	-	-
		Engineering Mathematics – II	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Physics of Materials	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓
		Environmental Science and Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Basic Civil and Mechanical Engineering	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	-	✓
		Cell Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓
		Engineering Practices Lab	✓	✓	✓	✓	-	✓	✓	-	-	-	✓	✓
		Cell Biology Lab	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	-
YEAR 2	SEM 3	Transforms and Partial Differential Equations	✓	✓	✓	✓	-	-	-	-	✓	-	✓	-
		Process Calculations	✓	✓	✓	✓	✓	✓	-	-	✓	-	✓	✓
		Basic Industrial Biotechnology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Microbiology	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓
		Biochemistry - I	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
		Molecular Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	✓
		Microbiology Laboratory	✓	-	-	✓	-	✓	✓	✓	✓	✓	-	✓
		Biochemistry Laboratory	✓	✓	✓	✓	✓	✓	-	-	-	-	-	✓
		Professional Skills Lab	✓	✓	✓	-	-	✓	-	-	✓	✓	✓	✓
	SEM 4	Applied Probability and Statistics	✓	✓	✓	✓	✓	✓	✓	-	-	-	✓	✓
		Biochemistry - II	✓	✓	-	✓	-	✓	-	-	-	-	✓	✓
		Enzyme Engineering	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓
		Fluid Mechanics and Heat Transfer Operations	✓	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Bioprocess Principles	✓	✓	✓	✓	-	✓	✓	-	-	-	-	✓
		Applied Thermodynamics for Biotechnologists	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Chemical Engineering Lab	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓
		Molecular Biology Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
YEAR 3	SEM 5	Mass Transfer Operations	✓	-	✓	✓	-	✓	-	-	-	-	✓	-
		Bioprocess Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	- ✓	
		Analytical methods & Instrumentation	✓	✓	-	✓	-	✓	-	-	-	-	✓	✓
		Protein Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
		Bioprocess Laboratory I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
		Analytical methods & Instrumentation Lab	-	-	-	✓	-	-	✓	-	✓	-	✓	✓
	SEM 6	Computational Biology	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
		Applied Chemical Reaction Engineering	✓	✓	✓	✓	-	✓	-	-	-	-	✓	-
		Genetic Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
		Bioprocess Laboratory II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
		Genetic Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
YEAR 4	SEM 7	Total Quality Management for Biotechnologists	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Downstream Processing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Immunology	✓	✓	✓	✓	✓	✓	✓	-	-	-	-	✓

YEAR	SEM	SUBJECT NAME	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Downstream Processing Laboratory	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓
		Immunology Laboratory	✓	✓	✓	✓	✓	-	-	✓	-	-	-	✓
	SEM 8	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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DEPARTMENT OF BIOTECHNOLOGY

B. TECH BIOTECHNOLOGY

REGULATIONS 2021
(Approved for the students admitted in the Batch 2021 – 2025)

I TO VIII SEMESTERS CURRICULUM

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	3	1	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem solving and python programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**24**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3	PH1255	Physics of Materials	BSC	3	3	0	0	3
4	GE1204	Environmental science and Engineering	HSMC	3	3	0	0	3
5	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6	BT1206	Cell Biology	PCC	3	3	0	0	3
PRACTICALS								
7	GE1207	Engineering Practices lab	ESC	4	0	0	4	2
8	BT1208	Cell Biology Lab	PCC	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**23**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2	BT1301	Process Calculations	PCC	3	3	0	0	3
3	BT1302	Basic Industrial Biotechnology	PCC	3	3	0	0	3
4	BT1303	Microbiology	PCC	3	3	0	0	3
5	BT1304	Biochemistry-I	PCC	3	3	0	0	3
6	BT1305	Molecular Biology	PCC	3	3	0	0	3
PRACTICALS								
7	BT1307	Microbiology Laboratory	PCC	4	0	0	4	2
8	BT1308	Biochemistry Laboratory	PCC	4	0	0	4	2
9	HS1310	Professional Skills Lab	EEC	2	0	0	2	1
			TOTAL	**29**	**19**	**2**	**10**	**24**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1452	Applied Probability and Statistics	BSC	4	3	1	0	4
2	BT1401	Biochemistry-II	PCC	3	3	0	0	3
3	BT1402	Enzyme Engineering	PCC	3	3	0	0	3
4	BT1403	Fluid Mechanics and Heat Transfer Operations	ESC	3	3	0	0	3
5	BT1404	Bioprocess Principles	PCC	3	3	0	0	3
6	BT1405	Applied Thermodynamics for Biotechnologists	PCC	3	3	0	0	3
7		Audit Course*	AC	2	2	0	0	0
PRACTICALS								
8	BT1407	Chemical Engineering Lab	ESC	4	0	0	4	2
9	BT1408	Molecular Biology Laboratory	PCC	4	0	0	4	2
			TOTAL	**29**	**21**	**0**	**8**	**23**

* Registration for any one of the audit courses is optional for the students

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1501	Mass Transfer Operations	PCC	3	3	0	0	3
2	BT1502	Bioprocess Engineering	ESC	3	3	0	0	3
3	BT1503	Analytical methods and Instrumentation	PCC	3	3	0	0	3
4	BT1504	Protein Engineering	PCC	3	3	0	0	3
5		Professional Elective- I	PEC	3	3	0	0	3
6		Open Elective-I	OEC	3	3	0	0	3
PRACTICALS								
7	BT1507	Bioprocess Laboratory-I	PCC	4	0	0	4	2
8	BT1508	Analytical methods and Instrumentation Lab	PCC	4	0	0	4	2
9	BT1510	In-plant Training**	EEC	0	0	0	0	1
			TOTAL	**26**	**18**	**0**	**8**	**23**

**Students should undergo two-week In-plant Training during IV semester vacation which will be evaluated during the V semester

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1601	Computational Biology	PCC Theory cum Lab	5	3	0	2	4
2	BT1602	Applied Chemical Reaction Engineering	ESC	3	3	0	0	3
3	BT1603	Genetic Engineering	PCC	3	3	0	0	3
4		Professional Elective-II	PEC	3	3	0	0	3
5		Professional Elective-III	PEC	3	3	0	0	3
6		Professional Elective-IV	PEC	3	3	0	0	3
PRACTICALS								
7	BT1607	Bioprocess Laboratory-II	PCC	4	0	0	4	2
8	BT1608	Genetic Engineering Laboratory	PCC	4	0	0	4	2
			TOTAL	**28**	**18**	**0**	**10**	**23**
Value added course* (**BVA001 - Advancements in Drug Designing- 1 week)			EEC	3	1	0	2	2

*** The credits earned through Value added course shall be over and above the total credits prescribed in the curriculum for the award of the degree

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	BT1701	Total Quality Management for Biotechnologists	BSC	3	3	0	0	3
2	BT1702	Downstream Processing	PCC	3	3	0	0	3
3	BT1703	Immunology	PCC	3	3	0	0	3
4		Professional Elective V	PEC	3	3	0	0	3
5		Professional Elective VI	PEC	3	3	0	0	3
6		Open Elective II	OEC	3	3	0	0	3
PRACTICALS								
7	BT1707	Downstream Processing Laboratory	PCC	4	0	0	4	2
8	BT1708	Immunology Laboratory	PCC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	BT1807	Project work	EEC	20	0	0	20	10
TOTAL				**20**	**0**	**0**	**20**	**10**

TOTAL NO. OF CREDITS:172

AUDIT COURSE* (AC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

* Registration for any of these courses is optional for students

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE–I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1001	Biophysics	PEC	3	3	0	0	3
2	BT1002	Principles of Food Processing	PEC	3	3	0	0	3
3	CE1025	Disaster Management	PEC	3	3	0	0	3
4	BT1004	Marine Biotechnology	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1005	Animal Biotechnology	PEC	3	3	0	0	3
2	BT1006	Systems Biology	PEC	3	3	0	0	3
3	BT1007	Biological Spectroscopy	PEC	3	3	0	0	3
4	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1009	Cancer Biology	PEC	3	3	0	0	3
2	BT1010	Biopharmaceutical Technology	PEC	3	3	0	0	3
3	BT1011	Molecular pathogenesis of diseases	PEC	3	3	0	0	3
4	BT1012	Bio-Entrepreneurship	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1013	Bioethics	PEC	3	3	0	0	3
2	GE1004	Fundamentals of Nanoscience	PEC	3	3	0	0	3
3	BT1015	Genomics and Proteomics	PEC	3	3	0	0	3
4	BT1016	Lifestyle diseases	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1017	Plant Biotechnology	PEC	3	3	0	0	3
2	BT1018	Metabolic Engineering	PEC	3	3	0	0	3
3	BT1019	Genetics	PEC	3	3	0	0	3
4	BT1020	Clinical Trials	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE–VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	BT1021	Tissue Engineering	PEC	3	3	0	0	3
2	BT1022	Biosafety and Hazard Management	PEC	3	3	0	0	3
3	BT1023	Stem Cell Technology	PEC	3	3	0	0	3
4	BT1024	Immunotechnology	PEC	3	3	0	0	3

OPEN ELECTIVE – I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE101	Air pollution and Control	OEC	3	3	0	0	3
2.	OME101	Automotive Systems	OEC	3	3	0	0	3
3.	OEI103	Basics of Biomedical Instrumentation	OEC	3	3	0	0	3
4.	OCS103	Introduction to Cloud computing	OEC	3	3	0	0	3
5.	OCH103	Environment and Agriculture	OEC	3	3	0	0	3
6.	OEI101	Sensors and Transducers	OEC	3	3	0	0	3

OPEN ELECTIVE–II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OME102	Design of Experiments	OEC	3	3	0	0	3
2.	OCE104	Green Building Design	OEC	3	3	0	0	3
3.	OCH101	Hospital Management	OEC	3	3	0	0	3
4.	OEI102	Robotics	OEC	3	3	0	0	3
5.	OCS101	Introduction to C programming	OEC	3	3	0	0	3
6.	OMB102	Logistics and Supply Chain Management	OEC	3	3	0	0	3

SUBJECT AREA-WISE DETAILS

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

ENGINEERING SCIENCE COURSES (ESC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1205	Basic Civil and Mechanical Engineering	ESC	4	3	0	0	3
5.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
6.	BT1403	Fluid Mechanics and Heat Transfer Operations	ESC	4	3	0	0	3
7.	BT1407	Chemical Engineering Laboratory	ESC	4	0	0	4	2
8.	BT1502	Bioprocess Engineering	ESC	3	3	0	0	3
9.	BT1602	Applied Chemical Reaction Engineering	ESC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics-I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics-II	BSC	4	3	1	0	4
6.	PH1255	Physics of Materials	BSC	3	3	0	0	3
7.	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
8.	MA1452	Applied Probability and Statistics	BSC	4	3	1	0	4
9.	BT1701	Total Quality Management for Biotechnologists	BSC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	BT1304	Biochemistry-I	PCC	3	3	0	0	3
2.	BT1308	Biochemistry Laboratory	PCC	4	0	0	4	2
3.	BT1301	Process Calculations	PCC	3	3	0	0	3
4.	BT1405	Applied Thermodynamics for Biotechnologists	PCC	3	3	0	0	3
5.	BT1302	Basic Industrial Biotechnology	PCC	3	3	0	0	3
6.	BT1401	Biochemistry – II	PCC	3	3	0	0	3
7.	BT1206	Cell Biology	PCC	3	3	0	0	3
8.	BT1307	Microbiology Laboratory	PCC	4	0	0	4	2
9.	BT1208	Cell Biology Laboratory	PCC	4	0	0	4	2
10.	BT1303	Microbiology	PCC	3	3	0	0	3
11.	BT1305	Molecular Biology	PCC	3	3	0	0	3
12.	BT1402	Enzyme Engineering	PCC	3	3	0	0	3
13.	BT1404	Bioprocess Principles	PCC	3	3	0	0	3
14.	BT1408	Molecular Biology Laboratory	PCC	4	0	0	4	2
15.	BT1501	Mass Transfer Operations	PCC	3	3	0	0	3
16.	BT1503	Analytical Methods and Instrumentation	PCC	3	3	0	0	3
17.	BT1504	Protein Engineering	PCC	3	3	0	0	3
18.	BT1507	Bioprocess Laboratory-I	PCC	4	0	0	4	2
19.	BT1508	Analytical Methods and Instrumentation Laboratory	PCC	4	0	0	4	2
20.	BT1601	Computational Biology	PCC	5	3	0	2	4
21.	BT1603	Genetic Engineering	PCC	4	3	0	0	3
22.	BT1607	Bioprocess Laboratory II	PCC	4	0	0	4	2
23.	BT1608	Genetic Engineering Laboratory	PCC	4	0	0	4	2
24.	BT1702	Downstream Processing	PCC	3	3	0	0	3
25.	BT1703	Immunology	PCC	3	3	0	0	3
26.	BT1707	Downstream Processing Laboratory	PCC	4	0	0	4	2
27.	BT1708	Immunology Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS1310	Professional skills Lab	EEC	2	0	0	2	1
2.	BT1510	In-plant Training	EEC	0	0	0	0	1
3.	BVA001	Advancements in Drug Designing	EEC	2	1	0	2	2
4.	BT1807	Project Work	EEC	20	0	0	20	10

SUMMARY OF CREDITS

S. No.	SUBJECT AREA	CREDITS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	6	-	-	-	-	-	-	09
2	BSC	12	7	4	4	-	-	3	-	30
3	ESC	9	5	-	5	3	3	-	-	25
4	PCC	-	5	19	14	13	11	10	-	72
5	PEC	-	-	-	-	3	9	6	-	18
6	OEC	-	-	-	-	3	-	3	-	06
7	AC	-	-	-	-	-	-	-	-	00
8	EEC	-	-	1	-	1	-	-	10	12
Total		**24**	**23**	**24**	**23**	**23**	**23**	**22**	**10**	**172**

I SEMESTER

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I: SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 9

Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh-Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions. **CO1**

UNIT II GENERAL READING AND FREE WRITING 9

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words. **CO2**

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs. **CO3**

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations. **CO4**

UNIT V EXTENDED WRITING 9

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu **CO5** speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013

John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102 **ENGINEERING MATHEMATICS –I**

L	T	P	C
3	1	0	4

OBJECTIVES:

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I: MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms **CO1**

UNIT II: CALCULUS OF ONE VARIABLE **12**

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity. **CO2**

UNIT III: CALCULUS OF SEVERAL VARIABLES **12**

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers. **CO3**

UNIT IV: INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. **CO4**

UNIT V: MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I: PROPERTIES OF MATTER **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams. **CO1**

UNIT II: LASER AND FIBER OPTICS **9**

Lasers : population of energy levels, Einstein’s A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system. **CO2**

UNIT III: THERMAL PHYSICS **9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee’s disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters. **CO3**

UNIT IV: QUANTUM PHYSICS **9**

Black body radiation – Planck’s theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger’s wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy. **CO4**

UNIT V: CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative). **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2019.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course,

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	2	-	-	-	-	-	1	1	1	1	2
CO2	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO3	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO4	2	2	1	3	3	1	2	-	-	1	1	2	2	2	3
CO5	2	2	2	3	3	2	-	1	-	2	1	2	2	2	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I:	**WATER AND ITS TREATMENT**		**9**
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.		**CO1**	
UNIT II:	**SURFACE CHEMISTRY AND CATALYSIS**		**9**
Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **Catalysis:** Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.		**CO2**	
UNIT III:	**PHASE RULE AND ALLOYS**		**9**
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **Alloys:** Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		**CO3**	
UNIT IV:	**FUELS AND COMBUSTION**		**9**
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **Combustion of fuels:** Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		**CO4**	
UNIT V:	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**		**9**
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		**CO5**	
		TOTAL PERIODS:	**45**

TEXT BOOKS:

1. P.C.Jain, Monica Jain, “Engineering Chemistry” 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCES:

1. B.K.Sharma “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, “Engineering Chemistry–Fundamentals and Applications”, Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, “Engineering Chemistry”, Firewall Media., New Delhi., (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course,

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I: ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi. **CO1**

UNIT II: INTRODUCTION TO PYTHON **9**

Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs. **CO2**

UNIT III: CONTROL FLOW, FUNCTIONS AND STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search. **CO3**

UNIT IV: LISTS, TUPLES, DICTIONARIES **9**

Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram. **CO4**

UNIT V: FILES, MODULES, PACKAGES **5**

Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist '', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCES:

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course,

CO1 Develop algorithmic solutions to simple computational problems

CO2 Develop simple console application in python

CO3 Develop python program by applying control structure and decompose program into functions.

CO4 Represent compound data using python lists, tuples, and dictionaries.

CO5 Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

GE1106	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I: PLANE CURVES AND FREEHAND SKETCHING **7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects **CO1**

UNIT II: PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. **CO2**

UNIT III: PROJECTION OF SOLIDS **5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method. **CO3**

UNIT IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. **CO4**

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method. **CO5**

TOTAL PERIODS: 90

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1 Understand the fundamentals and standards of Engineering graphics

CO2 Perform freehand sketching of basic geometrical constructions and multiple views of objects

CO3 Understand the concept of orthographic projections of lines and plane surfaces

CO4 Draw the projections of section of solids and development of surfaces

CO5 Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107 PYTHON PROGRAMMING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3. Scientific problem-solving using decision making and looping.
    - Armstrong number, palindrome of a number, Perfect number.

CO1

4. Simple programming for one dimensional and two-dimensional arrays.
    - Transpose, addition, multiplication, scalar, determinant of a matrix
5. Program to explore string functions and recursive functions.
6. Utilizing 'Functions' in Python
    - Find mean, median, mode for the given set of numbers in a list.
    - Write a function dups to find all duplicates in the list.
    - Write a function unique to find all the unique elements of a list.
    - Write function to compute gcd, lcm of two numbers.

CO2

7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.
10. Find the most frequent words in a text of file using command line arguments.
11. Demonstrate Exceptions in Python.
12. Applications**:** Implementing GUI using turtle, pygame.

CO3

TOTAL PERIODS: 60

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.

4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

http://www.edx.org

COURSE OUTCOMES

Upon completion of the course,

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

BS1108	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES

The students will be trained to perform experiments to study the following.

- ❖ The Properties of Matter
- ❖ The Optical properties, Characteristics of Lasers & Optical Fibre
- ❖ Electrical & Thermal properties of Materials
- ❖ Enable the students to enhance accuracy in experimental measurements.
- ❖ To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- ❖ Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS– PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young’s modulus of the material of the given beam by Non-uniform bending method. **CO1**

2.	Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO1**
3.	Determination of wavelength of mercury spectra using Spectrometer and grating.	**CO2**
4.	Determination of dispersive power of prism using Spectrometer.	**CO2**
5.	(a) Determination of wavelength and particle size using a laser.	**CO2**
	(b) Determination of numerical aperture and acceptance angle of an optical fibre.	**CO1**
	(c) Determination of width of the groove of compact disc using laser	**CO2**
6.	Determination of Young's modulus of the material of the given beam by uniform bending method.	**CO2**
7.	Determination of energy band gap of the semiconductor.	
8.	Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	**CO1**

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1.	Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	**CO5**
2.	Determination of total, temporary & permanent hardness of water by EDTA method.	**CO5**
3.	Determination of DO content of water sample by Winkler's method.	**CO5**
4.	Determination of chloride content of water sample by argentometric method.	**CO3**
5.	Estimation of copper content of the given solution by Iodometry.	**CO3**
6.	Determination of strength of given hydrochloric acid using pH meter.	**CO3**
7.	Determination of strength of acids in a mixture of acids using conductivity meter.	**CO4**
8.	Estimation of iron content of the given solution using potentiometer.	**CO4**
9.	Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	**CO4**
10.	Conductometric titration of strong acid vs strong base.	**CO4**
		CO3
		CO5

DEMONSTRATION EXPERIMENTS

1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
2. Estimation of sodium and potassium present in water using flame photometer.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

II SEMESTER

HS1201 **PROFESSIONAL ENGLISH**

L	T	P	C
3	0	0	3

OBJECTIVES:

- The Course prepares second semester engineering and Technology students to:
- Develop strategies and skills to enhance their ability to read and comprehend Engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I: INTRODUCTION TO PROFESSIONAL ENGLISH **9**

Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words. **CO1**

UNIT II: READING AND STUDY SKILLS **9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives. **CO2**

UNIT III: TECHNICAL WRITING AND GRAMMAR **9**

Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis. **CO3**

UNIT IV: REPORT WRITING **9**

Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter – Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals. **CO4**

UNIT V: GROUP DISCUSSION AND JOB APPLICATIONS **9**

Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press:2015.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	2	3	-	-	1	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	1	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	1	-	1
CO5	-	2	1	1	2	-	-	-	-	3	-	-	1	-	2

MA1202 **ENGINEERING MATHEMATICS - II**

L	T	P	C
3	1	0	4

OBJECTIVES:

- This course is designed to cover topics such as Differential Equations, Vector Calculus, Complex Analysis and Laplace Transform.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I: ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous first order linear differential equations with constant coefficients **CO1**

UNIT II: VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and simple application in evaluating line, surface and volume integrals. **CO2**

UNIT III: COMPLEX VARIABLES **12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties – Harmonic conjugates – Construction of analytic function (Milne-Thomson method) – Conformal mapping – Standard transformations W = Z + C, CZ, 1/Z - Bilinear transformation. **CO3**

UNIT IV: COMPLEX INTEGRATION **12**

Cauchy’s integral theorem –Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Cauchy’s Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line). **CO4**

UNIT V: LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function - Basic properties - Shifting theorems – transforms of derivatives and integrals –Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem – Application to solution of linear second order ordinary differential equations with constant coefficients. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCES:

1. G Bali N., Goyal M. and Watkins C., —Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. —Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, —Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., —Advanced Engineering Mathematics —Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course,

CO1	The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems
CO2	The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrotational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.
CO3	The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
CO4	The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.
CO5	Students will understand the purpose of using transforms to create new domain which can give easier ways to handle the problem that is being investigated.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	-	-	-	-	1	2	2	1	1
CO2	3	3	3	1	1	1	-	-	-	-	2	1	2	1	1
CO3	3	3	3	2	1	1	-	1	-	-	1	1	1	1	-
CO4	3	3	3	1	-	-	-	-	-	-	1	-	1	1	1
CO5	3	3	3	1	-	-	-	-	-	-	1	-	1	1	-

PH1255 **PHYSICS OF MATERIALS**

L	T	P	C
3	0	0	3

OBJECTIVES:

To make the student conversant with the

- Electronic properties in metals, properties of superconductors and its applications.
- Intrinsic and extrinsic semi conductors, Hall effect, LED, organic LED and solar cells.
- Types of magnetic materials and their applications, types of polarization and application
- Types, synthesis, properties and applications of nanostructured materials.
- Importance of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

UNIT I: CONDUCTING AND SUPERCONDUCTING MATERIALS **9**

Classical free electron theory – expression for electrical conductivity – thermal conductivity, Wiedemann-Franz law – electrons in metals: particle in a three-dimensional box (Qualitative) – degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential (concept only) – electron effective mass – concept of hole – Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS. **CO1**

UNIT II: SEMICONDUCTING MATERIALS **9**

Elemental Semiconductors – Compound semiconductors – Origin of band gap in solids (qualitative) – carrier concentration in an intrinsic semiconductor (derivation) – Fermi level –variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED – Organic LED-Solar cells. **CO2**

UNIT III: DIELECTRIC AND MAGNETIC MATERIALS **9**

Dielectric materials – Electronic, Ionic, Orientational and space charge polarization –Internal field and deduction of Clausius Mosotti equation –Frequency and temperature variation of dielectric materials- dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites - magnetoresistance - Giant magnetoresistance - Introduction to spintronics. **CO3**

UNIT IV: NANO MATERIALS **9**

Nanoscience and technology – Surface to volume ratio – Classifications of nanostructured materials – nano particles – quantum dots, nanowires, ultra-thin films-multilayered materials. Bottom-up Synthesis –Top-down Approach: Co-Precipitation, Ultrasonication, ball Milling, sol-gel method-Properties: electrical, magnetic, catalytic and antimicrobial resistance – Applications of nanomaterials in agriculture and medicine. **CO4**

UNIT V: NEW MATERIALS AND APPLICATIONS **9**

Metallic glasses – Shape memory alloys: Copper, Nickel and Titanium based alloys – graphene, graphene oxide and its properties – Ceramics: types and applications – Composites:classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Biomaterials: hydroxyapatite – PMMA – Silicone – Sensors: Chemical Sensors - Bio-sensors – conducting and semiconducting polymers – Nano fluids-Electro and magneto rheological fluids.. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd. 2014.
2. Kasap, S.O. “Principles of Electronic Materials and Devices”. McGraw-Hill Education, 2017.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES:

1. Askeland, D. “Materials Science and Engineering”. Brooks/Cole, 2010
2. Raghavan, V. “Materials Science and Engineering : A First course”. PHI Learning, 2015.
3. Smith, W.F., Hashemi, J. & Prakash. R. “Materials Science and Engineering”. Tata McGraw Hill Education Pvt. Ltd., 2014.

COURSE OUTCOMES

Upon completion of the course,

CO1	Have the knowledge about carrier density calculation in metals, properties of superconductors and its applications.
CO2	Have the knowledge about carrier density calculation in intrinsic and extrinsic semiconductors, Hall effect, LED, OLED and solar cells
CO3	Obtain the knowledge about magnetic and dielectric materials and their applications.
CO4	Explore the knowledge about types, synthesis, properties and applications of nanostructured materials.
CO5	Understand the importance, properties and applications of various new engineering materials like ceramics, SMA, metallic glasses and biomaterials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	1	1	1	1	1	2	1	1
CO2	3	3	2	2	1	1	1	1	1	1	1	2	2	1	1
CO3	3	3	2	3	2	1	1	1	1	1	1	3	3	2	1
CO4	3	3	3	3	2	3	3	1	2	1	2	3	3	2	1
CO5	3	3	3	3	2	3	2	1	2	1	2	3	3	2	1

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I: ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY **9**

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity. **CO1**

UNIT II: ENVIRONMENTAL POLLUTION **9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural. **CO2**

UNIT III: NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain. **CO3**

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT **9**

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness. **CO4**

UNIT V: HUMAN POPULATION AND THE ENVIRONMENT **9**

Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age international Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course,

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

GE1205 BASIC CIVIL AND MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System

UNIT I: SCOPE OF CIVIL AND MECHANICAL ENGINEERING **6**

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering
Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering **CO1**

UNIT II: SURVEYING AND CIVIL ENGINEERING MATERIALS **9**

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.
Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel – timber - modern materials **CO2**

UNIT III: BUILDING COMPONENTS AND STRUCTURES **12**

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. Civil Engineering Structures: Brick masonry – stonemasonry – beams – columns – lintels – roofing flooring – plastering – floor area, carpet area and floor space index – Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way. **CO3**

UNIT IV: INTERNAL COMBUSTION ENGINES AND POWER PLANTS 12

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps. **CO4**

UNIT V: REFRIGERATION AND AIR CONDITIONING SYSTEM 6

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. . Shanmugam G and Palanichamy MS ,“Basic Civil and Mechanical Engineering”, Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCES:

1. . Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,“BasicCivil Engineering”,AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,2000.

COURSE OUTCOMES

Upon completion of the course, students will be able

CO1	To impart basic knowledge on Civil and Mechanical Engineering
CO2	To familiarize the materials and measurements used in Civil Engineering.
CO3	To provide the exposure on the fundamental elements of civil engineering
CO4	To enable the students to distinguish the components and working principle of power plant, IC engines
CO5	To provide the exposure on the fundamental elements of R & AC system.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	3	-	3	2	2	3	2	3	2
CO2	3	2	3	3	3	3	2	-	2	1	1	3	1	2	1
CO3	3	2	3	3	2	3	2	-	3	2	1	3	1	2	1
CO4	3	2	3	2	2	3	2	-	3	2	2	3	1	1	1
CO5	3	2	3	2	2	3	2	-	2	2	1	3	1	2	1

BT1206	CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on the fundamentals of cell biology
- To help students understand the signaling mechanisms

UNIT I: CELL STRUCTURE AND FUNCTION OF THE ORGANELLES **9**

Prokaryotic, Eukaryotic cells, Sub-cellular organelles and functions. Principles of membrane organization membrane proteins, cyto-skeletal proteins. Extra cellular matrix, cell-cell junctions **CO1**

UNIT II: CELL DIVISION, CANCER, APOPTOSIS AND IMMORTALIZATION OF CELLS **9**

Cell cycle – Mitosis, Meiosis, Molecules controlling cell cycle, cancer, role of Ras and Raf in oncogenesis and apoptosis. Stem cells, Cell culture and immortalization of cells and its applications. **CO2**

UNIT III: TRANSPORT ACROSS CELL MEMBRANE **9**

Passive and Active Transport, Permeases, Ion channels, ATP pumps. Na+ / K+ / Ca+ 2Tpumps, uniport, symport antiporter system. Ligand gated / voltage gated channels, Agonists and Antagonists. **CO3**

UNIT IV: SIGNAL TRANSDUCTION **9**

Receptors – extracellular signaling, Cell surface / cytosolic receptors and examples, Different classes of receptors antocrine / paracrine / endocrine models, Secondary messengers molecules **CO4**

UNIT V: TECHNIQUES USED TO STUDY CELLS **9**

Cell fractionation and flow cytometry, Morphology and identification of cells using microscopic studies like SEM, TEM and Confocal Microscopy. Localization of proteins in cells – Immuno staining. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lodish, Harvey etal., “Molecular Cell Biology”, 7th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman “The Cell: A Molecular Approach”, VIIth Edition, ASM Press, 2007.

REFERENCES:

1. Alberts, Bruce etal., “Molecular Biology of the Cell”, IVth Edition, Garland Science (Taylors Francis), 2002.

COURSE OUTCOMES

Upon completion of the course, the students would have

CO1 Deeper understanding of cell at structural and functional level

CO2 Broad knowledge on the Cell division, and cell culturing methods

CO3 Deep knowledge on Cell transport mechanism and molecular interaction between cells.

CO4 Clear understanding of the signal transduction, secondary messengers.

CO5 Skill on working principles of microscopy and identification of cell types.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO2	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO3	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO4	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2
CO5	3	1	-	2	1	-	-	-	-	1	-	2	3	3	2

GE 1207	ENGINEERING PRACTICES LABORATORY	L	P	T	C
		0	0	4	2

OBJECTIVES

- ❖ To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works. **CO1**
(d) **Hands-on-exercise:**
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **18**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice **CO2**

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring

CO3

4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

CO4

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.

CO5

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**

4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**

MECHANICAL

1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	Study-purpose items: centrifugal pump, air-conditioner.	**1 each**

ELECTRICAL

1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**

ELECTRONICS

1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Able to fabricate carpentry components and pipe connections including plumbing works.
CO2	Able to use welding equipment to join the structures, carry out the basic machining operations, and make the models using sheet metal works.
CO3	Students will be able to isolate, grow and study the effect of external parameters on the microbial growth in batch culture.Able to illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.
CO4	Able to carry out basic home electrical works and appliances, measure the electrical quantities.
CO5	Able to elaborate on the electronic components and gates, soldering practices.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	-	-	3	2	-	1	1	-	3	1	1	3
CO2	3	2	3	-	-	3	1	-	2	1	-	3	2	2	3
CO3	3	1	2	-	-	2	2		1	1	-	3	2	1	3
CO4	3	2	3	3	1	3	1	1	1	1	2	3	1	1	3
CO5	3	2	3	3	1	2	1	1	1	1	2	3	1	1	3

BT1208	**CELL BIOLOGY LAB**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

- To demonstrate various techniques to learn the morphology, identification and propagation

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Identification of plant, animal and bacterial cells by microscopy
4. Gram's Staining
5. Leishman Staining
6. Giemsa Staining
7. Thin Layer Chromatography
8. Separation of Peripheral Blood Mononuclear Cells from blood
9. Osmosis and Tonicity
10. Trypan Blue Assay
11. Staining for different stages of mitosis in Allium Cepa (Onion)

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Hot Air Oven -1
2. Incubators -2
3. Light Microscopes -4
4. Incubator Shaker -1
5. Laminar Flow Chamber -2
6. Glassware, Chemicals as required

REFERENCE:

1. Rickwood, D. and J.R. Harris "Cell Biology : Essential Techniques",

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the basic techniques to work with cells

CO2 To demonstrate working principles of Microscopy

CO3 To understand and perform cell staining techniques

CO4 To identify the various stages of mitosis

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	2	2	-	-	-	1	-	1	1	3	3	2
CO2	1	1	1	2	3	-	-	-	1	-	1	-	3	3	2
CO3	1	2	1	1	2	-	1	-	1	-	1	1	3	3	2
CO4	1	1	1	1	2	1	-	-	1	-	1	2	3	3	2

SEMESTER III

MA1301 **TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**

L	T	P	C
3	1	0	4

OBJECTIVES:

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of difference equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT I: PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations (except $f(x^m z^k p, y^n z^k q) = 0$) – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types **CO1**

UNIT II: FOURIER SERIES **12**

Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis. **CO2**

UNIT III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Classification of PDE – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction. **CO3**

UNIT IV: FOURIER TRANSFORMS **12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity. **CO4**

UNIT V: Z - TRANSFORMS AND DIFFERENCE EQUATIONS **12**

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics”, 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, “Advanced Engineering Mathematics “, 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

REFERENCES:

1. Dass, H.K., and Er.RajnishVerma, “Higher Engineering Mathematics”, S.Chand Private Ltd.,2011.
2. Peter V.O’Neil, “Advanced Engineering Mathematics”, 7th Edition, Cengage learning,2012
3. James, G., “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand how to solve the partial differential equations and apply these concepts in the field of engineering.
CO2	Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.
CO4	Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis, image processing etc.
CO5	Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals etc.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	2	-	2	1	2	-	3	1	1
CO2	3	3	2	2	1	2	1	-	1	-	2	-	2	1	1
CO3	3	3	2	2	-	1	-	-	1	-	2	-	2	1	1
CO4	3	2	1	2	1	-	1	1	-	-	3	-	1	1	1
CO5	3	3	2	2	1	-	1	-	2	1	2	-	1	-	1

BT1301 **PROCESS CALCULATIONS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- The course aims to develop skills of the students in the area of Chemical Engineering with emphasis in process calculations and fluid mechanics.
- This will enable the students to perform calculations pertaining to processes and operations.

UNIT I: BASIC CHEMICAL CALCULATIONS **9**

Dimension – Systems of units esp. engineering FPS, Engineering MKS & SI systems – Conversion from one system to the other – composition of mixtures and solutions – mass fraction, mass %, mole fraction, mole %, mass ratios, molarity, molality, normality, ppm, composition by density. **CO1**

UNIT II: IDEAL AND ACTUAL GAS EQUATIONS **9**

Ideal and actual gas equations, Vander Walls, compressibility factor equations, Application to pure gas & gas mixtures – partial pressures, partial volumes – Air-water vapour systems, Humidity, Molar Humidity, Relative Humidity, % Saturation, humid Volume – Humidity chart – wet, Dry bulb, Dew point temperatures, pH of solutions, Vapour pressure. **CO2**

UNIT III: MATERIAL BALANCE WITHOUT CHEMICAL REACTIONS **9**

Material balance concept – overall & component – material balance applications for evaporator, gas absorber without reaction, Distillation (Binary system), Liquid extraction, solid-liquid extraction, drying, crystallization, Humidification, Reverse Osmosis separation and Mixing Recycle and Bypass illustration **CO3**

UNIT IV: ENERGY BALANCE **9**

General energy balance equation for open systems, closed system sensible heat calculation, Heat required for phase change thermo chemistry, application of steam tables, Saturated and superheated steam application in bioprocess **CO4**

UNIT V: MATERIAL BALANCE WITH CHEMICAL REACTION **9**

Chemical Reaction-Limiting, excess component, Fractional conversion, Percent conversion, Fractional yield in multiple reactions. Simple problems, Combustion Reactions **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bhatt B.I & SB Thakore, Stoichiometry - Fifth edition Tata McGraw Hill 2012
2. Geankoplis C.J. “Transport process & Separation process Principles 4th edition-PHI 2006.

REFERENCES:

1. McCabe W.L & J.C.Sonith & P.Harriot “Unit operations of chemical Engineering” 6thEdn McGraw Hill 2001
2. Robert W.Fox, Alan T.McDonald & Philip J.Pritchard “Introduction to FluidMechanics” 6th edn John Wiley & Sons 2003.
3. Himmelblau D.M “Basic principles & Calculations in Chemical Engineering” 6th edn PHI 2006.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	Tosolve problems related to units and conversions and fit the given data using the methodologies
CO2	Toapply their knowledge in the field of biochemical engineering from the principles of thermodynamics
CO3	Tosolve problems related to material balance concepts & design reactors for biochemical processes
CO4	To solve problems related to energy balance concepts & perform calculations pertaining to processes and operations.
CO5	To gain extensive knowledge on Conversion and Percent Yield for single and multiple chemical reactions.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
CO3	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1
CO4	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1
CO5	3	2	2	1	1	1	-	-	-	-	-	-	1	1	1

BT1302	**BASIC INDUSTRIAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs.
- The course prepares the students for the bulk production of commercially important modern Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures

UNIT I: INTRODUCTION TO INDUSTRIAL BIOPROCESS 9

Introduction to fermentation, Biochemistry of fermentation. Traditional and Modern Biotechnology- A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess, Process flow sheeting – block diagrams, pictorial representation. **CO1**

UNIT II: PRODUCTION OF PRIMARY METABOLITES 9

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids and alcohols. **CO2**

UNIT III: PRODUCTION OF SECONDARY METABOLITES 9

Secondary Metabolites- Production processes for various classes of secondary metabolites: Antibiotics, Vitamins and Steroids. **CO3**

UNIT IV: PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 9

Production of Industrial Enzymes, Biopesticides, Biofertilizer, Biopreservatives, Biopolymers Biodiesel. Beer, Cheese, SCP & Mushroom culture **CO4**

UNIT V: PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS 9

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines. **CO5**
Bioprocess strategies in Plant Cell and Animal Cell culture.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Satyanarayana, U. “Biotechnology” Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. “A Textbook on Biotechnology” IInd Edition. Affiliated East West Press Pvt.Ltd., 1998. 3. Balasubramanian, D. etal., “Concepts in Biotechnology” Universities Press Pvt. Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen “Basic Biotechnology” IInd Edition Cambridge University Press, 2001.
5. Dubey, R.C. “A Textbook of Biotechnology” S.Chand & Co. Ltd., 2006

REFERENCES:

1. Casida, L.E. “Industrial Microbiology”, New Age International (P) Ltd, 1968.
2. Presscott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
3. Cruger,Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, IInd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (Elsevier) 2004.
5. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, IInd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
6. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
7. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to learn, define and understand the basics in industrial bioprocess and to explain the steps involved in the production of bioproducts and methods to improve modern biotechnology.
CO2	Students will be able to measure and manufacture the primary metabolites of commercial importance and apply basic biotechnological principles, methods and models to solve biotechnological tasks.
CO3	Students will be able to measure, manufacture and formulate the secondary metabolites of commercial importance.
CO4	Students will be able to isolate, identify, characterize and apply in the production of enzymes and bioproducts.
CO5	Students will be able to estimate, evaluate and express the production of therapeutic and diagnostic products and design and deliver useful modern biotechnology products to the Society

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	1	2	-	-	-	-	-	1	1	1	1	2
CO2	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO3	2	2	1	3	2	1	-	-	-	1	1	2	2	2	3
CO4	2	2	1	3	3	1	2	-	-	1	1	2	2	2	3
CO5	2	2	2	3	3	2	-	1	-	2	1	2	2	2	3

BT1303 **MICROBIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:

- TointroducestudentstotheprinciplesofMicrobiologytoemphasizestructure, multiplication and biochemical aspects of various microbes
- To solve the problems in microbial infection and their control
- To Apply the knowledge in Industrial and environmental Biotechnology using microorganism

UNIT I: INTRODUCTION **9**

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining. **CO1**

UNIT II: MICROBES- STRUCTURE AND MULTIPLICATION **9**

Structural organization and multiplication of bacteria, viruses, algae and fungi, with special mention of life history of actinomycetes, yeast, mycoplasma and bacteriophages. **CO2**

UNIT III: MICROBIAL NUTRITION, GROWTHANDMETABOLISM **9**

Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic (Glycolysis, Pentose pathway) and anaerobic bioenergetics (TCA cycle and Glyoxylate cycle) and utilization of energy for biosynthesis of important molecules (Synthesis of amino acid, protein, peptidoglycan and nucleotides) **CO3**

UNIT IV: CONTROL OF MICROORGANISMS **9**

Physical and chemical control of microorganisms; host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms. **CO4**

UNIT V: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY **9**

Primary metabolites; secondary metabolites and their applications; preservation of food; productionof penicillin, alcohol, vitamin B-12; biogas; bioremediation; leaching of ores by microorganisms; biofertilizers and biopesticides; microorganisms and pollution control; biosensors	**CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

5. TalaronK,Talaron A, Casita, Pelczar and Reid.Foundations in Microbiology,W.C. Brown Publishers,1993.
6. PelczarMJ, Chan ECS and Krein NR, Microbiology, Tata McGraw Hill Edition, New Delhi,India.
7. PrescottL.M.,HarleyJ.P.,KleinDA,Microbiology,3rdEdition,Wm.C.BrownPublishers,1996

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will develop skills in the identification and grouping of different microbes using staining and microscopic techniques.
CO2	Students will gain the ability to define the structural features of microbes through microscopy by structure and biochemical aspects of various microbes.
CO3	Students will be able to understand the microbial metabolism and nutritional requirements of various microbes.
CO4	Students will be able to select a suitable method for the control of microbes and design of antimicrobial agents to prevent microbial infection.
CO5	Students will be able to realize and identify various micro organism for industrial and environmental applications

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	-	-	-	-	-	-	3	2	2
CO2	1	2	1	2	1	1	-	-	-	-	-	-	3	2	1
CO3	1	1	3	2	2	1	1	-	1	-	-	2	3	2	2
CO4	2	3	3	3	2	2	2	1	1	-	-	2	3	3	2
CO5	3	2	3	3	1	1	2	1	2	-	-	2	3	3	2

BT1304	BIOCHEMISTRY - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To know in detail about the elements of atom, charges and their bonding rule.
- To understand the fundamentals of biomolecules and biochemical process.
- To understand the reactions of intermediate metabolism and regulations

UNIT I: INTRODUCTION TO ORGANIC CHEMISTRY **9**

Basic principles of organic chemistry- Atoms, Electrons and Orbitals - Covalent Bonds - Octet rule - Polar covalent Bonds -Electronegativity- formal charges, Isomers-Structural and Stereoisomers. Acids and Bases - Arrhenius and Bronsted Lowry Theories, Lewis acid and base. Role of carbon, types of functional groups, chemical nature of water, pH and biological buffers- Types of buffers. **CO1**

UNIT II: STRUCTURE AND PROPERTIES OF CARBOHYDRATES **9**

Structure, Types and properties of Monosaccharides, Oligosaccharides and Polysaccharides. Chemical reaction of monosaccharides, Isomers- D and L configurations, epimers, anomers. Optical activity of Carbohydrates- Dextro and Levorotatory- Mutarotation. Proteoglycans, glucosaminoglycans. mutarotation, glycosidic bond, reducing sugars. Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. Hyaluronic acid, chondroitin sulfate. **CO2**

UNIT III: STRUCTURE AND PROPERTIES OF PROTEIN **9**

Amino Acids and their types, Peptides, Proteins, measurement, structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determine of primary structure. Strategy of Peptide Synthesis-Merrifield state peptide synthesis – Sequencing of Proteins- Sanger’s and Edman’s Method. **CO3**

UNIT IV: STRUCTURE AND PROPERTIES OF LIPIDS AND NUCLEIC ACIDS **9**

Lipids: fatty acids, glycerol-simple lipids: fats, oils and waxes-complex lipids: phospholipids, glycolipids, sphingolipids - derived lipids: steroids, terpenoids and carotenoids - Functions of lipids -saponification, iodination and hydrogenation. **CO4**
Nucleic acids: purines, pyrimidines, nucleoside, nucleotide, structure and function of RNA-mRNA, tRNA, rRNA and Watson and Crick structure of DNA. Sangers method of DNA Sequencing.

UNIT V: INTERMEDIARY METABOLISM AND REGULATION **9**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt & glyoxalate shunt. Fatty acid biosynthesis and oxidation, Cholesterol synthesis, Terpenes Biosynthesis. Amino acid degradation-deamination, transamination and decarboxylation, urea cycle. Electron transport chain- ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox
2. Satyanarayana, U. and U. Chakerapani, “Biochemistry” 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.

REFERENCES:
1. Berg, Jeremy M. et al. “Biochemsitry”, 6th Edition, W.H. Freeman & Co., 2006.
2. Murray, R.K., etal “Harper’s Illustrated Biochemistry”, 27th Edition, McGraw-Hill, 2006.
3. Voet, D. and Voet, J.G., “Biochemistry”, 3rd Edition, John Wiley & Sons Inc.,2004.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to outline the basics of organic chemistry.
CO2	Students will be able to describe the basic structure, types and function of carbohydrates.
CO3	Students will be able to gain extensive knowledge on amino acids and protein.
CO4	Students will be able to gain extensive knowledge on Lipids and nucleic acids.
CO5	Students will be able to gain knowledge in intermediate metabolism and to consolidate the energy yield from different metabolic pathway

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO2	1	2	-	-	-	-	-	-	-	-	-	1	2	2	1
CO3	1	2	2	1	2	1	-	-	-	-	-	1	2	2	2
CO4	1	2	1	1	1	1	-	-	-	-	-	1	2	2	1
CO5	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-

BT1305	**MOLECULAR BIOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:
- Familiarize students with the cell and molecular biology of both Prokaryotes and Eukaryotes.
- This will be needed for any project work in modern biotechnology.
- By doing this course students will acquire basic fundamental knowledge and explore skills in molecular biology and become aware of the complexity and harmony of the cells.
- This course will emphasize the molecular mechanism of DNA replication, repair,transcription, protein synthesis and gene regulation in various organisms.

UNIT I: CHEMISTRY OF NUCLEIC ACIDS **9**

Introduction to nucleic acids: Nucleic acids as genetic material, Structure and physicochemical properties of elements in DNA and RNA, Biological significance of differences in DNA and RNA. Primary structure of DNA: Chemical and structural qualities of 3’,5’-Phosphodiester bond. Secondary Structure of DNA: Watson & Crick model, Chargaff’s rule, X–ray diffraction analysis of DNA, Forces stabilizes DNA structure, Conformational variants of double helical DNA, Hogsteen base pairing, Triple helix, Quadruple helix, Reversible denaturation and hyperchromic effect. Tertiary structure of DNA: DNA supercoiling. **CO1**

UNIT II: DNA REPLICATION & REPAIR		**9**
Overview of Central dogma. Organization of prokaryotic and eukaryotic chromosomes. DNA replication: Meselson& Stahl experiment, bi–directional DNA replication, Okazaki fragments, Proteomics of DNA replication, Fidelity of DNA replication, Inhibitors of DNA replication, Overview of differences in prokaryotic and eukaryotic DNA replication, Telomere replication in eukaryotes. D-loop and rolling circle mode of replication. Mutagens, DNA mutations and their mechanism, various types of repair mechanisms.	**CO2**	
UNIT III: TRANSCRIPTION		**9**
Structure and function of mRNA, rRNA and tRNA. Characteristics of promoter and enhancer sequences. RNA synthesis: Initiation, elongation and termination of RNA synthesis, Proteins of RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription, Differences in prokaryotic and eukaryotic transcription. Basic concepts in RNA world: Ribozymes, RNA processing: 5'-Capping, Splicing-Alternative splicing, Poly 'A' tail addition and base modification.	**CO3**	
UNIT IV: TRANSLATION		**9**
Introduction to Genetic code: Elucidation of genetic code, Codon degeneracy, Wobble hypothesis and its importance, Prokaryotic and eukaryotic ribosomes. Steps in translation: Initiation, Elongation and termination of protein synthesis. Inhibitors of protein synthesis. Posttranslational modifications and its importance.	**CO4**	
UNIT V: REGULATION OF GENE EXPRESSION		**9**
Organization of genes in prokaryotic and eukaryotic chromosomes, Hierarchical levels of gene regulation, Prokaryotic gene regulation –lac and trp operon, Regulation of gene expression with reference to λ phage life cycle.	**CO5**	

TOTAL PERIODS: 45

TEXT BOOKS:

1. Friefelder, David. "Molecular Biology." Narosa Publications, 1999
2. Weaver, Robert F. "Molecular Biology" IInd Edition, Tata McGraw-Hill, 2003.
3. Karp, Gerald "Cell and Molecular Biology: Concepts and Experiments" IVth Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski "Essentials of Molecular Biology" IInd Edition, Panima Publishing, 1993.

REFERENCES:

1. Tropp, Burton E. "Molecular Biology: Genes to Proteins". IIIrd Edition. Jones and Bartlett, 2008.
2. Glick , B.R. and J.J. Pasternak. "Molecular Biotechnology: Principles and Applications of Recombinant DNA" 4th Edition. ASM, 2010.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Understand the basic structure and physicochemical properties of elements in DNA and RNA.
CO2	Understand the Central dogma of life and identify the principle and differences between the DNA replication of prokaryotes and eukaryotes.
CO3	Gain knowledge about the mechanism behind prokaryotic and eukaryotic transcription. They also additionally understand the basic concepts in RNA world: Ribozymes and RNA processing.
CO4	Know how to elucidate the genetic code and understand the mechanism and differences between prokaryotes and eukaryotes translation.
CO5	Gain knowledge about gene organization and mechanism of gene expression in various organisms.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	1	-	-	-	-	1	3	2	1
CO2	1	1	3	2	2	-	1	-	-	-	-	1	3	2	1
CO3	1	1	2	2	3	-	1	-	-	-	-	1	3	2	1
CO4	1	1	2	2	3	-	1	2	-	1	-	1	3	2	1
CO5	1	1	2	1	3	2	2	1	-	-	-	1	3	2	1

BT1307	MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To demonstrate various techniques to learn the morphology, identification and propagation of microbes
- The course prepares the students to have an idea in growth kinetics and behaviour of organism with antibiotic treatments

Exp No : 1 Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
Exp No : 2 Culture Media-Types and Use; Preparation of Nutrient broth and agar
Exp No : 3 Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
Exp No : 4 Microscopy – Working and care of Microscope
Exp No : 5 Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
Exp No : 6 Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining
Exp No : 7 Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
Exp No : 8 Effect of Disinfectants- Phenol Coefficient
Exp No : 9 Antibiotic Sensitivity Assay
Exp No : 10 Growth Curve in Bacteria and Yeast

Exp No : 11 Effect of pH, Temperature, UV radiation on Growth Bacteria

TOTAL PERIODS: 60

EQUIPMENT NEEDED FOR 30 STUDENTS

1. Autoclave - 1,
2. Hot Air Oven - 1,
3. Incubators - 2 ,
4. Light Microscopes - 4,
5. Incubator Shaker - 1,
6. Colorimeter - 2,
7. Lamina Flow Chamber - 2 ,
8. Glassware, Chemicals, Media as required.

TEXT BOOKS:
1. Cappuccino, J.G. and N. Sherman "Microbiology: A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, ChurchillLivingstone, 1996.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to culture and grow microbes on media.
CO2	Students will gain knowledge on identification and quantification of microbes.
CO3	Students will be able to isolate, grow and study the effect of external parameters on the microbial growth in batch culture.
CO4	Students will also study the effect of disinfectant and antibiotics on microbes.
CO5	Students will gain knowledge on radiation impacts on the microbes

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	1	-	-	-	-	-	-	3	2	2
CO2	1	2	1	2	1	1	-	-	-	-	-	-	3	2	1
CO3	1	1	3	2	2	1	1	-	1	-	-	2	3	2	2
CO4	2	3	3	3	2	2	2	1	1	-	-	2	3	3	2
CO5	3	2	3	3	1	1	2	1	2	-	-	2	3	3	2

BT1308	**BIOCHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

AIM:
- To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

EXPERIMENTS
1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.

10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Autocalve-1
2. Hot Air Oven -1
3. Incubators -2
4. Light Microscopes -4
5. Incubator Shaker -1
6. Colorimeter -2
7. Laminar Flow Chamber -2
8. Glassware, Chemicals, Media asrequired

TEXT BOOKS

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

REFERENCE:

2. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell,Appleton and Lange ,Stanford ,Conneticut.
3. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley LissPublishers

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The basic guidelines in laboratory and gain knowledge in fundamentals of units, measurements, accuracy and precision
CO2	The basic principles behind the qualitative analysis of carbohydrates and amino acids
CO3	Extraction and analysis of lipids
CO4	Different biochemical estimation methods of biomolecules and will be able to carry out both qualitative and quantitative analyses of the same.
CO5	Estimation of enzymatic activity and perform titrations using acids and bases.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	2	2	2	-
CO2	2	-	2	1	-	1	-	-	-	-	-	-	2	1	-
CO3	2	-	2	1	-	1	-	-	-	-	-	-	2	1	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-	2	2	1
CO5	1	2	1	1	-	-	-	-	-	-	-	-	2	1	1

HS1310 PROFESSIONAL SKILLS LABORATORY

L	P	T	C
0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs. **CO1**

UNIT II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language **CO2**

UNIT III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc **CO3**

UNIT IV **6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews–telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them. **CO4**

UNIT V **6**

Recognizing differences between groups and teams- managing time managing stress-networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes **CO5**

TOTAL : 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

One Server
30 Desktop Computers
One Hand Mike
One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014

4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, Orient BalckSwan: Hyderabad, 2016.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Make effective presentations

CO2 Participate confidently in Group Discussions

CO3 Attend job interviews and be successful in them.

CO4 Develop adequate Soft Skills required for the workplace

CO5 Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	2	-	2	1	-	-	-	2	3	-	-	1	2	1
CO2	-	2	-	2	-	-	-	-	2	3	-	-	1	2	1
CO3	-	-	-	-	-	-	-	-	2	2	-	-	-	2	1
CO4	-	-	-	-	-	-	-	-	2	2	-	2	-	2	1
CO5	-	2	1	1	2	-	2	-	2	3	-	2	1	2	1

IV SEMESTER

MA1452 APPLIED PROBABILITY AND STATISTICS

L	T	P	C
3	1	0	4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I: PROBABILITY AND RANDOM VARIABLES 12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. **CO1**

UNIT II: TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables). **CO2**

UNIT III: TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit. **CO3**

UNIT IV: DESIGN OF EXPERIMENTS 12

One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design **CO4**

UNIT V: STATISTICAL QUALITY CONTROL 12

Control charts for measurements (and R charts) – Control charts for attributes (p, c and np charts) –Tolerance limits - Acceptance sampling. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th IndianEdition, 2017.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", CengageLearning,New Delhi, 9th Edition, 2017.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4thEdition,Elsevier, 2009.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineersand Scientists", Pearson Education, Asia, 9th Edition, 2012.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Get ideas to handle situations involving more than one random variable
CO3	Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO4	Apply the basic concepts of design of experiments and handle the same.
CO5	Understand the concept of the Control charts to apply in the field of quality assessment, Production processes, to monitor process stability and control of the manufacturing product.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	1	-	-	-	-	1	1	2	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	2	1	1
CO3	3	3	2	3	3	2	1	-	-	-	2	2	2	2	1
CO4	3	3	2	3	2	2	1	-	-	-	1	2	1	2	1
CO5	3	3	3	3	2	2	1	-	-	-	2	1	2	2	1

BT1401 **BIOCHEMISTRY-II**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To orient towards the application of knowledge acquired in solving clinical problems.
- To provide a base for molecular modelling and drug designing

UNIT I: METABOLISM OF AMINO ACIDS **9**

Biosynthesis of Gly, Ser and Cys; Biosynthesis of six essential amino acids (Met, Thr, Lys, Ile,Val, Leu) and regulation of branched chain amino acids (concerted inhibition, allosteric regulation and enzyme multiplicity, sequential feedback) from oxaloacetate and pyruvate; Biosynthesis of aromatic amino acids. Metabolic disorders associated with branched chain and aromatic amino acid degradation. Important molecules derived from amino acids (auxins, DOPA, Serotonin, porphyrins, T3, T4, Adrenaline, Noradrenaline, histamine, GABA, polyamines etc) **CO1**

UNIT II: PROTEIN TRANSPORT AND DEGRADATION **9**

Protein targeting, signal sequence, secretion; Folding, Chaperons and targeting of organelle proteins, Protein degradation, receptor-mediated endocytosis, turnover. **CO2**

UNIT III: BIOCHEMISTRY OF MUSCLE CONTRACTION **9**

Contractile proteins, Actin, Myosin, Actin Polymerization, acto-myosin complexes, mechanism of myosin ATPase activity, excitation – contraction coupling nad relaxation, microtubules, microfilaments and their role in organelle movements. **CO3**

UNIT IV: VITAMINS AND COENZYMES **9**

Fat Soluble Vitamins, provitamins (A, D, E and K). Structure, physiological significance and deficiency symptoms. Water soluble vitamins, structure, coenzyme role and deficiency symptoms. Thiamine, riboflavin, pyridoxine, niacin, folic acid, biotin and Vitamin B12. Recommended dietary intake. Coenzymes: Their role in metabolic pathways. NAD, FAD, TPP, PLP, carboxy biotin. **CO4**

UNIT V: HORMONES **9**

Introduction. Effects of Hormones. Chemical classification of hormones. Peptide hormone vasopressin, protein hormone- insulin. Lipid and phospholipid derived hormones prostaglandin and phospholipids. Steroid hormones-testosterone, estrogen, cortisol. Monoamines: thyroxine, adrenaline. Mechanism of action of the different classes of hormones. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Nelson, D.L et al., "Lehninger's Principles of Biochemistry" Stryer, Lubert.
2. "Biochemistry".IVth Edition, W.H Freeman & Co., 2000.
3. Voet, D.J and J.G. Voet and C.W. Pratt "Principles of Biochemistry" IIIrd Edition, John Wiley & Sons Inc., 2008.
4. Murray, R.K., et al., "Harper's Illustrated Biochemistry". XXVIIth Edition. McGraw-Hill,2006..

REFERENCE:

1. Creighton. T.E., "Proteins: Structure and Molecular Properties" IInd Edition, W.H. Freeman and Co.,1993.
2. Salway, J.G., "Metabolism at a Glance". IInd Edition, Blackwell Science Ltd., 2000.

COURSE OUTCOMES

Upon completion of the course,

CO1 Student will gain knowledge on the reaction involve in amino acid synthesis

CO2 Students will have knowledge on protein transport and degradation

CO3 Students will gain knowledge in biochemistry of muscle contraction

CO4 Student will gain knowledge on the role of vitamins and co-enzymes in metabolic pathway

CO5 Students will gain knowledge on biomembranes, transport and electrical conductivity.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO2	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO3	1	2	-	1	-	-	-	-	-	-	-	1	2	2	-
CO4	1	2	-	-	-	-	-	-	-	-	-	1	2	2	-
CO5	1	2	-	1	-	-	-	-	-	-	-	1	2	2	-

BT1402	**ENZYME ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To enable the students

- To learn enzyme reactions and its characteristics along with the production and purification process
- To give the student a basic knowledge concerning biotransformation reactions with the usage of enzymes

UNIT I: INTRODUCTION TO ENZYMES **9**

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis. **CO1**

UNIT II: KINETICS OF ENZYME ACTION **9**

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions - mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod Changeux Wyman model, pH and temperature effect on enzymes & deactivation kinetics. **CO2**

UNIT III: ENZYME IMMOBILIZATION AND BIOSENSORS 9

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages, design of enzyme electrodes and their application as biosensors in industry, healthcare and environment. **CO3**

UNIT IV: PURIFICATION AND CHARACTERIZATION OF ENZYMES FROM NATURAL SOURCES 9

Production and purification of crude enzyme extracts from plant, animal and microbial sources; methods of characterization of enzymes; development of enzymatic assays. **CO4**

UNIT V: INDUSTRIAL APPLICATIONS OF ENZYMES 9

Enzymes in organic synthesis – Enzymes for food, pharmaceutical, tannery, textile, paper and pulp industries – Enzyme for environmental applications- Enzymes for analytical and diagnostic applications – Enzymes for molecular biology research. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Trevor Palmer , Enzymes IInd Horwood Publishing Ltd
2. Faber K ,Biotransformations in Organic Chemistry, IV edition , Springer

REFERENCES:

1. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.
2. James M. Lee, Biochemical Engineering, PHI, USA.
3. James. E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
4. Wiseman, Enzyme Biotechnology, Ellis Horwood Pub.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To gain knowledge on enzyme and enzyme reactions which will be the key step to proceed towards various concepts in biotechnology
CO2	To understand theoretical and practical aspects of kinetics which will deliver the importance and utility of enzyme kinetics towards research.
CO3	To know the process of immobilization which enables them to apply its techniques in food, pharmaceutical and chemical industries.
CO4	To technologically work on processing, production and purification of enzymes at an industrial scale.
CO5	To receive theoretical knowledge on biotransformation and industrial, health care and research application of enzymes.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	2	-	-	-	-	-	-	-	1	3	3	1
CO2	2	2	3	3	3	1	1	-	-	-	-	1	3	3	3
CO3	1	2	3	3	3	2	2	2	-	-	-	1	3	3	1
CO4	1	2	3	3	3	2	2	2	-	-	-	1	3	3	3
CO5	1	1	3	3	3	2	2	2	-	-	-	1	3	3	3

BT1403 FLUID MECHANICS AND HEAT TRANSFER OPERATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions.
- The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy and flow measurements.
- To enable the students to understand the fundamental principles and concepts of heat transfer by conduction, convection and radiation.
- The course will develop skills in the design and application of heat exchangers.
- This course will be a prerequisite for certain engineering subjects offered in the subsequent semesters.

UNIT I: FLUID PROPERTIES & FLUID MECHANICS 9

Fluid definition- compressible, in compressible fluids – coefficient of isothermal compressibility, Density, specific gravity, specific weight, surface tension, vapour pressure, viscosity. Newtonian and Non-newtonian fluids. Fluid statics – Barometric equation – application for incompressible and compressible fluids. Pressure changes in atmospheric air – Gauge and absolute pressure – pressure measurement with Bourdon gauge & manometers. Fluid Dynamics – equation of continuity – Bernoulli's equation – pressure loss in straight pipes – in fittings – expansion and contraction losses (applied to Newtonian Fluids only) Fluid flow measurement, Orifice, venturimeter & Rotameter for Newtonian fluids. **CO1**

UNIT II: FLOW OF FLUID THROUGH PACKINGS 9

Fluidization, Fluid transport -Industrial application of fluid flow through packing-characteristics of packed bed-Bed surface area-void fraction-Laminar flow and turbulent flow through packed bed - pressure drop experienced by the fluid-equations and application problems. Fluidization phenomena-Industrial application - minimum fluidization velocities. Industrial pipes and fittingsFluid moving machinery-pumps centrifugal, Reciprocating-gear, Peristaltic pumps, Introduction togas moving machinery-Fans, blowers, compressors. **CO2**

UNIT III:	**CONDUCTION HEAT TRANSFER**	**9**

Heat transfer phenomena-thermodynamics & heat transfer. Heat conduction – Fourier's equation – steady state conduction in planar and radial systems – Resistance concept – series and–and parallel resistances in conduction – unsteady state conduction – lumped capacity model – extended surfaces (Fins) –combined conduction & convection – 2 dimensional conduction. **CO3**

UNIT IV:	**CONVECTION HEAT TRANSFER**	**9**

Forced and natural convection – Dimensional analysis- Dimensional numbers- Convection heat transfer coefficient- Correlations for flow over plate, through tubes, over spheres and cylinders- Agitated systems- Packed columns- condensation phenomena- Film and drop wise condensation over tubes- Boiling phenomena- heat transfer coefficient. **CO4**

UNIT V:	**RADIATION HEAT TRANSFER AND HEAT TRANNSFER EQUIPMENTS**	**9**

Electromagnetic waves- energy of radiation- Planck's equation-Blackbody- Radiation exchange. Kirchhoff's law, Stefan Boltzmann equation of radiant energy – Wien's law- Radiation exchange between surfaces – black- gray bodies- view factors-sample problems. Concept of overall heat transfer coefficient- Heat exchangers- types, boilers- Kettles- Heat exchanger Design concept- NTU concept. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Geamkoplis. C.J "Transport Process & separation Process Principles" IVth Edition Prentice Hall of India,2005.
2.Heat & Mass Transfer by P. K. Nag, Tata McGraw Hill – IIIrd Edition 2003

REFERENCES:

1. Principles of Heat Transfer Frank Kreith, Raj M. ManglikVIIth edition Cenage Learning Inc Mark S. Bohn

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The basic understanding of the properties and behaviour of fluids, static and dynamic equilibrium .
CO2	The dynamics of fluids and integrated understanding of transport of mass, momentum and energy.
CO3	The process of Heat transfer through different bodies by means of conduction, convection and radiation.
CO4	The concept of heat flow over surfaces by natural and forced convection, phenomena of boiling and condensation heat transfer , estimation of heat transfer coefficient.
CO5	The basic laws, concept and mechanism of thermal radiation , types of heat exchangers and the design of heat exchangers for various bioprocesses.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	1	1	1	-	-	-	-	1	2	2	1	-
CO2	2	2	1	1	1	-	1	-	-	1	2	2	2	1	1
CO3	2	2	2	2	2	1	1	1	1	1	-	2	1	2	1
CO4	2	2	1	2	1	1	1	1	1	1	2	2	-	1	1
CO5	2	2	2	2	2	2	2	2	2	2	2	2	-	2	2

BT1404	**BIOPROCESS PRINCIPLES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To impart knowledge on design and operation of fermentation processes with all its prerequisites.
- To endow the students with the basics of microbial kinetics, metabolic Stoichiometry and energetics.

UNIT I: OVERVIEW OF FERMENTATION PROCESSES **9**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor (CSTR) and ancillaries, main parameters to be monitored and controlled in fermentation processes **CO1**

UNIT II: RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS **9**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods **CO2**

UNIT III: STERILIZATION KINETICS **9**

Thermal death kinetics of microorganisms, batch and continuous heat sterilization of liquid media, filter sterilization of liquid media, air sterilization and design of sterilization equipment - batch and continuous. **CO3**

UNIT IV: METABOLIC STOICHIOMETRY AND ENERGETICS **9**

Stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield coefficients of biomass and product formation, maintenance coefficients energetic analysis of microbial growth and product formation, oxygen consumption and heat evolution in aerobic cultures, thermodynamic efficiency of growth. **CO4**

UNIT V: KINETICS OF MICROBIAL GROWTH AND PRODUCT FORMATION 9

Batch cultivation and continuous cultivation. Simple unstructured models for microbial growth, Monod model, product formation kinetics - Leudeking- Piret models, substrate and product inhibition on cell growth and product formation. Biomass estimation – Direct and Indirect methods. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Shuler, Michael L. and Fikret Kargi, “ Bioprocess Engineering “, Prentice Hall, 1992.
2. Doran, Pauline “of Bioprocess Engineering Principles “. Elsevier, 1995
3. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.

REFERENCES:

1. Lydersen, Bjorn K. “Bioprocess Engineering Systems, Equipment and Facilities” John Wiley, 1994.
2. Bailey, James E. and David F. Ollis, “Biochemical Engineering Fundamentals”, IInd Edition. McGraw Hill , 1986.
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Understand about the assembly and functioning of Bioreactors and its utilities
CO2	Gain knowledge on media components, perform scientific media design and optimize its concentrations
CO3	Analyze the various sterilization methods and its Kinetics and solve the problems associated with it.
CO4	Understand the concepts of Metabolic stoichiometry, Energetics of cell growth and product formation
CO5	Gain knowledge on kinetics of Microbial growth and Product formation

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	2	-	-	-	-	-	-	1	3	2	2
CO2	1	1	3	3	2	-	1	-	-	-	-	1	1	3	2
CO3	2	3	3	3	2	-	-	-	-	-	-	-	1	3	2
CO4	1	2	2	3	1	-	-	-	-	-	-	-	1	3	1
CO5	1	2	3	2	2	-	-	-	-	-	-	-	1	3	1

BT1405 **APPLIED THERMODYNAMICS FOR BIOTECHNOLOGISTS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students to learn about basic concepts of classical and statistical thermodynamics

UNIT I: THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS **9**

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications. **CO1**

UNIT II: SOLUTION THERMODYNAMICS **9**

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation. **CO2**

UNIT III: PHASE EQUILIBRIA **9**

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria. **CO3**

UNIT IV: CHEMICAL REACTION EQUILIBRIA **9**

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions. **CO4**

UNIT V: THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION **9**

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VI Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
3. Christiana D. Smolke, "The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.

REFERENCES:

1.Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Explain the theoretical concepts of thermodynamics and how it applies to energy conversion in technological applications and biological systems.
CO2	Demonstrate the capability to analyze the energy conversion performance in a variety of modern applications in biological systems.
CO3	Design and carry out bioprocess engineering experiments, and analyze and interpret fundamental data to do the design and operation of bioprocesses.
CO4	Describe the criteria when two phases coexist in equilibrium and the vapour liquid equilibrium calculations microbial growth and product formation.
CO5	Apply their knowledge in the field of biochemical engineering from the principles of thermodynamics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	2	1	1	-	-	-	-	-	-	1	1	-
CO2	2	2	-	3	1	1	-	-	-	-	-	-	1	-	-
CO3	2	2	-	3	1	1	-	-	-	-	-	-	1	2	-
CO4	2	2	-	1	1	2	-	-	-	-	-	-	1	2	-
CO5	2	2	-	3	1	3	-	-	-	-	-	-	-	1	2

BT1407 CHEMICAL ENGINEERING LAB

L	T	P	C
0	0	4	2

OBJECTIVES:

- To provide basic understanding of chemical engineering principles and operations
- To course will enable the students to apply the principles in other chemical engineering and biotechnology subjects offered in higher semesters

LIST OF EXPERIMENTS

1.Flow measurement - Orifice meter
2. Flow measurement - Venturimeter,
3. Flow measurement - Rotameter
4. Pressure drop in flow through pipes
5. Pressure drop in flow through packed column
6. Pressure drop in flow through fluidized beds
7. Characteristics of centrifuge pump
8. Filtration through plate and frame filter press
9. Filtration in leaf filter
10. Simple and steam distillation
11. Adsorption phenomenon
12. Drying characteristics

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	To have knowledge on the basic principles of chemical engineering.
CO2	To apply the skill of material balance and energy balance in unit operations and unit process of chemical engineering and biotechnology.
CO3	To analyze the principles of chemical engineering and its applications in chemical, mechanical and biological perspectives.
CO4	To understand and analyze the mass transfer process and apply its knowledge in an industrial perspective.
CO5	To understand the design and working principles of fluid moving machinery and transport phenomena

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	1	-	-	-	-	-	-	1	2	1
CO2	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO3	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO4	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1
CO5	2	2	2	2	1	1	-	-	-	-	-	-	1	2	1

BT1408	MOLECULAR BIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- Provide hands-on experience in performing basic molecular biology techniques.
- Introduce students to the theory behind in each technique and to describe common applications of each methodology in biological research. This will facilitate the students to take up specialized project in Molecular biology and will be a pre-requisite for research work

LIST OF EXPERIMENTS

1. Electrophoresis _-Agarose and Polyacrylamide Gel
2. Isolation of microbial DNA
3. Isolation of genomic DNA
4. Quantification of DNA (UV/ Vis) and analysis of purity
5. Restriction enzyme digestion& Ligation
6. Competent cells preparation & Transformation
8. Selection of recombinants – Antibiotic sensitivity assay
9. Plating of λ phage
10. Lambda phage lysis of liquid cultures

Requirements:
Equipment Needed for 30 Students

1. Electrophoresis Kit 1
2. PCR 1
3. Incubators 2
4. Light Microscopes 4
5. Incubator Shaker 1
6. Spectrophotometer 2
7. Laminar Flow Chamber 2
8. Glassware, Chemicals, Media as required

TOTAL PERIODS: 60

REFERENCES:

1. Sambrook, Joseph and David W. Russell " The Condensed Protocols: From Molecular Cloning: A Laboratory Manual" Cold Spring Harbor , 2006.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be aware of the hazardous chemicals and safety precautions in case of emergency.
CO2	Students will learn to isolate nucleic acids from biological samples.
CO3	Demonstrate knowledge and understanding of the principles underpinning important techniques in molecular biology.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	3	-	-	-	2	2	3	-	3	-	-	3	-	-
CO2	2	3	-	3	2	-	-	-	-	-	-	-	3	3	2
CO3	2	3	1	3	2	-	-	-	-	-	-	-	3	3	3

V SEMESTER

BT1501	MASS TRANSFER OPERATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To define the principles of adsorption, absorption, leaching and drying extraction, distillation crystallization operations.
- To begin the concept of membrane separation process and develop skills of the students in the area of mass transfer operations with emphasis on separation and purification of products.

UNIT I: DIFFUSION AND MASS TRANSFER **9**

Molecular diffusion in fluids and solids; Interphase Mass Transfer; Mass Transfer coefficients; Analogies in Transport Phenomenon. **CO1**

UNIT II: GAS LIQUID OPERATIONS **9**

Principles of gas absorption; Single and Multi component absorption; Absorption with Chemical Reaction; Design principles of absorbers; Industrial absorbers; HTU, NTU concepts. **CO2**

UNIT III: VAPOUR LIQUID OPERATIONS **9**

V-L Equilibria; Simple, Steam and Flash Distillation; Continuous distillation; McCABE-THIELE & PONCHON-SAVARIT Principles; Industrial distillation equipments, HETP, HTU and NTU concepts. **CO3**

UNIT IV: EXTRACTION OPERATIONS **9**

L-L equilibria, Staged and continuous extraction, Solid-liquid equilibria, Leaching Principles. **CO4**

UNIT V: SOLID FLUID OPERATIONS **9**

Adsorption equilibria – Batch and fixed bed adsorption-Drying-Mechanism-Drying curves- Time of Drying; Batch and continuous dryers. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Treybal R.E. Mass Transfer Operations.IIIrd edition. Mcgraw Hill, 1981.
2. Geankoplis C.J. Transport Processes and Unit Operations. IIIrd edition, Prentice Hall of India, 2002.

REFERENCES:

1.Coulson and Richardson's Chemical Engineering. Vol I & II, Asian Books Pvt Ltd, 1998.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Gas -liquid, vapour- liquid and solid- liquid and liquid–liquid equilibrium.
CO2	Classify and use the accurate engineering correlations of diffusion and mass transfer coefficients to model a separation process.
CO3	Investigate multi-stage equilibrium separation processes, simultaneous phase equilibrium and mass balances in continuous separation processes
CO4	Design and understand operating principles of extraction and leaching
CO5	Design and construction with operating principles of process economics of separating equipments (Dryers and Adsorbers)

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	-	-	-	-	-	-	-	2	2	2
CO2	2	2	3	2	1	-	-	-	-	-	-	-	2	2	3
CO3	3	2	3	2	-	-	-	-	-	-	-	-	2	3	3
CO4	2	2	3	2	1	1	-	-	-	-	-	-	3	3	3
CO5	3	2	2	3	1	-	-	-	-	-	-	-	3	3	3

BT1502 BIOPROCESS ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES: The course will enable the students

- To impart knowledge about bioreactor configuration and their application in processes.
- To understand the regime analysis of bioprocesses in reactor design.
- To learn about kinetics and applications of immobilised systems.
- To develop skills in modelling and simulation of bioprocessses.
- To understand the requirements of recombinant cell cultivation and bioreactor considerations.

UNIT - I CONFIGURATION OF BIOREACTORS

Ideal reactors and its characteristics, Fed batch cultivation, Cell recycle cultivation, Cell recycle cultivation in waste water treatment, two stage cultivation, Packed bed reactor, airlift reactor, introduction to fluidized bed reactor, bubble column reactors. **CO1**

UNIT - II BIOREACTOR SCALE – UP **9**

Regime analysis of bioreactor processes, oxygen mass transfer in bioreactors – microbial oxygen demands; methods for the determination of mass transfer coefficients; mass transfer correlations. Scale up criteria for bioreactors based on oxygen transfer, power consumption and impeller tip speed. **CO2**

UNIT - III BIOREACTOR CONSIDERATION IN ENZYME SYSTEMS **9**

Analysis of film and pore diffusion effects on kinetics of immobilized enzyme reactions; formulation of dimensionless groups and calculation of effectiveness factors. Design of immobilized enzyme reactors – packed bed, fluidized bed and membrane reactors **CO3**

UNIT - IV MODELLING AND SIMULATION OF BIOPROCESSES **9**

Study of structured models for analysis of various bioprocess – compartmental models, models of cellular energetics and metabolism, single cell models, plasmid replication and plasmid stability model. Dynamic simulation of batch, fed batch, steady and transient culture metabolism. **CO4**

UNIT V RECOMBINANT CELL CULTIVATION 9

Different host vector system for recombinant cell cultivation strategies and advantages. E.coli, yeast Pichiapastoris / Saccharomyces cereviseae, Animal cell cultivation, plant cell cultivation, Insect cell cultivation. High cell density cultivation, process strategies, reactor considerations in the above system **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering, Basic Concept, 2nd Edition Prentice Hall PTR, 2002.
2. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications
3. Harvey W. Blanch, Douglas S. Clark, Biochemical Engineering, Marcel Dekker, Inc

REFERENCES:

1. Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To select appropriate bioreactor configurations and operation modes based on the nature of bio products and other criteria.
CO2	To analyse the regime analysis and hydrodynamics of bioprocesses and apply the criteria in the design of bioreactors.
CO3	To apply and analyse diffusion effects and kinetics of immobilized enzyme systems and the design of immobilized enzyme reactors.
CO4	To develop skills in modelling and simulation of bioprocesses so as to reduce costs and to enhance the quality of products and systems.
CO5	To plan a research career or to work in the biotechnology industry with strong foundation about bioreactor processes and design considerations.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	1	1	1	1	2	2	2	2	2
CO2	2	2	2	1	2	2	1	1	2	2	2	2	2	2	3
CO3	2	2	2	2	2	1	2	1	1	2	2	1	2	3	3
CO4	2	2	2	3	3	2	2	2	2	2	2	2	2	3	3
CO5	1	1	2	3	2	2	2	2	2	2	2	2	2	3	3

BT1503	ANALYTICAL METHODS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To have a fundamental knowledge about the Light spectrum, Absorption, Fluorescence, NMR, Mass spectroscopy
- To acquire knowledge on the different chromatographic methods for separation of biological products.

UNIT I: INTRODUCTION TO SPECTROMETRY **9**

Properties of electromagnetic radiation- wave properties – components of optical instruments – Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Principle of Fourier Transform optical Measurements. **CO1**

UNIT II: MOLECULAR SPECTROSCOPY **9**

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence – Instrumentation – Applications – Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications. **CO2**

UNIT III: MAGNETIC RESONANCE SPECTROSCOPY AND MASS SPECTROMETRY **9**

Theory of NMR – environmental effects on NMR spectra – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources – Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation **CO3**

UNIT IV: SEPARATION METHODS **9**

General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography principles of GC and applications – HPLC- Capillary electrophoresis – Applications. **CO4**

UNIT V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY **9**

Electrochemical cells- Electrode potential cell potentials – Potentiometry- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – Voltammetry – Cyclic and pulse voltammetry- Applications of voltammetry . Study of surfaces – Scanning probe microscopes – AFM and STM. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis". 6th Edition, Cengage Learning , 2016.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". 7th Edition, CBS, 1986.
3. Braun, Robert D. "Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, 1985.

REFERENCES:

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis: Analytical Chemistry” Goel Publishing House, 1972.
2.Haven, Mary C., etal., “Laboratory Instrumentation “. 4th Edition, John Wiley, 1995.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Students would have a fundamental knowledge about the light spectrum and basics of measurement.
CO2	Students would have gained knowledge about the working principle of optical methods and working principle of spectroscopic techniques.
CO3	Students would have developed knowledge about the working principle of resonance and mass spectrometry.
CO4	At the end of the course the student would acquire knowledge on different types of chromatographic methods for separation of biological products
CO5	At the end of the course the student would acquire knowledge on different types of electroanalytical methods and electron microscopes.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	1	3	-	-	-	-	-	-	2	3	-	-
CO2	3	-	-	1	3	-	-	-	-	-	-	2	3	2	2
CO3	3	-	-	2	3	-	-	-	-	-	-	3	3	2	3
CO4	3	-	-	1	3	-	-	-	-	-	-	3	3	2	2
CO5	3	-	-	1	3	-	-	-	-	-	-	3	3	2	3

BT1504	**PROTEIN ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To make the students identify the importance of protein biomolecules.
- The course prepares the students to realize the structure-function relationships in proteins.

UNIT I: BONDS, ENERGIES, BUILDING BLOCKS OF PROTEINS **9**

Covalent, Ionic, Hydrogen, Coordinate, hydrophobic and Vander walls interactions in protein structure. Interaction with electromagnetic radiation (radio, X-ray) and elucidation of protein structure. Amino acids (the students should be thorough with three and single letter codes) and their molecular properties (size, solubility, charge, pKa), Chemical reactivity in relation to post-translational modification (involving amino, carboxyl, hydroxyl, thiol, imidazole groups). **CO1**

UNIT II: PROTEIN ARCHITECTURE **9**

Primary structure: peptide mapping, peptide sequencing - automated Edman method & mass spec. High-throughput protein sequencing setup Secondary structure: Alpha, beta and loop structures and methods to determine Super-secondary structure: Alpha-turn-alpha, beta-turn beta (hairpin), beta-sheets, alpha-beta-alpha, topology diagrams, up and down & TIM barrel structures nucleotide binding folds, prediction of substrate binding sites. **CO2**

UNIT III: TERTIARY STRUCTURE **9**

Tertiary structure: Domains, folding, denaturation and renaturation, overview of methods to determine 3D structures. Quaternary structure: Modular nature, formation of complexes. Computer exercise on the above aspects. **CO3**

UNIT IV: STRUCTURE-FUNCTION RELATIONSHIP **9**

DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp Repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Membrane proteins: General characteristics, Transmembrane segments, prediction, bacteriorhodopsin and Photosynthetic reaction center, Immunoglobulins: IgG Light chain and heavy chain architecture, abzymes and Enzymes: Serine proteases, understanding catalytic design by engineering trypsin, chymotrypsin and elastase, substrate-assisted catalysis other commercial applications. Computer exercise on the above aspects. **CO4**

UNIT V: PROTEOMICS **9**

Introduction to the concept of proteome, components of proteomics, proteomic analysis, importance of proteomics in biological functions, protein-protein interactions and methods to study it: protein arrays, cross linking methods, affinity methods, yeast hybrid systems and protein arrays. Computer exercise on the above aspects. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Branden C. and Tooze J., "Introduction to Protein Structured" 2nd Edition, Garland Publishing, 1999.
2. Creighton T.E. "Proteins" 2nd Edition. W.H. Freeman, 1993.
3. Pennington, S.R and M.J. Dunn, "Proteomics: Protein Sequence to Function". Viva Books, 2002.
4. Liebler, "Introduction to Proteomics" Humana Press, 2002.

REFERENCES:

1. Voet D. and Voet G., "Biochemistry". 3rd Edition. John Wiley and Sons, 2008.
2. Haggerty, Lauren M."Protein Structure: Protein Science and Engineering". Nova Science Publications, 2011. 3. Williamson, Mike "How Proteins Work". Garland Science, 2012.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will learn and understand about the basic of protein architecture in a protein molecule.
CO2	Students will educate about the structural fold and basic tools used to identify the protein sequence & structure.
CO3	Students will know how to identify the higher hierarchy of protein fold with the advanced tools & also to know the protein – protein interaction
CO4	Students will know about the basic structural & functional relationship to gain a knowledge on protein utilisation for modern applications.
CO5	Students will understand the various advancement and wide requirement of informatics tools towards the medical diagnostic purposes.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	1	-	3	-	-	2	-	-	-	-	1	2	3	2
CO2	-	1	-	2	-	-	-	-	-	-	-	-	2	3	2
CO3	1	2	-	3	1	2	-	-	-	-	-	-	1	3	-
CO4	1	-	-	1	2	-	-	-	-	-	-	1	3	2	1
CO5	-	3	2	-	-	1	2	-	-	-	-	1	2	3	1

BT1507 BIOPROCESS LABORATORY I

L	T	P	C
0	0	4	2

OBJECTIVES:

- To train the students on enzyme kinetics and parameters which influence enzyme activity.
- To train the students on enzyme immobilization and medium optimization methods.
- To train on methods to investigate the growth of microorganisms in different systems under different conditions.

LIST OF EXPERIMENTS

1.Enzyme kinetics – Determination of Michaelis - Menten parameters
2. Enzyme activity – Effect of Temperature and Deactivation Kinetics
3. Enzyme activity – Effect of pH
4. Enzyme inhibition kinetics
5. Enzyme immobilization – Gel entrapment method
6. Enzyme immobilization –Cross-linking method
7. Enzymatic conversion in Packed bed Column Reactor
8. Growth of Bacteria – Estimation of Biomass, Calculation of Specific Growth Rate and Yield Coefficient
9. Optimization of medium by Plackett Burman Design
10. Optimization by of medium Response Surface Methodology

Required Equipment:

1. Autoclave,
2. Hot Air Oven,
3. Incubators,
4. Light Microscopes,
5. Incubator Shaker,
6. Colorimeter,
7. Laminar Flow Chamber

TOTAL PERIODS: 60

REFERENCES:

1Bailey and Ollis, “ Biochemical Engineering Fundamentals”, McGraw Hill (2nd Ed.), 1986.
2. Shuler and Kargi, “ Bioprocess Engineering “, Prentice Hall, 1992.
3. Pauline Doran, Bioprocess Engineering Calculation, Blackwell Scientific Publications.
4. Peter F. Stanbury, Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology,
5. Science & Technology Books.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Explain about Enzyme kinetics and parameters involved in enzyme activities.
CO2	Understand and have thorough knowledge in methods adopted for enzyme immobilization
CO3	Evaluate the growth kinetics of microorganisms and become adept with medium optimization techniques
CO4	Understand about the fundamentals involved in operation a reactor system
CO5	Evaluate the value of inhibition kinetics and their effect on enzyme activities

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	-	1	-	-	-	-	-	-	-	2	2	3
CO2	1	2	3	-	3	-	-	-	-	-	-	-	1	2	3
CO3	1	2	2	1	1	-	-	-	-	-	-	-	2	2	3
CO4	3	1	2	2	1	-	-	-	-	-	-	-	3	2	2
CO5	2	1	3	1	2	-	-	-	-	-	-	-	1	2	3

BT1508 **ANALYTICAL METHODS AND INSTRUMENTATION LAB**

L	T	P	C
0	**0**	**4**	**2**

OBJECTIVES:
To train the students

- To have a practical hands on experience on Absoprtion Spectroscopic methods
- To acquire experience in the purification by performing chromatography
- To validate and analysis using spectrometric and microscopic techniques

LIST OF EXPERIMENTS
1. Precision and validity in an experiment using absorption spectroscopy .
2. Validating Lambert-Beer's law using $KMnO_4$
3. Finding the molar absorbtivity and stoichiometry of the Fe (1,10 phenanthroline)3 using absorption spectrometry.
4. Finding the pKa of 4-nitrophenol using absorption spectroscopy.
5. UV spectra of nucleic acids.

6. Chemical actinometry using potassium ferrioxolate.
7. Estimation of SO_4^{2--} by nephelometry.
8. Estimation of Al^{3+} by Flourimetry.
9. Limits of detection using aluminium alizarin complex.
10. Chromatography analysis using TLC.
11. Chromatography analysis using column chromatography.

Requirements:
Equipment Needed for 20 Students

1. Colorimeter 2,
2. Glassware,
3. Chemicals as required

TOTAL PERIODS: 60

REFERENCES:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”. 6th Edition, Cengage Learning , 2016.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. 7th Edition, CBS, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, 5th Edition, McGraw-Hill, 1985.

COURSE OUTCOMES

Upon completion of the course, the students

CO1	Would have a fundamental knowledge on the principles and types of bioanalytical instruments.
CO2	Would have gained knowledge about the use of the instrumental methods (spectroscopy) in biological sample analysis.
CO3	Would have developed knowledge about the chromatographic method principle and resolving a compound using it.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	1	3	-	-	2	-	-	-	-	3	3	2
CO2	3	-	-	1	3	-	-	2	-	-	-	-	3	3	3
CO3	3	-	-	1	3	-	-	2	-	-	-	-	3	3	3

VI SEMESTER

BT1601	COMPUTATIONAL BIOLOGY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To improve the programming skills of the student
- To let the students know the recent evolution in biological science

UNIT I: INTRODUCTION **9+6**

Introduction to Operating systems, Linux commands, File transfer protocols ftp and telnet, Introduction to Bioinformatics and Computational Biology, Biological sequences, Biological databases, Genome specific databases, Data file formats, Data life cycle, Database management system models, Basics of Structured Query Language (SQL). **CO1**

UNIT II: SEQUENCE ALIGNMENT **9+6**

Sequence Analysis, Pair wise alignment, Dynamic programming algorithms for computing edit distance, string similarity, shotgun DNA sequencing, end space free alignment. Multiple sequence alignment, Algorithms for Multiple sequence alignment, Generating motifs and profiles, Local and Global alignment, Needleman and Wunsch algorithm, Smith Waterman algorithm, BLAST, PSIBLAST and PHIBLAST algorithms. **CO2**

UNIT III: PHYLOGENETIC METHODS **9+6**

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping. Structural genomics. Applications of informatics techniques in genomics and proteomics: Assembling the genome, STS content mapping for clone contigs and other mapping techniques. **CO3**

UNIT IV: PROTEIN STRUCTURE ANALYSIS **9+6**

Protein Secondary structure and tertiary structure prediction methods, Homology modeling, ab initio approaches, Threading, Critical Assessment of Structure Prediction. Machine learning techniques: Artificial Neural Networks in protein secondary structure prediction, Hidden Markov Models for gene finding, Decision trees, Support Vector Machines. Introduction to Systems Biology and Synthetic Biology, Microarray analysis, DNA computing, Bioinformatics approaches for drug discovery. Functional annotation, Peptide mass fingerprinting. **CO4**

UNIT V: PERL PROGRAMMING **9+6**

Basics of PERL programming for Bioinformatics: Data types: scalars and collections, operators, Program control flow constructs, Library Functions: String specific functions, User defined functions, File handling. **CO5**

TOTAL PERIODS: 45+30 = 75

TEXT BOOKS:

1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by R.Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring HarborLaboratory Press.

5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media

REFERENCES:

1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Understand the fundamentals of operating systems, biological sequences and sequence databases.
CO2	Gain knowledge about the sequence alignment programs and its importance in Bioinformatics.
CO3	Understand about phylogenetic trees and mapping techniques.
CO4	Understand the principle behind molecular modelling and drug designing related advanced techniques.
CO5	Gain knowledge in programming language and to develop bioinformatics related tools with programming skills.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	2	2	3	2	2	2	2	2	1	1	2
CO2	3	3	3	2	2	2	2	1	2	2	2	3	2	2	2
CO3	3	2	3	2	3	2	2	1	2	2	2	3	3	3	3
CO4	2	2	3	3	3	2	2	2	1	2	3	3	2	3	3
CO5	2	2	2	2	2	2	1	1	2	2	3	3	2	2	3

BT1602	APPLIED CHEMICAL REACTION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

UNIT I: SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING **9**

Broad outline of chemical reactors, rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors. **CO1**

UNIT II:	**IDEAL REACTORS**		**9**
Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.		**CO2**	
UNIT III:	**GAS-SOLID, GAS-LIQUID REACTIONS**		**9**
RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.		**CO3**	
UNIT IV:	**GAS-SOLID, GAS-LIQUID REACTIONS**		**9**
Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.		**CO4**	
UNIT V:	**FIXED BED AND FLUID BED REACTORS**		**9**
G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.		**CO5**	

TOTAL PERIODS: 45

TEXT BOOKS:

1. Levenspiel O. Chemical Reaction Engineering. IIIrd Edition. John Wiley.2006.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002.

REFERENCES:

1. Missen R.W., Mims C.A., Saville B.A. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley.1999
2. Dawande, S.D., "Principles of Reaction Engineering", Ist Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., "Coulson Richardson - Chemical Engineering",Vol.III, IIIrd Edition, Butterworth- Heinemann- Elsevier, 2006.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Calculating the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.
CO2	Designing reactors for heterogeneous reactions and optimizing operating conditions.
CO3	Demonstrating experimental data using standard statistical methods to establish quantitative results.
CO4	Understanding fluid – solid reactions and the resistances encountered during reactions.
CO5	Designing a reactor for bio based products to achieve production and yield specifications.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	-	-	-	-	-	-	-	1	2	2
CO2	1	2	3	3	1	1	-	-	-	-	-	-	1	2	3
CO3	1	2	3	3	1	1	-	-	-	-	-	-	1	2	3
CO4	2	2	2	3	1	1	-	-	-	-	-	-	1	2	3
CO5	2	2	3	3	1	1	-	-	-	-	-	-	1	2	3

BT1603	GENETIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the gene cloning methods, tools and techniques involved in gene cloning, genome analysis and genomics.
- To explain the heterologous expression of cloned genes in different hosts.

UNIT I: BASICS OF RECOMBINANT DNA TECHNOLOGY — 9

Manipulation of DNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods. **CO1**

UNIT II: DNA LIBRARIES — 9

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs,Chromosomal walking and jumping, Screening of DNA libraries using nucleic acid probes and antisera. **CO2**

UNIT III: SEQUENCING AND AMPLIFICATION OF DNA — 9

Maxam Gilbert's and Sanger's methods of DNA sequencing. PCR & Variants of PCR: Inverse PCR, Nested PCR, AFLP PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis. **CO3**

UNIT IV: ORGANIZATION AND STRUCTURE OF GENOMES — 9

Organization and structure of genomes, Genome sequencing methods, Conventional and shotgun genome sequencing methods, Next generation sequencing technologies , Ordering the genome sequence, Genetic maps and Physical maps, STS content based mapping, Restriction Enzyme Finger Printing, Hybridization mapping, Radiation Hybrid Maps, Optical mapping. ORF finding and functional annotation. **CO4**

UNIT V: CURRENT STATUS OF GENOME SEQUENCING PROJECTS 9

Current status of genome sequencing projects, Introduction to Functional genomics, Microarrays,Serial Analysis of Gene expression (SAGE), Subtractive hybridization, DIGE, TOGA, Yeast Twohybrid System, Comparative Genomics, Proteogenomics, Web resources for Genomics,Applications of genome analysis and genomics. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Old RW, Primrose SB, "Principles Of Gene Manipulation, An Introduction To GeneticEngineering ", Blackwell Science Publications, 1993.
2. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed.(Blackwell Publishing)

REFERENCES:

1. Ansubel FM, Brent R, Kingston RE, Moore DD, "Current Protocols In Molecular Biology"Greene Publishing Associates, NY, 1988.
2.Berger SI, Kimmer AR, "Methods In Enzymology", Vol 152, Academic Press

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Cloning aspects and enzymes involved in creating rDNA for producing commercially important genes.
CO2	Knowledge about library creation and current techniques used for screening of libraries
CO3	Knowledge about recent PCR techniques used in amplification of DNA
CO4	Awareness of current techniques used in gene and genome sequencing.
CO5	Awareness about microarrays, Analysis of Gene expression and proteomics.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	3	-	2	-	1	1	-	-	-	-	3	2	1
CO2	1	-	2	-	3	-	-	-	-	-	-	-	2	2	3
CO3	3	1	2	1	3	-	-	-	-	-	-	-	1	3	2
CO4	2	2	2	1	3	-	-	-	-	-	-	-	2	3	3
CO5	2	2	2	1	3	-	-	-	-	-	-	-	2	2	3

BT1607 **BIOPROCESS LABORATORY II**

L	T	P	C
0	0	4	2

OBJECTIVES:

- The course applies earlier learned knowledge on bioreactors and sterilization kinetics.
- Skills and knowledge gained is useful by analogy when solving problems typical for the bioindustry or for research

LIST OF EXPERIMENTS:

1. Estimation of Mixing Time in reactor
2. Residence time distribution
3. Estimation of K_La – Power Correlation Method
4. Estimation of K_La – Sulphite Oxidation Method
5. Estimation of K_La – Dynamic Gassing-out method,
6. Estimation of Overall Heat Transfer Coefficient
7. Batch Sterilization kinetics
8. Batch cultivation with exhaust gas analysis.
9. Fed batch cultivation and Total cell retention cultivation
10. Photo bioreactor

TOTAL PERIODS: 60

EQUIPMENT NEEDED FOR 30 STUDENTS

1. Reactors 6
2. Incubators 1
3. Incubator Shaker 1
4. Spectrophotometer 1
5. Laminar Flow Chamber 1
6. Glassware, Chemicals, Media as required

REFERENCES:

1. Anton Moser, "Bioprocess Technology, Kinetics and Reactors", , Springer Verlag.
2. James E. Bailey & David F. Ollis, Biochemical Engineering Fundamentals, McGraw Hill.
3. James M. Lee, Biochemical Engineering, PHI, USA.
4. Atkinson, Handbook of Bioreactors,
5. Harvey W. Blanch, Douglas S. Clark, BiochemicalEngineering, Marcel Decker Inc.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand and design the different modes of bioreactor

CO2 To estimate the heat transfer and oxygen transfer coefficient

CO3 To estimate the residence time and the mixing time in the bioreactor

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	2	1	2	1	2	-	-	-	-	-	3	2
CO2	-	-	2	2	2	1	1	2	-	-	-	-	-	3	2
CO3	-	-	2	1	1	3	2	2	-	-	-	-	-	3	2

BT1608 **GENETIC ENGINEERING LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- Provide hands-on experience in performing basic recombinant DNA techniques.
- Introduce students to the theory behind in each techniques and to describe common applications of each methodology in biological research.

LIST OF EXPERIMENTS

1.Preparation of plasmid DNA
2. Elution of DNA from agarose gels
3. Restriction digestion
4. Ligation of DNA into expression vectors
5. Transformation & Selection of recombinants – Blue white screening assay
6. Optimisation of time of inducer for recombinant protein expression
7. Expression of protein profiling by SDS - PAGE
8. Blotting Techniques : Western and Southern blotting methods
9. PCR - Amplification of genes
10. Colony lysate PCR.

Required Equipments:

1. Electrophoresis Unit, Glassware , PCR, Laminar Flow Chamber, Incubators and Incubator Shaker, Gel Documentation, Spectrophotometer, Cooling Centrifuge and Gel Rocker

TOTAL PERIODS: 60

REFERENCES:

1.Sambrook, J. and Russsel, D.W., “Molecular cloning – A laboratory manual”, Third edition, Cold Spring Harbor Laboratory Press, Cold Spring harbor, New York, USA, 2001.
2. Old RW, Primrose SB, “Principles Of Gene Manipulation, An Introduction To Genetic Engineering “, Blackwell Science Publications, 1993.
3. Ansubel FM, Brent R, Kingston RE, Moore DD, “Current Protocols In Molecular Biology “, Greene Publishing Associates, NY, 1988.
4. Berger SI, Kimmer AR, “Methods In Enzymology”, Vol 152, Academic Press, 1987

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	Describe the main principles, methods for preparation and cloning of DNA in various organisms.
CO2	Express clearly about the gene amplification and methods for analysis of DNA, such as hybridization,restriction analysis and gene expressions.
CO3	Use genetic and biotechnological techniques to manipulate genetic materials and develops new and improved living organisms.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	2	3	1	1	1	-	-	-	-	2	2	3
CO2	2	1	2	2	3	-	-	-	-	-	-	-	2	3	3
CO3	2	1	2	2	3	1	1	1	-	-	-	-	3	2	3

BVA001 **ADVANCEMENTS IN DRUG DESIGNING**

L	T	P	C
1	0	2	2

OBJECTIVES:

- To understand the basics of drug designing
- To understand genetic makeup of the individual to have better approach on health care
- To characterize a drug for its pharmacokinetics and metabolism
- To understand advanced drug designing techniques
- To understand the methods to immunize test animals and to raise anti-sera

UNIT I: FUNDAMENTALS OF DRUG DESIGNING **3+6**

Introduction to bioinformatics and understanding of biological databases; Introduction to pharmacogenomics and their applications in drug discovery research **CO1**

UNIT II: PERSONALIZED MEDICINES **3+6**

Omics and personalized medicine; Pharmacist role and their new challenges in personalized medicine; Ethical, legal, economical and social issues in pharmacogenomics **CO2**

UNIT III: PHARMACEUTICAL ANALYSIS AND MODELLING **3+6**

Protein modelling; Protein databank; Alignment of protein sequences; Mutational analysis using multiple sequence alignment; Gene expression using genome scan and gene mark **CO3**

UNIT IV: ADVANCED DRUG DESIGNING TECHNIQUES **3+6**

Secondary structure prediction – hydropathic index; Active site prediction – activity pockets; Ligand modelling – pharmacophore redesigning; Denova designing; Virtual screening – drug likeness and toxicology **CO4**

UNIT V: TARGETED DELIVERY AND CANCER TREATMENT **3+6**

Lecture on raising and harvesting monoclonal antibodies; biomarkers screening for cancer – targeted delivery and bioimaging; commercial products and research application in cancer therapy **CO5**

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand the basics of drug designing.

CO2 Understand the importance of personalized medicine and its futuristic applications.

CO3 Characterize a drug for its pharmacokinetics and metabolism.

CO4 Understand the mechanism behind drug designing using online tools.

CO5 Understand the product development and bioimaging for targeted delivery.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	3	2	2	2	1	2	2	2	2	3	3
CO2	2	2	2	3	3	2	1	2	2	2	2	2	2	2	3
CO3	3	3	3	3	3	1	2	1	2	2	2	1	2	2	3
CO4	3	3	3	3	3	2	2	1	2	2	3	2	2	3	3
CO5	3	3	3	2	3	2	2	2	2	2	3	3	3	3	3

VII SEMESTER

BT1701 TOTAL QUALITY MANAGEMENT FOR BIOTECHNOLOGISTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.
- To apply the tools and techniques in bioproduct industry for product quality improvement
- To familiarize with the concepts of quality management system and Biosafety levels

UNIT I: INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention. **CO1**

UNIT II: TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. **CO2**

UNIT III: TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including Bioproduct industries - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. **CO3**

UNIT IV: TQM TOOLS AND TECHNIQUES II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures **CO4**

UNIT V: QUALITY MANAGEMENT SYSTEM **9**

Introduction—to ISO 9000 Series of Standards—Benefits of ISO Registration- Internal audits Sector Specific Standards—Requirements and benefits -ISO 22000- Food safety Management - HACCP and Elements of Biosafety Levels **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8 th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. https://www.researchgate.net/publication/339711956
5. ISO9001-2015 standards - https://www.iso.org/standards.html

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To understand the basic concepts of total quality management principles and importance of customer
CO2	To comprehend the knowledge on principles and philosophies of quality management
CO3	To realize the importance in applying the tools and techniques in bioproduct industries
CO4	To apply the tools and techniques of quality management to manufacturing and services processes.
CO5	To understand the importance of ISO and safety level regulations in Bioproduct industries

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	1	1	2	1	2	2	1	2	2	1	-	1
CO2	-	-	-	-	2	2	1	2	3	2	2	2	-	1	3
CO3	1	2	2	1	3	1	-	1	2	1	3	1	-	-	2
CO4	1	2	3	2	2	-	-	1	-	-	1	1	1	1	1
CO5	-	1	-	-	2	2	1	1	1	1	1	2	-	-	1

BT1702 DOWNSTREAM PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the students to understand the methods to obtain pure proteins, enzymes and bioproducts in general.
- Have depth knowledge on downstream processes required in multi-factorial manufacturing environment in a structured and logical fashion.

UNIT I: INTRODUCTION **9**

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pretreatment and stabilisation of bioproducts. **CO1**

UNIT II: PHYSICAL METHODS OF SEPARATION **9**

Unit operations for solid-liquid separation: Filtration - types of filtration, constant rate and constant pressure filtration, filtration equipments. Centrifugation – types of centrifugation, centrifugation equipment, scale-up of centrifuges. **CO2**

UNIT III: ISOLATION OF PRODUCTS **9**

Precipitation of proteins,adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation operations for product isolation. **CO3**

UNIT IV: PRODUCT PURIFICATION **9**

Chromatography – principles, instruments and practice. Adsorption, reverse phase, ion exchange, size exclusion, hydrophobic interaction, and affinity chromatographic techniques. **CO4**

UNIT V: PRODUCT POLISHING AND FORMULATION **9**

Drying, lyophilization and Crystallization in final product formulation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Belter, P.A., E.L. Cussler and Wei-Houhu "Bioseparations – Downstream Processing for Biotechnology", John Wiley, 1988.
2. Sivasankar, B. "Bioseparations: Principles and Techniques". PHI, 2005.
3. Asenjo, Juan A. "Separation Processes in Biotechnology". CRC / Taylor & Francis, 1990.

REFERENCES:

1. Ghosh, Raja "Principles of Bioseparations Engineering". World Scientific, 2006
2. "Product Recovery in Bioprocess Technology". (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The product recovery, unit operations involved and factors affecting bioseparation of bioproducts and recombinant products.
CO2	Selection and design of filtration and centrifugation operation for bioseparation.
CO3	To identify a suitable unit operation for isolation and concentration for the given bioproduct.
CO4	To select a suitable chromatographic operation for purification of given bioproducts.
CO5	Design of various bioproducts polishing methods and purification of various bioproducts/recombinant products.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	3	2	2	3	1	-	1	-	2	-	1	1	-
CO2	1	1	2	1	2	3	1	-	-	-	2	-	-	2	-
CO3	3	1	2	1	1	1	1	-	-	-	1	-	3	-	-
CO4	1	3	3	3	3	1	1	-	-	-	1	-	-	-	2
CO5	1	3	2	1	1	1	1	-	-	-	1	3	1	-	3

BT1703	IMMUNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the structure, functions and integration of immune system.
- To explain the antigen-antibody interactions and how the immune system is protecting the body from foreign pathogens/germs.
- To explain various techniques of monoclonal and engineered antibodies (important therapeutic molecules) production, for treating most of the human diseases.

UNIT I: INTRODUCTION TO IMMUNE SYSTEM **9**

Organisation and classification of immune system – immune cells and organs; innate and acquired immunity; classification of antigens – chemical and molecular nature; haptens, adjuvants; antigen presenting cells **CO1**

UNIT II: HUMORAL AND CELLULAR IMMUNITY **9**

Development, maturation, activation, regulation, differentiation and classification of T-cells and B-cells, antigen processing and presentation, theory of clonal selection, TCR; antibodies: structure and functions; antibodies: genes and generation of diversity; antigen-antibody reactions **CO2**

UNIT III: IMMUNITY AGAINST PATHOGENS AND TUMORS **9**

Inflammation; protective immune responses to virus, bacteria, fungi and parasites; cytokines; complement pathway, tumor antigens, tumor immune response, tumor diagnosis, tumor immunotherapy **CO3**

UNIT IV: IMMUNE TOLERANCE AND HYPERSENSITIVITY **9**

Immune tolerance, Immunodeficiencies; Major Histocompatibility Complex; Transplantation – genetics of transplantation; laws of transplantation; Allergy and hypersensitivity – Types of hypersensitivity, Autoimmunity, Autoimmune disorders and diagnosis **CO4**

UNIT V: APPLIED IMMUNOLOGY **9**

Monoclonal antibodies, engineering of antibodies; Classification of Vaccines-Active and Passive immunization, protein based vaccine, DNA vaccine, edible vaccine, immunodiagnostic methods (Immuno diffusion, ELISA, FACS, Cr5I release assay) **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Peter J Delves, Seamus J Martin, Dennis R Burtn and Ivan M Roitt., Roitts Essentia lImmunology, 13th Edition, Wiley –Blackwell, 2016.
2. Judith a Owen, Jenni Punt and Sharon A Stranford, Kuby Immunology, Macmillan Internation, 7th Edition, 2012
3. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 2006

REFERENCE:

1. Coico, Richard “Immunology: A Short Course” VIth Edition. John Wiley, 2008.
2. Khan, Fahim Halim “Elements of Immunology” Pearson Education, 2009.

COURSE OUTCOMES

Upon completion of the course,

CO1	Students would have a fundamental knowledge about the various organs involved in immune response and the types of antigen invading the immune system.
CO2	Students would have developed knowledge about development, maturation, activation and regulation of T cells, B cells and also about the application of antigen-antibody reaction.
CO3	Students would have gained knowledge about the mechanism by which the body interacts with pathogenic microorganisms and in tumor immunology.
CO4	After completing this course, students get familiar about the laws of transplantation, autoimmunity, allergy and have gained the knowledge in immunodeficiency disorders
CO5	At the end of the course the student would acquire knowledge on various techniques of monoclonal, engineered antibodies, immunodiagnostic method and have gained the knowledge about the basic criteria for designing a vaccine

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	1	2	-	-	-	1	-	-	-	-	-	-	1	1	-
CO3	-	-	-	2	1	2	-	-	-	-	-	-	1	2	3
CO4	-	-	-	2	2	2	-	-	-	-	-	-	1	2	2
CO5	-	-	2	2	2	1	-	-	-	-	-	-	1	1	2

BT1707	DOWNSTREAM PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To provide hands on training in downstream processing through simple experimentations in the laboratory. This will be a pre-requisite for project work.
  The objectives of this course is to practice the students
- To understand various methods for end product isolation, concentration, purification and stabilization.
- To design processes for the recovery and subsequent purification of target biological products.

LIST OF EXPERIMENTS:

1. Solid liquid separation – centrifugation
2. Solid liquid separation - microfiltration
3. Cell disruption techniques –ultrasonication
4. Cell disruption techniques –French press or Dynomill
5. Precipitation – ammonium sulphite precipitation
6. Aqueous two phase extraction of biological product
7. Adsorption of protein
8. High resolution purification – affinity chromatography
9. High resolution purification – ion exchange chromatography
10. Product polishing – spray drying or freeze drying

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR 30 STUDENTS

1. Centrifuge 1
2. Microfiltration set up 1
3. Sonicator 1
4. French press or Dynomill 1
5. Spray dryer or Freeze dryer 1
6. Chromatography kits and other class wares and chemicals.

REFERENCES:

1. P.A. Belter, E.L. Cussler And Wei-Houhu – Bioseparations – Downstream Processing For Biotechnology, Wiley Interscience Pun. (1988).
2. R.O. Jenkins, (Ed.) – Product Recovery In Bioprocess Technology – Biotechnology ByOpen Learning Series, Butterworth-Heinemann (1992).
3. J.C. Janson And L. Ryden, (Ed.) – Protein Purification – Principles, High ResolutionMethods And Applications, VCH Pub. 1989.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The separation of whole cells and other insoluble ingredients from the culture broth.
CO2	Cell disruption techniques to release intracellular products
CO3	Various techniques like evaporation, extraction, precipitation, membrane separation for concentrating biological products
CO4	Basic principles and techniques of chromatography to purify the biological products
CO5	The methods of formulation of biological products for end uses

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	2	-	-	-	-	-	-	-	-	-	3	2
CO2	-	-	2	2	-	-	-	-	-	-	-	-	-	3	2
CO3	-	-	2	3	-	-	-	-	-	-	-	-	-	3	2
CO4	-	-	1	2	2	-	-	-	-	-	-	-	-	3	2
CO5	-	-	1	2	2	-	1	-	-	-	-	-	-	3	2

BT1708 **IMMUNOLOGY LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

- To give practical training in the functioning of immune system.
- To give laboratory training in different immunological and immunotechnological techniques.

EXPERIMENTS

1. Identification of immune cells in a blood smear
2. Identification of blood group
3. Testing for typhoid antigens by Widal test
4. Immunodiffusion – Ouchterlony Double Diffusion
5. Immunoelectrophoresis – Rocket or Counter Current immune electrophoresis
6. Enzyme Linked ImmunoSorbent Assay (ELISA)
7. Isolation of peripheral blood mononuclear cells
8. Isolation of monocytes from blood
9. Immunofluorescence
10. Identification of t cells by T-cell rossetting using sheep RBC.

TOTAL PERIODS: 60

Equipment Needed for 20 Students

1. Elisa reader -1
2. Microscopes -8
3. Microwave owen-1
4. Hot plate -4
5. Vortex mixer -4
6. Table top refrigerated Centrifuge- 1
7. Fluorescent microsope- 1

REFERENCE:

1. Roitt I, Male, Brostoff. Immunology, Mosby Publ., 2002.
2. Kuby J, Immunology, WH Freeman & Co., 2000.
3. Ashim K. Chakravarthy, Immunology, TataMcGraw-Hill, 1998.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Handle different types of animals and to immunize the animals and raise antisera.

CO2 Identify the blood grouping, cells and to isolate the mononuclear cells.

CO3 Identify the Typhoid antigen

CO4 Determine the antigen and antibody concentration.

CO5 Identify and analyse the antigen.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	3	-	2	2	-	3	1	-	-	1	-	-	-
CO2	1	-	3	-	2	2	-	3	1	-	-	1	-	-	-
CO3	-	-	1	1	2	-	-	1	-	-	-	1	-	-	-
CO4	1	-	1	2	3	-	-	1	-	-	-	1	-	-	-
CO5	1	-	1	2	3	-	-	1	-	-	-	1	-	-	-

SEMESTER VIII

BT1807 **PROJECT WORK**

L	T	P	C
0	0	20	10

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Identify their field of interest

CO2 Search and think about logical solutions

CO3 Formulate and analyze a problem

CO4 Plan experiments to find solutions in a logical manner

CO5 Analyze the results, interpret and communicate in an effective manner

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	2	-	2	1	2	-	2	1	1	-
CO2	2	2	2	1	1	2	-	2	2	2	-	2	1	3	1
CO3	2	2	1	1	1	1	1	2	2	2	1	2	1	3	2
CO4	2	1	2	2	2	1	2	3	3	2	2	3	1	3	2
CO5	3	2	3	3	2	2	2	3	3	3	2	3	1	2	2

PROFESSIONAL ELECTIVE - I

BT1001	BIOPHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To gain structural knowledge of biological systems.
- To understand transport and dynamic properties of biological systems.

UNIT I: MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS **9**

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures –general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes. **CO1**

UNIT II: CONFORMATION OF NUCLEIC ACIDS **9**

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids – hydration of nucleic acids. **CO2**

UNIT III: CONFORMATION OF PROTEINS **9**

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index. **CO3**

UNIT IV: CELLULAR PERMEABILITY AND ION – TRANSPORT **9**

Ionic conductivity – transport across ion channels – mechanism - ion pumps- proton transfer – nerve conduction – techniques of studying ion transport and models. **CO4**

UNIT V: ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS **9**

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Biophysics ; R. Glaser, Springer Verlag , 2000.
2. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCES:

1. Cantror, Charles R. and Paul R. Schimmel "Biophysical Chemistry" . 1-3 Vols. W.H.Freeman& Co.,1980

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand the forces in biomolecules.

CO2 Understand configurational determinants and stabilizing factors of nucleic acids.

CO3 Understand configurational determinants and stabilizing factors of proteins.

CO4 Gain the knowledge of cellular permeability and ion transport.

CO5 Understand the energetics and dynamics of biological systems.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**											**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	1	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	-	1	-	-	-	-	-	-	-	2	3	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	2	3	-	-
CO4	3	2	1	2	-	-	-	-	-	-	-	3	3	-	1
CO5	3	2	1	2	-	-	-	-	-	-	-	3	3	-	2

BT1002	**PRINCIPLES OF FOOD PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

To enable the students

- To know about the constituents and additives present in the food.
- To gain knowledge about the microorganisms, which spoil food and food borne diseases.
- To know different techniques used for the preservation of foods.

UNIT I: FOOD AND ENERGY 9

Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietarysources, role and functional properties in food, contribution to organoleptic and textural characteristics.

UNIT II: FOOD ADDITIVES 9

Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.

UNIT III: MICROORGANISMS ASSOCIATED WITH FOOD 9

Bacteria, yeasts and molds – sources, types and species of importance in food processing and preservation; fermented foods and food chemicals, single cell protein.

UNIT IV: FOOD BORNE DISEASES 9

Classification – food infections – bacterial and other types; food intoxications and poisonings –bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products

UNIT V: FOOD PRESERVATION 9

Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods.

TOTAL PERIODS: 45

REFERENCE:

1. T.P. Coultate – Food – The Chemistry Of Its Components, 2nd Edn. Royal Society,London,1992.
2. B. Sivasanker – Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. NewDelhi 2002.
3. W.C. Frazier And D.C. Westhoff – Food Microbiology, 4th Ed., Mcgraw-Hill Book Co., NewYork 1988.
4. J.M. Jay – Modern Food Microbiology, Cbs Pub. New Delhi, 1987.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Know different constituents present in food and microorganisms involved in processing of food.
CO2	Understand Roles and regulatory levels of food additives during food processing.
CO3	Gain knowledge on principles and different preservations techniques of food can also be known.
CO4	Know about diseases associated with the toxic effects of spoiled food.
CO5	Know the importance of Unit operations in modern food processing and impact of the process on food quality

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	-	3	-	1	1	-	-	-	-	-	2	2	2
CO2	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO3	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO4	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3
CO5	1	1	-	3	-	2	2	-	-	-	-	-	2	2	3

CE1025	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I: INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‘ts during various types of Disasters. **CO1**

UNIT II:	**APPROACHES TO DISASTER RISK REDUCTION (DRR)**		**9**
	Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.	**CO2**	
UNIT III:	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**		**9**
	Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.	**CO3**	
UNIT IV:	**DISASTER RISK MANAGEMENT IN INDIA**		**9**
	Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.	**CO4**	
UNIT V:	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**		**9**
	Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.	**CO5**	

TOTAL PERIODS: 45

TEXT BOOKS:

1. Singhal J.P. Disaster Management, Laxmi Publications, 2010.
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012.
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Differentiate the types of disasters, causes and their impact on environment and society
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation
CO3	Enhance awareness of institutional processes in the country
CO4	Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

CO5	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	-	2	2	1	3	-	1	2	-	1	3
CO2	3	2	-	-	-	2	2	1	2	-	2	1	-	1	3
CO3	3	2	-	-	-	1	2	1	2	-	1	2	-	2	2
CO4	3	2	-	-	-	1	1	1	1	-	1	3	-	1	2
CO5	3	2	-	-	-	1	2	1	3	-	1	3	-	1	2

BT1004	**MARINE BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I: INTRODUCTION TO MARINE ENVIRONMENT **9**

World oceans and seas – ocean currents – physical and chemical properties of sea water –abiotic and biotic factors of the sea – ecological divisons of the sea – history of marine biology – bioecochemical cycles – food chain and food web. **CO1**

UNIT II: IMPORTANT MARINE ORGANISMS **9**

Phytoplanktons – zooplantons – nektons – benthos – marine mammals – marine algae – mangroves – coral reefs – deep sea animals and adaptation – intertidal zone – fauna and flora. **CO2**

UNIT III: MARINE ENVIRONMENTAL BIOTECHNOLOGY **9**

Marine pollution – biology indicators (marine micro , algae) – biodegradation and bioremediation – marine fouling and corrosion. **CO3**

UNIT IV: MARINE PHARMACOLOGY **9**

Medicinal compound from marine flora and fauna – marine toxins , antiviral and antimicrobial agents. **CO4**

UNIT V: AQUACULTURE TECHNOLOGY **9**

Important of coastal aquaculture – marine fishery resources – common fishing crafts and gears – aquafarm design and construction **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:
1. Recent advances in marine biotechnology volume 3 – M.Fingerman , R . Nagabhushanam Mary – Frances Thomson.
2. Recent advances marine biotechnology volume 2 – M.Fingerman , R .Nagabhushanam Mary – Frances Thomson

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to study the interrelationship between marine organism and its environment
CO2	Students will be able to classify various marine organisms and their adaptations
CO3	Students will acquire knowledge about combating environmental issues using marine organisms as indicators
CO4	Students will be able to formulate medicinal components derived from marine organisms
CO5	Students will gain knowledge about design and construction of aquaculture and usage of its technology

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	-	-	2	-	-	-	-	1	1	-	-
CO2	1	1	-	1	2	1	1	-	-	-	-	-	-	-	-
CO3	2	2	2	2	2	1	3	1	1	-	-	1	2	3	2
CO4	1	1	2	1	2	1	1	2	1	-	-	1	2	2	2
CO5	1	1	1	1	2	1	1	1	1	-	1	1	-	-	1

PROFESSIONAL ELECTIVE –II

BT1005 **ANIMAL BIOTECHNOLOGY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the fundamentals of animal cell culture, details of the diseases and therapy
- To offer the knowledge about the micromanipulation and transgenic animals

UNIT I: ANIMAL CELL CULTURE **9**

Introduction to basic tissue culture techniques; chemically defined and serum free media; animal cell cultures, their maintenance and preservation; various types of cultures suspension cultures, continuous flow cultures, immobilized cultures; somatic cell fusion; cell cultures as a source of valuable products; organ cultures. **CO1**

UNIT II: ANIMAL DISEASES AND THEIR DIAGNOSIS **9**

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, in-situ hybridization; northern and southern blotting; RFLP. **CO2**

UNIT III: THERAPY OF ANIMAL DISEASES **9**

Recombinant cytokines and their use in the treatment of animal infections; monoclonal antibodies in therapy; vaccines and their applications in animal infections; gene therapy for animal diseases. **CO3**

UNIT IV: MICROMANIPULATION OF EMBRYO'S **9**

What is micromanipulation technology; equipments used in micromanipulation; enrichment of x and y bearing sperms from semen samples of animals; artificial insemination and germ cell manipulations; in vitro fertilization and embryo transfer; micromanipulation technology and breeding of farm animals. **CO4**

UNIT V: TRANSGENIC ANIMALS **9**

Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell cultures in the production of transgenic animals **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ranga M.M. Animal Biotechnology. Agrobios India Limited, 2002
2. Ramadass P, Meera Rani S. Text Book Of Animal Biotechnology. Akshara Printers, 1997.

REFERENCE:

1. Masters J.R.W. Animal Cell Culture: Practical Approach. Oxford University Press.2000

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the basic of animal Tissue culture, Maintenance and its preservation along with different culture techniques
CO2	Learn various viral and bacterial disease and different molecular biology Techniques.
CO3	Develop vaccines by understanding the Recombinant cytokines and their use in the treatment of animal infections.

CO4	Learn about micromanipulation technology of Embryos for the enrichment of X and Y bearing sperms for artificial insemination and embryo transfer
CO5	Appreciate the concepts of transgenic animal technology and choose among the strategies for the production of transgenic animals

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	2	3	3	1	2	1	-	-	-	-	3	2	2
CO2	3	1	3	3	3	2	2	-	-	-	-	1	3	3	3
CO3	2	1	1	1	3	2	2	1	-	-	-	1	2	3	2
CO4	3	1	1	2	3	3	2	2	-	-	-	1	2	3	3
CO5	2	1	2	2	3	3	3	2	1	-	-	1	3	2	3

BT1006 SYSTEMS BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to utilize the bioinformatic tools to design and develop biological complex data models.

UNIT I: INTRODUCTION **9**

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modeling: Model Scope, Model Statements, System state, Variables, parameters and constants, Model behavior, classification and steady state. Merits of computational modeling **CO1**

UNIT II: KINETIC MODELING **9**

Kinetic modeling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modeling. **CO2**

UNIT III: FLUX BALANCE ANALYSIS **9**

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks. **CO3**

UNIT IV: NETWORK MOTIFS AND MODELS **9**

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models. **CO4**

UNIT V: RESOURCES AND SBML 9

Tools and databases for modeling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. EddaKlipp, Wolfram Liebermeister, ChristophWierling ,Systems Biology a Textbook by Wiley-BlackWell Publications (2009 Edition).
2. Uri Alon , An introduction to Systems Biology: Design Principles of Biological Circuits, (Chapman and Hall / CRC 2007 Edition)
3. EddaKlipp, Ralf Herwig, Axel kowald, ChristophWierling, Hans Lehrach ,Systems Biology in practice: concepts, implementation and application. (Wiley – VCH 2005)

REFERENCES:

1. Foundations of Systems Biology Edited by Hiroaki Kitano (MIT Press)
2. Systems Biology: Definitions and perspectives by Lilia Albhergina (Springer Publications 2008)

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand basic, advanced principles of systems biology and biological networks

CO2 Apply kinetics principles to develop systems level mathematical models in biology

CO3 Learn stoichiometry and energetics of metabolism.

CO4 Understand networks behaviour and emergent properties of biological networks/ systems

CO5 Apply computational based solutions for modeling biological perspectives

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	-	1	-	1	-	-	-	-	3	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	1
CO3	3	2	2	3	1	-	-	-	-	-	-	-	3	1	1
CO4	3	3	3	3	-	-	-	2	-	-	-	-	3	2	-
CO5	3	3	3	3	3	-	-	-	1	-	-	-	3	2	3

BT1007 BIOLOGICAL SPECTROSCOPY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications.

UNIT I: OPTICAL ROTATORY DISPERSION **9**

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins. **CO1**

UNIT II: TYPES OF NUCLEAR MAGNETIC RESONANCE **9**

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – ESR multidimensional nmr spectroscopy – determination of macromolecular structure by NMR – magnetic resonance imaging. **CO2**

UNIT III: TYPES OF MASS SPECTROMETRY **9**

Introduction on sources sample introduction – mass analyzers and ion detectors – bimolecular mass spectrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications. **CO3**

UNIT IV: X-RAY DIFFRACTION **9**

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction. **CO4**

UNIT V: SPECIAL TOPICS AND APPLICATIONS **9**

Electron microscopy – transmission and scanning electron microscopy – scanning tunnelling and atomic force microscopy – combinatorial chemistry and high throughput screening methods. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Banwell, Colin N. and E.M. McCash. "Fundamentals of Molecular Spectroscopy" 4th Edition, Tata McGraw-Hill, 2017.
2. Aruldas, G. "Molecular Structure and Spectroscopy". 2nd Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. " Introduction to Spectroscopy:" 3rd Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. "Spectroscopic Methods in Organic Chemistry". 6th Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Siuzdak, Gary. "Mass Spectrometry for Biotechnology ". Academic Press / Elsevier,1996.
2. Hammes, Gordon G. "Spectroscopy for the Biological Sciences". John Wiley, 2005.
3. Campbell I.D and Dwek R.A., " Biological Spectroscopy ", Benjamin Cummins and Company, 1986.
4. Atkins P.W., "Physical Chemistry ",10th Edition, Oxford University Press India, 2014.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Know the basics and biological applications of optical rotatory dispersion methods.

CO2 Predict the structure of biological macromolecule using nuclear magnetic resonance spectroscopy.

CO3 Analyze the peptide and protein molecules by mass spectrometry.

CO4 Understand the principle of X-ray diffraction and its applications.

CO5 Gain knowledge on advanced microscopic techniques and its applications.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	2	3	-	-	-	-	-	-	-	3	2	3
CO2	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO3	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO4	3	-	-	2	3	-	-	-	-	-	-	2	3	2	3
CO5	3	-	-	1	3	-	-	-	-	-	-	2	3	2	3

GE1001	**INTELLECTUAL PROPERTY RIGHTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

UNIT I: INTRODUCTION **9**

Introduction to IPRs: Basic concepts and need for Intellectual Property, Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – The way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations – Important examples of IPR. **CO1**

UNIT II: REGISTRATION OF IPRs **10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad **CO2**

UNIT III: AGREEMENTS AND LEGISLATIONS **10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. **CO3**

UNIT IV: DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies. **CO4**

UNIT V: ENFORCEMENT OF IPRs **7**

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. V. ScopleVinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, LexisNexis, 2017.

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition,2017.
2. PrabuddhaGanguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Get an adequate knowledge on patent and copyright for their innovative research works

CO2 Get idea about the registration process of IPR

CO3 Study various agreements and Acts regarding IPR

CO4 Inculcate the knowledge on innovations, developments and IP laws

CO5 Gain awareness about the knowledge of enforcement and current issues

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	2	1	1	2	2	2	3	2	2	-
CO2	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO3	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO4	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-
CO5	3	2	2	2	1	2	1	1	2	2	2	3	2	-	-

PROFESSIONAL ELECTIVE – III

BT1009 CANCER BIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the students to understand

- Basic biology of cancer
- Impact of antibodies against cancer in the human body leading to more effective treatments
- Enhanced immunology based detection methods and imaging technique

Development of cell based and cytokine based immunotherapy against cancer.

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY 9

Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumour suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. **CO1**

UNIT II: PRINCIPLES OF CARCINOGENESIS 9

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis. **CO2**

UNIT III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes. Oncogenes/proto oncogene activity. Growth factors related to transformation. Telomerases. **CO3**

UNIT IV: PRINCIPLES OF CANCER METASTASIS 9

Clinical significances of invasion, heterogeneity of metastatic phenotype, metastatic cascade, basement membrane disruption, three step theory of invasion, proteinases and tumour cell invasion. **CO4**

UNIT V: NEW MOLECULES FOR CANCER THERAPY 9

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Weinberg, R.A. “The Biology of Cancer” Garland Science, 2007
2. McDonald, F etal., “ Molecular Biology of Cancer” IInd Edition. Taylor & Francis, 2004.

REFERENCES:

1. King, Roger J.B. “Cancer Biology” Addison Wesley Longman, 1996.
2. Ruddon, Raymond W. “ Cancer Biology” IIIrd Edition . Oxford University Press, 1995.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the fundamentals of cancer biology such as cell cycle, molecular diagnostic assays and molecular markers.
CO2	Understand the basic principles involved in creating carcinogenesis and mechanism of carcinogenesis.
CO3	Have depth knowledge in Oncogenic genes molecular mechanism and importance of growth factors
CO4	Have awareness on cancer metastasis and its clinical significance
CO5	Have awareness on medical applications of cytokines and immune cells against cancer

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	3	-	-	-	-	-	-	-	-	3	2	2
CO2	1	2	1	1	3	-	-	3	-	-	-	-	1	2	3
CO3	1	-	3	2	3	-	-	-	-	-	-	-	2	2	3
CO4	1	1	1	3	3	-	-	3	-	-	-	-	2	3	2
CO5	1	1	3	1	3	-	-	1	-	-	-	-	3	2	1

BT1010 BIOPHARMACEUTICAL TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- The aim of the course is to give strong foundation and advanced information on biopharmaceutical aspects in relation to drug development.
- This course provides core responsibilities for the development and monitoring of the drug and the preparation of medicines according to the norms.
- To gain knowledge in physicochemical properties, pharmacology and the formulation of commonly used biopharmaceuticals.

UNIT I: INTRODUCTION 9

Pharmaceutical industry & development of drugs ; types of therapeutic agents and their uses; economics and regulatory aspects . **CO1**

UNIT II: DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; pharmacokinetics. **CO2**

UNIT III: MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 9

Types of reaction process and special requirements for bulk drug manufacture. **CO3**

UNIT IV: PRINCIPLES OF DRUG MANUFACTURE 9

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP. **CO4**

UNIT V: BIOPHARMACEUTICALS 9

Various categories of therapeutics like vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Finkel, Richard, etal., "Lippincott's Illustrated Reviews Pharmacology" IVth Edition. Wolters Kluwer / Lippincott Williams & Wilkins, 2009.

REFERENCES:

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems, Eleventh Edition .Loyd V. Allen, Jr. ,Wolters Kluwer, 2017.

COURSE OUTCOMES

Upon completion of the course

CO1	Students would have a fundamental knowledge about the various phases and the regulatory aspects involved in the drug development.
CO2	Students would have gained knowledge about mechanism of action of drug on a human body and how a body responds to a drug.
CO3	Students would have developed knowledge about chemical reactions and processes involved in manufacturing a drug product.
CO4	Students get familiar about the preparation of various dosage forms of drug and its quality control.
CO5	Student would acquire knowledge on different types of biopharmaceuticals.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	1	2	2	1	1	-	-	-	1	-	2	-
CO2	2	-	2	1	-	1	1	1	-	-	-	1	-	-	-
CO3	1	1	1	1	2	1	1	2	-	-	1	-	2	-	-
CO4	1	1	1	1	3	1	-	1	-	-	-	-	-	-	2
CO5	1	1	1	1	3	1	1	1	-	-	-	-	2	-	-

BT1011 **MOLECULAR PATHOGENESIS OF DISEASES**

L	T	P	C
3	0	0	3

OBJECTIVES:

To enable the students

- To understand about the microbial toxins and modern molecular pathogenesis
- To know about the host pathogen interaction and identifying virulence factors
- To control pathogens by modern approaches.

UNIT I: OVERVIEW **5**

Historical perspective - discovery of microscope, Louis Pasteur's contributions, Robert Koch's postulates, early discoveries of microbial toxins, toxic assays, vaccines, antibiotics and birth of molecular genetics and modern molecular pathogenesis studies, Various pathogen types and modes of entry. **CO1**

UNIT II: HOST-DEFENSE AGAINST PATHOGENS AND PATHOGENIC STRATEGIES **8**

Attributes & components of microbial pathogenesis, Host defense: skin, mucosa, cilia, secretions, physical movements, limitation of free iron, antimicrobial compounds, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process, general disease symptoms, Pathogenic adaptations to overcome the above defenses. **CO2**

UNIT III: MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **16**

Virulence, virulence factors, virulence- associated factors and virulence lifestyle factors, molecular genetics and gene regulation in virulence of pathogens, Vibrio Cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival E.coli pathogens: EnterotoxigenicE.coli (ETEC), labile & stable toxins, Entero- pathogenic E.coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment; EnterohaemerrohogicE.coli (EHEC), mechanism of bloody diarrhoea and Hemolytic Uremic Syndrome, EnteroaggregativeE.coli (EAEC). Shigella: Entry, macrophage apoptosis, induction of macropinocytosis, uptake by epithelial cells, intracellular spread, inflammatory response, tissue damage Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitiparous vacuoles, and knob protein transport, Antimalarials based on transport processes. Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantidine. **CO3**

UNIT IV: EXPERIMENTAL STUDIES ON HOST-PATHOGEN INTERACTIONS **8**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors, attenuated mutants, molecular characterization of virulence factors, signal transduction & host responses **CO4**

UNIT V: APPROACHES TO CONTROL PATHOGENS **8**

Classical approaches based on serotyping. Modern diagnosis based on highly conserved virulence factors, immune & DNA-based techniques. New therapeutic strategies based on recent findings on molecular pathogenesis of a variety of pathogens, Vaccines - DNA, subunit and cocktail vaccines. **CO5**

TOTAL PERIODS: 45

REFERENCES:
1. Iglewski B.H and Clark V.L "Molecular basis of Bacterial Pathogenesis", Academic Press, 1990.
2. Peter Williams, Julian Ketley & George Salmond, "Methods in Microbiology: Bacterial Pathogenesis, Vol. 27", Academic Press, 1998.
3. Recent reviews in Infect. Immun., Mol. Microbiol., Biochem. J., EMBO etc
4. Nester, Anderson, Roberts, Pearsall, Nester, "Microbiology: A Human Perspective", McGraw Hill, 3rd Edition, 2001.
5. Eduardo A. Groisman, Principles of Bacterial Pathogenesis, Academic Press, 2001.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Gain knowledge in understanding the basic about the historical perspective in molecular Pathogenesis and various pathogen types and mode of entry
CO2	Develop knowledge in host-defense mechanism against pathogen and pathogenic strategy
CO3	Gain knowledge in various bacterial and viral pathogens along with their virulence factor and gene regulation
CO4	Develop knowledge in various virulence assay and understand molecular characterization of virulence factor
CO5	Acquire knowledge to control the pathogens and to diagnose various pathogens in immunological and molecular level

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	1	-	-	-	-	-	1	2	1	-
CO2	1	-	-	-	-	-	-	-	-	-	-	1	2	1	-
CO3	1	-	-	-	-	1	-	-	-	-	-	1	2	2	-
CO4	-	2	2	1	1	1	-	-	-	-	-	1	2	2	2
CO5	1	2	2	2	2	2	-	-	-	-	-	2	2	2	2

BT1012	BIO-ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To learn the basics of entrepreneur skills and apply in developing business plan
- To identify suitable locations and market in the business
- To understand the basics of finance and its management, legal, social aspect of business

UNIT I: **9**

Should You Become an Entrepreneur? What Skills Do Entrepreneurs Need?, Identify and Meet a Market Need, Entrepreneurs in a Market Economy, Select a Type of Ownership **CO1**

UNIT II: **9**

Develop a Business Plan **CO2**

UNIT III: **9**

Choose Your Location and Set Up for Business, Market Your Business, Hire and Manage a Staff **CO3**

UNIT IV: **9**

Finance, Protect and Insure Your Business, Record Keeping and Accounting, Financial Management **CO4**

UNIT V: **9**

Meet Your Legal, Ethical, Social Obligations, Growth in Today's Marketplace. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

Entrepreneurship Ideas in Action—South-Western, 2000.

REFERENCES:

Handbook of Bioentrepreneurship: 4 (International Handbook Series on Entrepreneurship), by Holger Patzelt , Thomas Brenner

COURSE OUTCOMES

Upon completion of the course,

CO1	Students will be able to understand the fundamentals of Entrepreneurship and will be able to understand and analyze Market.
CO2	Students will be able to plan and develop a Business plan.
CO3	Students will be able to learn, understand setting up a business and also the basics of leadership quality, customer relationship and team work.
CO4	Students will be able to learn, understand, calculate and analyze finance.
CO5	Students will be able to define and apply the ethical rights and also forecast and estimate the global issues.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	1	-	2	-	3	2	2	2	1	1	1	-
CO2	-	-	-	1	-	1	-	2	2	3	1	2	-	2	-
CO3	-	-	-	-	-	3	2	2	3	3	3	2	3	-	-
CO4	-	-	-	-	-	1	1	2	1	2	3	2	-	-	2
CO5	-	-	-	-	-	3	3	3	1	1	2	2	1	-	2

PROFESSIONAL ELECTIVE – IV

BT1013	BIOETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- The course will provide Fundamental ethical to Advanced clinical trial management including drug development and trial planning; Project management in clinical trials; Consent and data protection; Quality assurance and governance.

UNIT I: INTRODUCTION TO CLINICAL TRIALS 9

Fundamentals of clinical trials; Basic statistics for clinical trials; Clinical trials in practice; Reporting and reviewing clinical trials; Legislation and good clinical practice - overview of the European directives and legislation governing clinical trials in the 21stcentury; International perspectives; Principles of the International Committee on Harmonisation (ICH)-GCP. **CO1**

UNIT II: REGULATIONS OF CLINICAL TRIALS 9

Drug development and trial planning - pre-study requirements for clinical trials; Regulatory approvals for clinical trials; Consort statement; Trial responsibilities and protocols - roles and responsibilities of investigators, sponsors and others; Requirements of clinical trials protocols; Legislative requirements for investigational medicinal products. **CO2**

UNIT III: MANAGEMENT AND ETHICS OF CLINICAL TRIALS 9

Project management in clinical trials - principles of project management; Application in clinical trial management; Risk assessment; Research ethics and Bioethics - Principles of research ethics; Ethical issues in clinical trials; Use of humans in Scientific Experiments; Ethical committee system including ahistorical overview; the informed consent; Introduction to ethical codes and conduct; Introduction to animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulation regarding use of animals in research. **CO3**

UNIT IV: INFORMED CONSENT 9

Consent and data protection- the principles of informed consent; Consent processes; Data protection; Legislation and its application; Data management – Introduction to trial master files and essential documents; Data management. **CO4**

UNIT V: QUALITY CONTROL AND GUIDELINES 9

Quality assurance and governance - quality control in clinical trials; Monitoring and audit; Inspections; Pharmacovigilance; Research governance; Trial closure and pitfalls-trial closure; Reporting and legal requirements; Common pitfalls in clinical trial management. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Lee, Chi-Jen; etal., “Clinical Trials or Drugs and Biopharmaceuticals.” CRC / Taylor &Francis,2011.
2. Matoren, Gary M. “The Clinical Research Process in the Pharmaceutical Industry.”Marcel Dekker,1984.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Gain knowledge on the fundamental aspects of clinical trials, legal standards and GCP.
CO2	Acquire knowledge on the regulatory approvals and legislative requirements of clinical trials.
CO3	Understand the principles of project management , ethical system in clinical trials and research.
CO4	Understand the perspectives of informed consent , data protection and management systems.
CO5	Understand and appreciate the procedures of quality control assurance & governance in clinical trials.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	1	2	2	-	-	-	2	2	1	2	2	1	2	-
CO2	-	1	2	2	1	-	-	2	1	2	1	1	1	-	-
CO3	--	-	-	1	-	2	-	3	2	1	2	1	-	1	-
CO4	-	-	-	1	-	1	-	2	2	1	2	1	-	-	2
CO5	-	-	-	1	1	1	-	2	2	2	2	2	-	-	1

GE1004	**FUNDAMENTALS OF NANOSCIENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I: INTRODUCTION **8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). **CO1**

UNIT II: GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. **CO2**

UNIT III: NANOMATERIALS **12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications. **CO3**

UNIT IV: CHARACTERIZATION TECHNIQUES **9**

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. **CO4**

UNIT V: APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Acquire knowledge in general methods of preparation of nano materials.
CO3	Understand the Nano forms of Carbon and methods of synthesis
CO4	Acquire knowledge in characteristic nanomaterial on various technique.
CO5	Gain knowledge on various application of nano materials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	1	2	1	1	2	1	1	3	2	1	1
CO2	3	2	3	3	1	2	1	1	2	1	1	3	2	3	3
CO3	3	3	3	3	1	2	1	1	2	1	1	3	3	3	3
CO4	3	3	3	3	1	2	1	1	2	1	2	3	3	3	3
CO5	3	2	3	3	1	2	1	1	2	1	2	3	3	3	3

BT1015 **GENOMICS AND PROTEOMICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide the students a broader knowledge on the structure and function of genomes, the technologies developed for genomics, functional genomics and proteomics.

UNIT I: INTRODUCTION **9**

Introduction to genome, transcriptome, and proteome; Overview of genomes of bacteria, archae, and eukaryote; Genomes of organelles. **CO1**

UNIT II: GENOME MAPPING AND SEQUENCING **9**

Genetic and physical mapping, Linkage analysis, RFLP, SNP, SSLP, Restriction mapping, STS mapping, FISH, Top-down and bottom-up sequencing strategies, Whole genome sequencing, Gap closure, Pooling strategies. **CO2**

UNIT III: FUNCTIONAL GENOMICS **9**

Genome annotation, ORF and functional prediction, Gene finding, Substractive DNA library screening, Differential display and Representational difference analysis, SAGE,TOGA, Introduction to DNA microarray. **CO3**

UNIT IV: TECHNIQUES IN PROTEOMICS **9**

In-vitro and in vivo-labeling of proteins, One and two-dimensional gel electrophoresis, Detection of proteins on SDS gels, Protein cleavage, Edman protein microsequencing, Mass spectrometry-principles of MALDI-TOF, Peptide mass fingerprinting. **CO4**

UNIT V: PROTEIN PROFILING **9**

Large-scale protein profiling using proteomics, Post-translational modifications, Phosphoprotein and glycoprotein analyses; Analysis of protein-protein interactions, Protein microarrays. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Suhai, Sandor "Genomics and Proteomics: Functional and Computational Aspects". Springer, 2000
2. Pennington, S.R. and M.J. Dunn "Proteomics: From Protein Sequence to Function". VivaBooks Pvt. Ltd., 2002.
3. O'Connor, C.D. and B.D.Hames. " Proteomics". Scion Publishing, 2008.
4. Primrose, S.B. and Twyman. "Principles of Genome Analysis and Genomics". 7th Edition, Blackwell Publishing, 2006

REFERENCES:

1. Cantor, Charles R. and Cassandra L. Smith. "Genomics: The Science and Technology Behind the Human Genome Project". John Wiley & Sons, 1999.
2. Liebler, R.C. "Introduction to Proteomics". Humana Press, 2002.
3. Hunt, Stephen P. and Frederick J. Livesey. "Functional Genomics". Oxford University Press,2000.
4. Conard, Edward. "Genomics". Apple Academics, 2010

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand the fundamentals of Genomics and Proteomics

CO2 Acquire knowledge on various genome mapping and sequencing methods and genomic markers

CO3 Gain knowledge about microarray technology and methods used in functional genomics

CO4 Gain knowledge about current techniques involved in protein analysis

CO5 Acquire knowledge on various techniques used for protein filing and post translational modification

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	-	-	-	-	-	-	-	-	3	2	1
CO2	2	2	1	-	3	-	-	-	-	-	-	-	2	2	2
CO3	3	1	2	1	3	-	-	-	-	-	-	-	2	1	3
CO4	1	2	1	-	3	-	-	-	-	-	-	-	2	2	3
CO5	2	1	1	2	1	-	-	-	-	-	-	-	2	2	2

BT1016	LIFESTYLE DISEASES	L	T	P	C
		3	0	0	3

UNIT I: INTRODUCTION **9**

Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise. **CO1**

UNIT II: CANCER **9**

Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment **CO2**

UNIT III: CARDIOVASCULAR DISEASES **9**

Coronoary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse – Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation **CO3**

UNIT IV: DIABETES AND OBESITY **9**

Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI **CO4**

UNIT V: RESPIRATORY DISEASES 9

Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. R.Kumar&Meenal Kumar, "Guide to Prevention of Lifestyle Diseases", Deep & Deep Publications, 2003
2. Gary Eggar et al, "Lifestyle Medicine", 3rd Edition, Academic Press, 2017

REFERENCES:

1. James M.R, "Lifestyle Medicine", 2nd Edition, CRC Press, 2013
2. Akira Miyazaki et al, "New Frontiers in Lifestyle-Related Disease", Springer, 2008

COURSE OUTCOME

Upon completion of the course,

CO1	Students would have a fundamental knowledge about the various diseases related to their lifestyle and methods to prevent through diet and exercise
CO2	After completing this course, students get familiar about the various forms of cancer and methods to diagnose and treat
CO3	Students will be able to gain extensive knowledge on cardiovascular diseases and know the usage of diagnose these diseases
CO4	Students would have gained knowledge and the various types of diabetes and know about the consequence of obesity
CO5	At the end of the course the student would acquire knowledge on respiratory diseases and the effect of smoking and tobacco usage

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	1	-	1	-	2	-	1	-	2	1	-	1
CO2	2	1	-	-	-	-	-	1	-	-	-	1	2	-	2
CO3	1	1	-	-	-	1	-	1	-	1	-	1	2	-	2
CO4	2	1	-	-	-	1	-	2	-	1	-	2	1	-	2
CO5	2	1	-	-	-	1	-	1	-	1	-	1	1	-	1

PROFESSIONAL ELECTIVE - V

BT1017 **Plant Biotechnology**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give the details of plant cells and its functions
- To provide the basics of Agrobacterium and applications of plant biotechnology

UNIT I: ORGANIZATION OF GENETIC MATERIAL **9**

Genetic material of plant cells – nucleosome structure and its biological significance; junk and repeat sequences; outline of transcription and translation. **CO1**

UNIT II: CHLOROPLAST & MITOCHONDRIA **9**

Structure, function and genetic material; rubisco synthesis and assembly, coordination, regulation and transport of proteins. Mitochondria: Genome, cytoplasmic male sterility and import of proteins. **CO2**

UNIT III: NITROGEN FIXATION **9**

Nitrogen cycle, importance of symbiotic and nonsymbiotic organisms, nodulation- bacteroids, nod genes, nod factors, Nitrogenase activity, and nif genes. **CO3**

UNIT IV: AGROBACTERIUM & VIRAL VECTORS **9**

Pathogenesis, crown gall disease, genes involved in the pathogenesis, Ti plasmid – t-DNA, importance in genetic engineering. Viral Vectors: Gemini virus, cauliflower mosaic virus, viral vectors and its benefits. **CO4**

UNIT V: APPLICATION OF PLANT BIOTECHNOLOGY **9**

Outline of plant tissue culture, transgenic plants, herbicide and pest resistant plants, molecular pharming, therapeutic products. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1.Gamburg OL, Philips GC, Plant Tissue & Organ Culture fundamental Methods, Narosa Publications. 1995.
2. Singh BD. Text Book of Biotechnology, Kalyani Publishers. 1998

REFERENCES:

1. Heldt HW. Plant Biochemistry & Molecular Biology, Oxford University Press. 1997.
2. Ignacimuthu .S, Applied Plant Biotechnology, Tata McGraw Hill. 1996.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To understand the fundamentals of plant cells, structure and functions
CO2	To know the importance of chloroplast and mitochondria & its function
CO3	To learn the nitrogen fixation mechanism and significance of viral vectors
CO4	To gain the knowledge about the plant tissue culture and transgenic plants
CO5	To develop therapeutic products using plants

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	3	2	2	1	-	-	-	1	2	2	2
CO2	2	2	3	2	3	2	2	2	1	-	-	1	2	2	3
CO3	2	3	3	3	3	2	2	2	-	-	-	1	3	2	2
CO4	2	2	3	3	3	2	3	2	2	-	2	-	3	3	3
CO5	2	2	3	3	3	2	3	2	2	1	2	2	3	3	3

BT1018 METABOLIC ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a quantitative basis, based on thermodynamics, enzyme kinetics, for the understanding of metabolic networks in single cells and at the organ level.
- To enable the students to use organisms to produce valuable substances on an industrial scale in cost effective manner.

UNIT I: INTRODUCTION TO EXAMPLES OF PATHWAY MANIPULATION - QUALITATIVE TREATMENT **9**

Enhancement of Product Yield and Productivity, Extension of substrate Range, Extension of Product spectrum and Novel products, Improvement of Cellular properties, Xenobiotic degradation. **CO1**

UNIT II: MATERIAL BALANCES AND DATA CONSISTENCY **9**

Comprehensive models of cellular reactions; stoichiometry of cellular reactions, reaction rates, dynamic mass balances, yield coefficients and linear rate equations, analysis of over determined systems- identification of gross measurement errors. Introduction to MATLAB® **CO2**

UNIT III: METABOLIC FLUX ANALYSIS **9**

Theory, overdetermined systems, underdetermined systems- linear programming, sensitivity analysis, methods for the experimental determination of metabolic fluxes by isotope labeling, applications of metabolic flux analysis **CO3**

UNIT IV: METABOLIC CONTROL ANALYSIS **9**

Fundamentals of Metabolic Control Analysis, control coefficients and the summation theorems, Determination of flux control coefficients, MCA of linear pathways, branched pathways, theory of large deviations **CO4**

UNIT V: ANALYSIS OF METABOLIC NETWORKS **9**

Control of flux distribution at a single branch point, Grouping of reactions, case studies, extension of control analysis to intermetabolite, optimization of flux amplifications, consistency tests and experimental validation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Gregory N. Stephanopoulos ,Aristos A. Aristidou, Jens Nielsen, Metabolic Engineering: Principles and Methodologies ,Academic Press 1998.
2. Sang Yup Lee E. Terry Papoutsakis Marcel Dekker, Metabolic Engineering.inc 1998
3. Nielsen J and Villadsen J. (1994) Bioreaction Engineering Principles. New york: Plenum Press

REFERENCES:

1. Computational Analysis of Biochemical Systems: A Practical Guide for Biochemists and Molecular Biologists by Eberhard O. Voit Cambridge University Press 2000
2. Applications of Plant Metabolic Engineering. R. Verpoorte, A. W. Alfermann and T. S. Johnson (eds). Springer, P.O. Box 17, 3300 AA Dordrecht, The Netherlands. 2007.
3. Systems Modeling in Cellular Biology: From Concepts to Nuts and Bolts Edited by ZoltanSzallasi, JorgStelling and VipulPeriwal MIT Press Cambridge 2006

COURSE OUTCOMES

Upon completion of the course,

CO1	Students would have gained knowledge on regulation, manipulation and synthesis of metabolic pathways
CO2	Students would have acquired knowledge on data consistency and how to solve material balances
CO3	Students would have developed knowledge about analysis and methods for the metabolic flux
CO4	After completing this course, students get familiar with the application of metabolic flux analysis.
CO5	Students would have learnt to analyse and optimise metabolic flux networks.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO2	1	2	-	-	-	1	-	-	-	-	-	-	2	2	1
CO3	2	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO4	2	1	-	-	2	2	-	-	-	-	-	-	2	2	1
CO5	2	1	-	-	2	2	-	-	-	-	-	-	2	-	1

BT1019	**GENETICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give an understanding on the fundamentals of conventional genetics and its relevance in disease and therapy
- To describe various genetic laws, learn the chromosome structure function and understand methodologies for cytogenetic applications

UNIT I: BACTERIAL GENETICS 9

Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes-plasmids and episomes **CO1**

UNIT II: CLASSICAL GENETICS **9**

Mendel's principles and experiments, segregation, multiple alleles – Independent Assortments, Genotypic interactions, epistasis and Sex chromosomes, Sex determination, Dosage compensation, sex linkage and pedigree analysis **CO2**

UNIT III: APPLIED GENETICS **9**

Chromosome organization, structure and variation in prokaryotes and eukaryotes, Giant chromosomes – polytene and lampbrush, deletion, inversion, translocation, duplication. variation in chromosomal numbers – aneuploidy, euploidy, polyploidy, Ames test, karyotyping, Linkage, Crossing over – cytological basis of crossing over, chromosome mapping – two and three factor cross – interference, somatic cell hybridization **CO3**

UNIT IV: POPULATION GENETICS **9**

Hardy-Weinberg equilibrium, Extensions of Hardy- Weinberg equilibrium, non random mating, population analysis, Models for population genetics. Mutation and Migration size, Genetic variation and Sociobiology **CO4**

UNIT V: GENETIC DISEASES **9**

Inborn errors of metabolism, Sickle cell, hemochromatosis, cystic fibrosis, hypogonadotropichypogonadism, Gaucher's disease, achondroplasia, phenylketonuria, Huntington's Disease, Cystic fibrosis, hemoglobinopathies, Age-related macular degeneration, Obesity, Type 2 diabetes, Psychiatric disease, including missing heritability, autism **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Tamarin, R.H., "Principles of Genetics", Tata McGraw Hill, New Delhi, 2002
2. De Robertis, E. D. P. and De Robertis, E. M. F., "Cell and Molecular Biology", 8th Edition,Lippincott Williams & Wilkins, New York, USA, 2001.

REFERENCES:

1. Gardner, E.J, Simmons, M.J, and Snustad, D.P., "Principles of Genetics",8th Edition, JohnWiley& Sons, Singapore, 2003.
2. Strickberger, M.W., "Genetics", 3rd Edition, Prentice Hall of India, New Delhi, 2008.
3. Klug, W.S. and Cummings, M.R., "Concepts of Genetics", Pearson Education, New Delhi 2003.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Gain knowledge about basic techniques involved in Gene transfer methods
CO2	Gain depth knowledge about principles involved in Classical genetics
CO3	Understand about the methods involved in mapping and hybridisation
CO4	Familiar with population genetics and genetic variations
CO5	Have awareness about genetically transferred diseases and its analysis

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	-	3	-	1	1	-	-	-	-	2	2	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	3	2	1
CO3	2	2	1	1	3	-	1	1	-	-	-	-	2	3	1
CO4	1	-	-	-	-	-	1	1	-	-	-	1	2	2	2
CO5	2	2	1	2	3	-	-	-	-	-	-	-	3	2	1

BT1020 CLINICAL TRIALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials.

UNIT I: ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT 9

Drug Discovery, regulatory guidance and governance, pharmaceutical manufacturing, nonclinical research, clinical trials, post-marketing surveillance, ethical conduct during clinical trials. **CO1**

UNIT II: FUNDAMENTALS OF TRIAL DESIGN 9

Randomised clinical trials, uncontrolled trials. Protocol development, endpoints, patient selection, source and control of bias, randomization, blinding, sample size and power. **CO2**

UNIT III: ALTERNATE TRIAL DESIGNS 9

Crossover design, factorial design, equivalence trials, bioequivalence trials, non-inferiority trials, cluster randomized trials, multi-center trials. **CO3**

UNIT IV: BASICS OF STATISTICAL ANALYSIS 9

Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, missing data. **CO4**

UNIT V: REPORTING OF TRIALS 9

Overview of reporting, trial profile, presenting baseline data, use of tables, figures, critical appraisal of report, meta-analysis. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Fundamentals of Clinical Trials, Lawrence M. Friedman, Springer Science & Business Media, 2010
2. Textbook of Clinical Trials, David Machin, Simon Day, Sylvan Green, John Wiley & Sons, 2007
3. Clinical Trials: A Practical Approach, Stuart J. Pocock, John Wiley & Sons, 17-Jul-2013

REFERENCES:

1. Clinical trials, A practical guide to design, analysis and reporting. Duolao Wang and AmeetBakhai. Remedica. 2006.
2. Introduction to statistics in pharmaceutical clinical trials. T.A. Durham and J Rick Turner. Pharmaceutical Press.
3. Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, Tom Brody, Academic Press, 2016.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	The student will be able to study the epidemiologic methods, study design, protocol preparation
CO2	To gain knowledge in the basics of fundamentals of trial design
CO3	The student will be able to explain key concepts in the design of clinical trials.
CO4	The student will be able to study designs used, identify key issues in data management for clinical trials.
CO5	The student will be able to describe the roles of regulatory affairs in clinical trials.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	-	-	-	-	1	-	-	1	-	1
CO2	1	2	2	1	2	-	-	-	2	2	-	-	2	-	2
CO3	1	2	1	1	2	2	-	-	2	2	-	-	2	-	2
CO4	2	1	1	2	2	2	2	1	2	2	-	1	1	-	2
CO5	2	1	3	2	3	1	1	1	1	3	-	1	1	-	1

PROFESSIONAL ELECTIVE – VI

BT1021	TISSUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

To enable the students

- To learn the fundamentals of tissue engineering and tissue repairing
- To acquire knowledge on clinical applications of tissue engineering
- To understand the basic concept behind tissue engineering focusing on the stem cells, biomaterials and its applications

UNIT I: INTRODUCTION **9**

Introduction to tissue engineering: Basic definition; current scope of development; use intherapeutics, cells as therapeutic agents, cell numbers and growth rates, measurement of cellcharacteristics morphology, number viability, motility and functions. Measurement of tissue characteristics, appearance, cellular component, ECM component, mechanical measurements and physical properties. **CO1**

UNIT II: TISSUE ARCHITECTURE **9**

Tissue types and Tissue components, Tissue repair, Basic events of wound healing, Engineering wound healing and its sequential events. Applications of growth factors: VEGF/angiogenesis, Basic properties,Cell-Matrix& Cell-Cell Interactions, telomeres and Self-renewal, Control of cell migration in tissue engineering. **CO2**

UNIT III: BIOMATERIALS **9**

Biomaterials: Types of biomaterials, biological and synthetic materials,Biopolymers, Properties of biomaterials ,Surface, bulk, mechanical and biological properties.Scaffolds & tissue engineering, Applications of biomaterials, Modifications of Biomaterials, Role of Nanotechnology. **CO3**

UNIT IV: BASIC BIOLOGY OF STEM CELLS **9**

Stem Cells: Introduction, hematopoietic differentiation pathway,Potency and plasticity of stemcells, sources, embryonic stem cells, hematopoietic and mesenchymal stem cells, Stem Cellmarkers, FACS analysis, Differentiation,Stem cell systems- Liver, neuronal stem cells, Types &sources of stem cell with characteristics: embryonic, adult, haematopoetic, fetal, cord blood,placenta, bone marrow, primordial germ cells, cancer stem cells induced pleuripotent stem cells. **CO4**

UNIT V: CLINICAL APPLICATIONS **9**

Stem cell therapy, Molecular therapy, In vitro organogenesis, Neurodegenrative diseases, spinalcord injury, heart disease, diabetes, burns and skin ulcers, muscular dystrophy,orthopedicapplications, Stem cells and Gene therapy. Physiological models, tissue engineeredtherapies, product characterization, components, safety, efficacy. Preservation – freezing anddrying. Patent protection and regulation of tissue-engineered products, ethical issues. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1.Bernhard O.Palsson, SangeetaN.Bhatia, ”Tissue Engineering” Pearson Publishers 2009.

2. Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. .Fundamentals of TissueEngineering and Regenerative Medicine.2009.

REFERENCES:
1. Bernard N. Kennedy (editor). Stem cell transplantation, tissue engineering, and cancerapplications, Nova Science Publishers, 2008.109
2. Raphael Gorodetsky, Richard Schäfer..Stem cell-based tissue repair. RSC Publishing,2011.
3. R. Lanza, I. Weissman, J. Thomson, and R. Pedersen, Handbook of Stem Cells, Two-Volume, Volume 1-2: Volume 1-Embryonic Stem Cells; Volume 2-Adult & Fetal Stem Cells,Academic Press, 2004.
4. R. Lanza, J. Gearhart etal (Eds), Essential of Stem Cell Biology, Elsevier Academicpress,2006.
5. J. J. Mao, G. Vunjak-Novakovic et al (Eds), Translational Approaches In TissueEngineering &Regenrative Medicine" Artech House, INC Publications, 2008.
6. Naggy N. Habib, M.Y. Levicar, , L. G. Jiao,.andN. Fisk, Stem Cell Repair andRegeneration, volume-2, Imperial College Press,2007.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the components of the tissue architecture and fundamental properties of cells and tissues
CO2	Gain depth knowledge in wound healing and growth factors
CO3	Be Aware about the properties and broad applications of biomaterials
CO4	Opportunity to get familiarized with the stem cell characteristics and their relevance in medicine
CO5	Overall exposure to the role of tissue engineering and stem cell therapy in Organogenesis

MAPPING OF COs WITH POs AND PSOs														
COs	**PROGRAM OUTCOMES (POs)**											**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	2	-	-	-	-	-	-	-	-	3	2	1
CO2	2	2	1	1	2	-	-	-	-	-	-	-	3	2	2
CO3	2	2	2	2	-	1	-	2	-	-	-	-	3	3	2
CO4	2	2	2	2	3	1	2	3	-	-	-	1	3	2	3
CO5	2	2	2	2	3	1	2	3	-	-	-	2	3	2	3

BT1022	**BIOSAFETY AND HAZARD MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:
- To introduce awareness on the importance of plant safety and risk analysis
- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification

UNIT I: INTRODUCTION **9**

Need for safety in industries; Safety Programmes – components and realization; Potential hazards-extreme operating conditions, toxic chemicals; safe handling **CO1**

UNIT II: QUALITY CHECKS **9**

Implementation of safety procedures – periodic inspection and replacement; Accidents – identification and prevention; promotion of industrial safety **CO2**

UNIT III: RISK ANALYSIS **9**

Overall risk analysis--emergency planning-on site & off site emergency planning, risk management ISO 14000, EMS models case studies. Quantitative risk assessment – rapid and comprehensive risk analysis; Risk due to Radiation, explosion due to over pressure, jet fire-fire ball. **CO3**

UNIT IV: SAFETY AUDITS **9**

Hazard identification safety audits, checklist, what if analysis, vulnerability models event tree analysis fault tree analysis, Hazan past accident analysis Fixborough-Mexico-Madras-VizagBopal analysis. **CO4**

UNIT V: HAZARDOUS OPERATIONS **9**

Hazop-guide words, parameters, derivation-causes-consequences-recommendation-coarse Hazop study-case studies-pumping system-reactor-mass transfer system. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Fawatt, H.H. and Wood, W.S., “Safety and Accident Prevention in Chemical Operation“, Wiley Interscience, 1965.
2. Marcel, V.C., Major Chemical Hazard- Ellis Harwood Ltd., Chi Chester, UK, 1987.
3. Skeleton, B., Process Safety Analysis: An introduction, Institution of chemical Engineers, U.K., 1997.
4. Hyatt, N., Guidelines for process hazards analysis, hazards identification & risk analysis, Dyadem Press, 2004.

REFERENCES:

1. Handley, W., “Industrial Safety Hand Book “, 2nd Edn., McGraw-Hill Book Company,1969.
2. Heinrich, H.W. Dan Peterson, P.E. and Rood, N., “Industrial Accident Prevention“, McGraw-Hill Book Co., 1980.
3. Chemical Process Safety: Fundamentals with Applications, Daniel A. Crowl, J.F. Louvar, Prentice Hall, NJ, 1990.
4. Taylor, J.R., Risk analysis for process plant, pipelines and transport, Chapman and Hall, London, 1994.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To understand the need for safety programmes and potential hazards in industries.

CO2 To know and implement the safety procedures and quality checks in industries.

CO3 To perform risk assessment and emergency planning in industries.

CO4 To carry out safety audit- Hazid and event /fault tree analysis.

CO5 To perform Hazop - Hazan and identify the consequences.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	1	1	1	2	2	1	1	-	-	1
CO2	-	-	1	-	-	1	1	1	2	2	1	2	-	-	1
CO3	-	-	-	-	1	1	1	2	2	2	1	2	-	-	1
CO4	-	-	-	-	1	1	1	2	2	2	1	1	-	1	1
CO5	-	-	-	-	-	1	1	2	2	2	1	1	-	-	1

BT1023 STEM CELL TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- The course objectives are imparting the basic knowledge of students about stem cell, culturing and its clinical applications.

UNIT I: STEM CELLS AND TYPES **9**

Stem cells: Definition, Classification, Sources and Properties –Types of stem cells: methods of isolation, study of stem cells and their viability IPSCs, embryonic stem cells, cancer stem cells. – Preservations of Stem cell. Embryonic stem cell: Isolation, Culturing, Differentiation, Properties – Adult stem cell: Isolation, Culturing, Differentiation, Trans-differentiation, Plasticity, and Properties **CO1**

UNIT II: STEM CELLS IN PLANTS AND ANIMALS **9**

Stem cell and founder zones in plants –particulary their roots – stem cells of shoot meristems of higher plants. Skeletal muscle stem cell – Mammary stem cells – intestinal stem cells – keratinocyte stem cells of cornea – skin and hair follicles –tumour stem cells. **CO2**

UNIT III: STEM CELLS DIFFERENTIATION **9**

Factors influencing proliferation, physical, chemical and molecular methods for differentiation of stem cells – hormonal role in differentiation. **CO3**

UNIT IV: REGENERATION AND EXPERIMENTAL METHODS **9**

Germ cells, hematopoietic organs, and kidney, cord blood transplantation, donor selection, HLA matching, patient selection, peripheral blood and bone marrow transplantation, - Stem cell Techniques: fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging **CO4**

UNIT V: APPLICATION AND ETHICAL ISSUES **9**

Stem cell Therapy for neurodegenerative diseases, spinal cord injury, heart disease, diabetes, burns, skin ulcers, muscular dystrophy and orthopaedic applications. Stem cell policy and ethics, stem cell research: Hype, hope and controversy. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Stem cells by C.S Potten., Elsevier, 2006.
2. Essentials of Stem Cell Biology by Robert Lanza., fourth edition. Elsevier 2014.

REFERENCES:

1. Stem cell biology and Gene Therapy by Peter Quesenberry., First Edition, Wiley-Liss, 1998.
2. Embryonic Stem cells – Protocols by KursadTurksen., Second Edition Humana Press, 2002.
3. Stem Cells: From Bench to Bedside by AriffBongso, EngHinLee., World Scientific Publishing Company, 2005.
4. Stem cells in clinic and Research by Ali Gholamrezanezhad., Intech, 2013

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the cell sources and basic properties involved stem cells isolation and development
CO2	Understand the role and applications of stem cells plants and animals
CO3	Understand the fundamental properties of stem cells differentiation
CO4	Gain knowledge about the current techniques used in characterization of stem cells
CO5	Gain knowledge about the applications of stems cells and moral ethics involved in implementation of the technology

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	2	2	-	-	-	-	-	-	-	3	2	1
CO2	3	2	1	3	2	-	1	2	-	-	-	3	3	2	2
CO3	2	1	1	2	2	-	-	-	-	-	-	-	2	2	1
CO4	2	1	1	-	3	-	2	3	-	-	-	-	2	2	2
CO5	2	1	1	-	3	-	2	3	-	-	-	3	2	2	3

BT1024	**IMMUNOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

The students who would have learnt the science of immunology will now be able to apply the science for the development of relevant immunotechnology.

UNIT I: INTRODUCTION **9**

Cells of the immune system and their development; primary and secondary lymphoid organs; humoral immune response; cell mediated immune responses; complement. **CO1**

UNIT II: ANTIBODIES **10**

Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay; Plaque Forming Cell Assay. **CO2**

UNIT III: CELLULAR IMMUNOLOGY **12**

PBMC seperation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing. **CO3**

UNIT IV: VACCINE TECHNOLOGY **6**

Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology **CO4**

UNIT V: DEVELOPMENT OF IMMUNOTHERAPEUTICS **5**

Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001
3. Goldsby , R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H. Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand fundamental knowledge about the various organs involved in immune response, immune responses and complement systems.
CO2	Developed knowledge about the production and application of producing monoclonal antibodies and will have knowledge in various immunological techniques.
CO3	Gain knowledge in the separation and identification of lymphocytes and various CD markers. They also gain knowledge in cytokine assay.
CO4	Gain the knowledge about the basic principles and application of various vaccine development
CO5	Acquire knowledge on development aspects in engineering antibodies and gain knowledge in combinatorial libraries for antibody isolation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	-	-	2	2	2	1	-	-	-	-	-	-	1	1	2
CO3	-	-	3	3	2	1	-	-	-	-	-	-	2	2	2
CO4	-	1	2	2	2	1	-	-	-	-	-	1	2	2	2
CO5	1	2	2	2	2	2	-	-	-	-	-	-	2	2	2

OPEN ELECTIVE - I

OCE101 **AIR POLLUTION AND CONTROL** **L T P C**
3 0 0 3

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I: AIR QULALITY MONITORING **9**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Analysis of Particulate and Gaseous Pollutants. **CO1**

UNIT II: EFFECT OF ATMOSPHERIC DISPERSION **9**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise **CO2**

UNIT III: PARTICULATE CONTAMINANTS **9**

Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment. **CO3**

UNIT IV: GASEOUS CONTAMINANTS **9**

Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing. **CO4**

UNIT V: INDOOR AIR QUALITY MONITORING **9**

Sources types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution– Standards–Control and Preventive measures. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies‟ , Allied Publishers (P) Ltd., India 2002

REFERENCES:

1. David H.F. Liu, Bela G. Liptak „Air Pollution‟ , Lweis Publishers, 2000.
2. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)‟ , Academic Press, 2006.
3. Wayne T.Davis, „Air Pollution Engineering Manual‟ , John Wiley & Sons, Inc.,2000

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	3
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	3
CO3	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3
CO4	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3
CO5	3	2	-	-	-	1	-	-	-	-	-	-	1	-	3

		L	T	P	C
OME101	**AUTOMOTIVE SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I: AUTOMOTIVE ENGINE AUXILIARY SYSTEMS **9**

Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system. **CO1**

UNIT II: VEHICLE FRAMES AND STEERING SYSTEM **9**

Vehicle construction and different Chassis layouts –classifications of chassis- types of frames-frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's-Devi's steering system - types of stub axle – Types of rear axles. **CO2**

UNIT III: TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres. **CO3**

UNIT IV: SUSPENSION AND BRAKES SYSTEMS **9**

Suspension Systems- conventional Suspension Systems -independent Suspension Systems – leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient. **CO4**

UNIT V: ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers -Engine emission control by three way catalytic converter system. Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2020

REFERENCES:

1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 2004.
3. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA , 2007.
4. Newton, Steeds and Garrett, "Motor Vehicles", Butterworth Publishers, 2001.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1 To identify the different components in automobile Engineering.

CO2 To understand the different types of vehicle frames and steering mechanism.

CO3 To have clear understanding on different auxiliary and transmission systems usual.

CO4 To understand the vehicle suspension and different types of brakes systems.

CO5 To understand the alternative energy used for vehicle.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO2	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO4	3	2	3	2	2	1	-	-	-	-	1	1	3	2	1
CO5	1	3	-	-	1	3	3	1	-	-	-	1	3	2	1

OEI103	**BASICS OF BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I: HUMAN BODY SUBSYSTEM AND TRANSDUCERS **9**

Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes **CO1**

UNIT II: NON ELECTRICAL PARAMETERS MEASUREMENT **9**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of blood pCO2, pO2. **CO2**

UNIT III: ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY **9**

ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current - Instruments for checking safety parameters of biomedical equipments. **CO3**

UNIT IV: IMAGING MODALITIES AND BIO-TELEMETRY **9**

Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems. **CO4**

UNIT V: LIFE ASSISTING AND THERAPEUTIC DEVICES **9**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy. **CO5**

TOTAL PERIODS:45

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2.Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3.Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4.Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5.M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Understand the physiological systems and the various components of a biomedical system.
CO2	Understand the techniques and instruments used to measure blood pressure, cardiac output, blood pH and various pulmonary function measurements.
CO3	Understand the working of different electrodes used to sense bio signals; know about the electrical safety in biomedical measurement, and about electrical parameter acquisition.
CO4	Understand the techniques for imaging such as CT scan, MRI, Ultrasonography, fluoroscopic, and radiographic techniques.
CO5	Understand the working of various life assisting, therapeutic and robotic devices.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO2	2	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO3	2	-	1	2	2	2	2	2	2	2	2	3	2	2	2
CO4	2	-	2	2	2	2	2	2	2	2	2	3	2	2	2
CO5	1	-	1	2	1	2	1	2	2	2	2	3	2	2	2

OCS103 **INTRODUCTION TO CLOUD COMPUTING**

L	T	P	C
3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges
- To have knowledge on the various virtualization techniques that serve in computation and storage services on the cloud
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing **CO1**

UNIT II VIRTUALIZATION 9

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization **CO2**

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage. **CO3**

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security. **CO4**

UNIT V CASE STUDIES 9

CO5

Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud

TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

COURSE OUTCOMES

Upon completion of the course, the students will

CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	1	-	-	-	-	-	2	1	-	-	-	2	-	-	1
CO5	2	1	1	-	2	2	-	-	2	-	-	3	2	2	2

OCH103	ENVIRONMENT AND AGRICULTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

UNIT I: ENVIRONMENTAL CONCERNS **8**

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems. **CO1**

UNIT II: ENVIRONMENTAL IMPACTS **9**

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts. **CO2**

UNIT III: CLIMATE CHANGE **8**

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification. **CO3**

UNIT IV: ECOLOGICAL DIVERSITY AND AGRICULTURE **10**

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns. **CO4**

UNIT V: EMERGING ISSUES **10**

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCES:

1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 To gain knowledge on the issues of environmental concerns

CO2 To understand the environmental impacts on agriculture and watershed.

CO3 To gain knowledge on the basic concepts of Climate Change, Water scarcity and water knowledge

CO4 To understand the ecosystem, ecological diversity

CO5 To understand the global and local emerging issues on agriculture and biotechnology

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO2	2	1	2	1	2	2	2	1	-	-	1	2	2	2	2
CO3	3	3	3	1	-	3	3	1	-	-	1	3	3	3	3
CO4	2	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO5	3	1	2	1	-	2	2	1	-	-	1	2	2	3	3

OEI101 **SENSORS AND TRANSDUCERS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I: INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types. **CO1**

UNIT II: MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **CO2**

UNIT III: FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Variable reluctance transducers, Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers **CO3**

UNIT IV: OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors-Film sensor, MEMS & Nano Sensors, LASER sensors. **CO4**

UNIT V: SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – A/D converter - Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Digital recording systems - Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

4. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Understand various calibration techniques, error analysis and signal types for sensors.

CO2 Gain knowledge about motion, proximity and ranging sensors.

CO3 Ability to understand force, magnetic and heading sensors.

CO4 Study the basic principles of optical, pressure and temperature sensors.

CO5 Implement the DAQ systems along with signal conditioning circuits.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO2	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO3	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3
CO4	3	3	3	3	1	1	2	1	-	1	1	2	3	3	3
CO5	3	3	3	3	1	2	2	1	-	1	1	2	3	3	3

OPEN ELECTIVE - II

OME102	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE).
- To demonstrate knowledge and understanding of Taguchi's approach.
- To develop skills to design and conduct experiments using DOE and Taguchi's approach.
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT I: FUNDAMENTALS OF EXPERIMENTAL DESIGNS **9**

Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance. **CO1**

UNIT II: SINGLE FACTOR EXPERIMENTS **9**

Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications. **CO2**

UNIT III: FACTORIAL DESIGNS **9**

Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications. **CO3**

UNIT IV: SPECIAL EXPERIMENTAL DESIGN **9**

Blocking and Confounding in 2K Designs- blocking in replicated design- 2K Factorial Design in two blocks- Complete and partial confounding- Confounding 2K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2K Design- introduction to response surface methods, central composite design. **CO4**

UNIT V: TAGUCHI METHODS **9**

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Douglas C. Montgomery, “Design and Analysis of Experiments”, John Wiley & sons, 2012.

REFERENCES:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., “Statistics for Experimenters: Design, Innovation, and Discovery”, 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, India, 2011.
3. Phillip J. Ross, “Taguchi Techniques for Quality Engineering”, Tata McGraw-Hill, India, 2005.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand the basic principle of DOEs and ANOVA.
CO2 Understand the various single factor experiments
CO3 Learn full and fraction factorial experiment design.
CO4 Design various resolution using 2^k.
CO5 Understand the Taguchi Orthogonal Arrays.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	-	-	-	-	-	2	2	1	2	1
CO2	2	2	2	3	-	-	-	-	-	-	2	2	1	2	1
CO3	1	1	1	2	-	-	-	-	-	-	2	2	1	2	1
CO4	1	1	1	2	-	-	-	-	-	-	2	2	-	1	-
CO5	1	1	1	2	-	-	-	-	-	-	2	2	-	1	-

OCE104	GREEN BUILDING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- The course aims to develop skills of the students in the area of Civil Engineering with emphasis in environmental implications of buildings and comforts in building
- This will enable the students to perform calculations pertaining to processes and operations.

UNIT I ENVIRONMENTAL IMPLICATIONS OF BUILDINGS **9**

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings. **CO1**

UNIT II IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS **9**

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings. **CO2**

UNIT III COMFORTS IN BUILDING **9**

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations **CO3**

UNIT IV UTILITY OF SOLAR ENERGY IN BUILDINGS **9**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings. **CO4**

UNIT V GREEN COMPOSITES FOR BUILDINGS **9**

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment. **CO5**

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand core building science fundamentals

CO2 Perform some building sustainability concepts

CO3 Understand energy efficiency in relation to cost performance, ROI, etc

CO4 Understand and perform some building performance testing and be exposed to different agencies involved in the testing.

CO5 Understand and perform some weatherization fundamentals.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO2	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO3	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO4	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO5	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I: OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning **CO1**

UNIT II: HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning. **CO2**

UNIT III: RECRUITMENT AND TRAINING 9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer. **CO3**

UNIT IV: SUPPORTIVE SERVICES 9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services **CO4**

UNIT V: COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL 9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 To explain the principles of hospital administration.

CO2 To identify the importance of human resource management.

CO3 To list various marketing research techniques.

CO4 To identify information management systems and its uses.

CO5 To understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	-	1	2	1	2	1	1	1	-	-
CO2	1	1	1	-	1	-	-	2	3	2	3	1	1	-	1
CO3	1	2	2	1	1	-	1	2	3	2	3	1	1	-	-
CO4	1	2	2	1	1	-	1	2	3	2	3	1	1	-	-
CO5	1	2	2	1	1	1	1	2	3	2	3	2	1	1	1

OIE102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I: FUNDAMENTALS OF ROBOT **6**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications. **CO1**

UNIT II: ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations. **CO2**

UNIT III: SENSORS AND MACHINE VISION 12

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation. **CO3**

UNIT IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING 13

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs. **CO4**

UNIT V: IMPLEMENTATION AND ROBOT ECONOMICS 5

RGV (Rail Guided Vehicle), AGV (Automatic Guided Vehicle); Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations, Hazards of robot, Economic Analysis of Robots- Payback, EUAC, ROI Method. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	To learn concepts of Robotic system, its components and instrumentation and control related to robotics.
CO2	To improve skills on hardware drives and interfacing aspects.
CO3	To enhance basics of different sensors and machine vision interaction.
CO4	To develop student's skills in performing kinematics analysis of robot systems.
CO5	To provide the student with some knowledge and skills associated with robot economics control.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	1	2	-	-	-	-	-	-	-	3	2	1
CO2	2	3	2	2	2	-	-	-	-	-	-	-	3	2	1
CO3	2	2	3	2	3	2	-	-	-	-	-	-	3	2	1
CO4	2	2	2	3	3	2	-	1	-	-	1	-	3	2	1
CO5	1	3	1	2	1	3	2	2	-	1	3	2	3	2	1

OCS101	**INTRODUCTION TO C PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the basic concepts in C Programming Language.
- To understand Input and Output Statements.
- To enhance analyzing and problem solving skills and use the same for writing programs in C.
- To familiarize the basic syntax in arrays and pointers
- To provide exposure to problem-solving through programming

UNIT I INTRODUCTORY CONCEPTS & C FUNDAMENTALS 9

Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants. **CO1**

UNIT II OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS **9**

Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement **CO2**

UNIT III FUNCTIONS & PROGRAM STRUCTURE **9** **CO3**

Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions

UNIT IV ARRAYS & POINTERS **9** **CO4**

Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions

UNIT V STRUCTURES, UNIONS & DATA FILES **9** **CO5**

Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files

TOTAL : 45 PERIODS

TEXT BOOKS

1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.

REFERENCE BOOKS

1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition.
2. Let Us C Yashavant kanetkar, BPB

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Identify situations where computational methods and computers would be useful.
CO2	Demonstrate the use of operators, input and output statements and control statements
CO3	Identify solution to a problem and apply control structures and user defined functions for solving the problem
CO4	Demonstrate the use of numeric arrays and pointers
CO5	Demonstrate the ability to design creative solutions to real life problems faced by the industry.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	1	1	1
CO2	3	3	3	2	2	2	-	-	-	2	2	2	1	1	1
CO3	3	3	3	2	2	2	-	-	-	2	2	2	1	2	1
CO4	3	3	3	2	2	2	-	-	-	2	2	2	1	2	1
CO5	3	3	3	2	2	2	-	-	-	2	2	2	-	-	1

OMB102 LOGISTICS AND SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I: INTRODUCTION **9**

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Supply chain and competitive Strategies – Drivers of Supply Chain Performance and Obstacles. **CO1**

UNIT II: SOURCING AND NETWORK DESIGN **9**

Role of sourcing supply chain - Outsourcing – Make Vs buy -Sourcing strategy - Supplier Selection and Contract Negotiation. Building strategic partnerships and trust within a supply chain -Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions. **CO2**

UNIT III: LOGISTICS IN SUPPLY CHAIN **9**

Introduction to logistics – Role of logistics in Competitive strategy– Value added logistics services – Roleof transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation **CO3**

UNIT IV: TRANSPORTATON AND PACKAGING **9**

Transportation System – Evolution, Infrastructure and Networks. Freight Management–Containerization; Modal Characteristics - Inter-modal Operators and Transport Economies; International Logistics-objectives, importance in global economy, Characteristics of global supply chains; Packaging - Design considerations – Logistics outsourcing **CO4**

UNIT V: IT IN SUPPLY CHAIN 9

The role IT in supply chain- Supply Chain Integration – Agile Supply chain – Green Supply chain – Reverse Supply chain – E-logistics –future of IT in supply chain – E-Business in supply chain – Supply chain analytics - Blockchain **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.

REFERENCES:

1. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To understand the basics of Supply chain, the strategic role of SCM and the drivers of supply chain performance.
CO2	To understand the different distribution networks in Supply chain, the factors influencing design of these networks and to develop a framework of network for distribution.
CO3	To understand about the logistic part of supply chain management and the methods to identify the optimized route for transportation.
CO4	To understand about sourcing, selection of suppliers and supply chain coordination
CO5	To understand the role of IT in Supply chain management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	3	3	1	2	1	1	1	3	-	-	2
CO2	3	3	1	2	3	1	3	2	1	1	1	1	-	-	2
CO3	3	3	2	1	3	2	3	3	1	1	2	3	-	-	2
CO4	2	1	2	3	3	1	3	3	3	1	2	1	-	-	2
CO5	2	3	3	2	2	3	1	2	3	1	3	3	-	-	2

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I: INTRODUCTION 9

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features **CO1**

UNIT II: CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 9

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties **CO2**

UNIT III: ORGANS OF GOVERNANCE 9

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions **CO3**

UNIT IV: EMERGENCY PROVISIONS 9

Emergency Provisions - National Emergency, President Rule, Financial Emergency **CO4**

UNIT V: LOCAL ADMINISTRATION 9

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1 Able to understand history and philosophy of Indian Constitution.

CO2 Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

CO3 Able to understand powers and functions of Indian government.

CO4 Able to understand emergency rule.

CO5 Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRA M OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I: INTRODUCTION TO VALUE EDUCATION 9

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments **CO1**

UNIT II: IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity,Patriotism, Love for nature, Discipline **CO2**

UNIT III: INFLUENCE OF VALUE EDUCATION **9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth. **CO3**

UNIT IV: REINCARNATION THROUGH VALUE EDUCATION **9**

Aware of self-destructive habits, Association and Cooperation, Doing best for saving natureCharacter and Competence –Holy books vs Blind faith, Self-management and Good health,Science of reincarnation **CO4**

UNIT V: VALUE EDUCATION IN SOCIAL EMPOWERMENT **9**

Equality, Non violence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively **CO5**

TOTAL PERIODS: 45

REFERENCE:

Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1 Gain knowledge of self-development

CO2 Learn the importance of Human values

CO3 Develop the overall personality through value education

CO4 Overcome the self destructive habits with value education

CO5 Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003 **PEDAGOGY STUDIES**

L	T	P	C
2	0	0	0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I: INTRODUCTION AND METHODOLOGY **9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories oflearning, Curriculum, Teacher education - Conceptual framework, Research questions - Overviewof methodology and Searching. **CO1**

UNIT II: THEMATIC OVERVIEW **9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developingcountries - Curriculum, Teacher education. **CO2**

UNIT III: EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **9**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies. **CO3**

UNIT IV: PROFESSIONAL DEVELOPMENT **9**

Professional development: alignment with classroom practices and follow up support - Peersupport - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes **CO4**

UNIT V: RESEARCH GAPS AND FUTURE DIRECTIONS **9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	**STRESS MANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I: INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga) **CO1**

UNIT II: YAM **9**

Do`s and Don’t’s in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan **CO2**

UNIT III: NIYAM **9**

Do`s and Don’t’s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha **CO3**

UNIT IV: ASAN 9

Various yog poses and their benefits for mind & body **CO4**

UNIT V: PRANAYAM 9

Regularization of breathing techniques and its effects-Types of pranayam **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Develop healthy mind in a healthy body thus improving social health also improve efficiency

CO2 Learn Do’s and Don’t’s in life through Yam

CO3 Learn Do’s and Don’t’s in life through Niyam

CO4 Develop a healthy mind and body through Yog Asans

CO5 Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I: NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) **CO1**

UNIT II: NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) **CO2**

UNIT III: ORGANS OF GOVERNANCE **9**

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48 **CO3**

UNIT IV: EMERGENCY PROVISIONS **9**

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 **CO4**

UNIT V: LOCAL ADMINISTRATION **9**

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 –Verses 37,38,63 **CO5**

TOTAL PERIODS:45

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P,Bhartrihari's ThreeSatakam ,Nitisringarvairagya, Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, the students will be

- **CO1** To develop basic personality skills holistically
- **CO2** To develop deep personality skills holistically to achieve happy goals
- **CO3** To rewrite the responsibilities
- **CO4** To reframe a person with stable mind, pleasing personality and determination
- **CO5** To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006 **UNNAT BHARAT ABHIYAN**

L	T	P	C
2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of “Soul of India lies in villages” – (Gandhi Ji), Rural infrastructure, problems in rural area. **CO1**

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . **CO2**

Assignment: Describe your analysis of rural household economy, it’s challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT - III RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3-Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **CO3**

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor. **CO4**

UNIT - V FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

• Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities

• Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site

• Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures

• Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)

• Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization

• Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps

• Participate in Gram Sabha meetings, and study community participation

• Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries

CO5

• Attend Parent Teacher Association meetings, and interview school drop outs

• Visit local Anganwadi Centre and observe the services being provided

• Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.

• Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys

• Raise understanding of people's impacts of climate change, building up community's disaster preparedness

• Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants

• Formation of committees for common property resource management, village pond maintenance and fishing.

Total Periods: 45

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- **CO1** Understand of rural life, culture and social realities
- **CO2** Understand the concept of measurement by comparison or balance of parameters.
- **CO3** Develop a sense of empathy and bonds of mutuality with local community
- **CO4** Appreciate significant contributions of local communities to Indian society and economy
- **CO5** Value the local knowledge and wisdom of the community
- **CO6** Understand of rural life, culture and social realities

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The course will introduce the students to

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I: INTRODUCTION TO CULTURE **9**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India **CO1**

UNIT II: INDIAN LANGUAGES AND LITERATURE **9**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languagesand Literature – II: Northern Indian Languages & Literature **CO2**

UNIT III: RELIGION AND PHILOSOPHY **9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only) **CO3**

UNIT IV: FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India **CO4**

UNIT V: EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Understand philosophy of Indian culture.

CO2 Distinguish the Indian languages and literature.

CO3 Learn the philosophy of ancient, medieval and modern India.

CO4 Acquire the information about the fine arts in India.

CO5 Know the contribution of scientists of different eras.

CO6 Understand education systems in India

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO6	-	-	-	-	-	-	-	-	1	1		1	-	-	-

AD1008 SANGA TAMIL LITERATURE APPRECIATION

L	T	P	C
2	0	0	0

OBJECTIVES:

The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
3. ‘Attruppadai’ in SangaTamil Literature.
4. ‘Puranaanuru’ in SangaTamil Literature.
5. ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT I: SANGA TAMIL LITERATURE – AN INTRODUCTION **9 CO1**

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s GrammarTamil Sangam Literature’s parables.

UNIT II: ‘AGATHINAI’AND‘PURATHINAI’ **9 CO2**

Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History of Culture from Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.

UNIT III: ‘ATTRUPPADAI’. **9 CO3**

AttruppadaiLiterature–Attruppadaiin‘Puranaanuru’-Attruppadaiin‘Pathitrupaththu’-Attruppadaiin ‘Paththupaattu’.

UNIT IV: ‘PURANAANURU’ **9 CO4**

Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.

UNIT V: ‘PATHITRUPATHTHU’ **9 CO5**

Pathitrupaththuin‘Ettuthogai’–Pathitrupaththu’sParables–Tamildynasty:Valor,Administration,Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

TOTAL PERIODS: 45

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Appreciate and apply the messages in Sanga Tamil Literature in their life.

CO2 Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.

CO3 Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.

CO4 Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.

CO5 Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CURRICULUM & SYLLABUS

(1^{st} to 8^{th} Semester)

under

REGULATION 2021

(Approved in the Third Board of Studies meeting held on 23^{rd} May 2024 and

Academic Council Meeting held on 23.05.2024)

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St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119.

B. TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

BATCH – (2021 – 2025)

Candidate Admitted on 2021

B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATION - 2021

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULAM AND SYLLABUS

BATCH – (2021 – 2025)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To demonstrate technical skills, competency in fundamentals of Mathematics, Programming and Artificial Intelligence in modelling, designing and conducting of experiments to provide solutions for industry's complex technological problems.

PEO 2: To enrich graduates with creativity that applies the concepts of Machine Learning to create, build and deploy solutions for various business problems

PEO 3: To build graduates with potential and ability to engage in continuous professional development and life-long learning.

PEO 4: To train graduates to work in multi-disciplinary teams with superior work ethics and build innovative solutions to serve the needs of the society.

PEO 5: To enable graduates to research, design and implement AI/ML products and services with effective Communication and Entrepreneurial Skills.

PROGRAM OUTCOMES POs:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend andwrite effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Graduates should be able to acquire and apply practical competency with engineering knowledge in the field of artificial intelligence for efficient design of intelligent systems of varying complexity.

PSO 2: Graduates should be able to contribute constructive ideas and innovative Machine learning solutions for multi-disciplinary problems.

PSO 3: Graduates should be able to build systems by applying AI/ML methods, techniques and tools for solving engineering problems.

MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES WITH PROGRAM OUTCOMES

A broad relation between the Program objective and the outcomes is given in the following table

PROGRAM EDUCATIONAL OBJECTIVES	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3	2										
2	3	2	1	1								1
3			3									3
4			2		1	2	2	1				
5				3		1		1	1	2	2	1

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAM OUTCOMES

Abroad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OBJECTIVES	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
1	3											
2		2	3			1						
3	1		2	1	2		1		1	1	1	

Contribution 1: Reasonable **2: Significant** **3: Strong**

MAPPING OF PROGRAM SPECIFIC OUTCOMES WITH PROGRAM EDUCATIONAL OBJECTIVES

PROGRAM SPECIFIC OUTCOMES (PSOs)	PROGRAM EDUCATIONAL OBJECTIVES				
	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PSO 1	3	2	3	2	1
PSO 2	2	3	3	3	2
PSO 3	3	2	2	2	2

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

YEAR	SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	Communicative English		✓	✓	✓	✓		✓			✓			✓	✓	✓
		Engineering Mathematics - I	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Engineering Physics	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
		Engineering Chemistry	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓
		Problem Solving and Python Programming	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Engineering Graphics	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
		Python Programming Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Physics and Chemistry Laboratory	✓	✓	✓	✓		✓		✓	✓	✓			✓	✓	✓
	II	Professional English		✓	✓	✓	✓		✓	✓	✓	✓			✓		✓
		Linear Algebra	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓
		Physics for Information Science	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓	✓
		Environmental Science and Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
		Basic Electrical, Electronics and Measurement Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Programming in C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Engineering Practices Laboratory	✓	✓	✓			✓						✓	✓	✓	✓
		Programming in C Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

YEAR	SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
II	III	Probability and Bayesian Inference	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
		Data Structures	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
		Introduction to Artificial Intelligence	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
		Data Foundation	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Object Oriented Software Engineering (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
		Optimization for Machine Learning	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
		Data Structures Laboratory using Python	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Artificial Intelligence Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Skills Laboratory		✓		✓					✓	✓			✓	✓	✓
	IV	Discrete Mathematics and Graph Theory	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
		Design and Analysis of Algorithms	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	✓
		Operating Systems	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Database Design and Management (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
		Foundations of Machine Learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Statistics for Machine Learning	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Operating Systems Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Machine Learning Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓

YEAR	SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	V	Reinforcement Learning	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Advanced Artificial Intelligence	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
		Nature Inspired Computing Techniques	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
		Web programming (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Applied Reinforcement Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Advanced Artificial Intelligence Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	VI	Deep Learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Autonomous Mobile Robot (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
		Probabilistic Graphical Models	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
		Big Data Analytics	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
		Deep Learning Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Socially relevant Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IV	VII	Statistical Natural Language Processing	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓
		Formal Languages and Automata Theory	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
		Image Processing and Vision Techniques	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Edge AI	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Industrial AI Applications Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Capstone Project-Phase1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Advanced Data Management and Machine Intelligence	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓
	VIII	Capstone Project-Phase2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MAPPING OF PROFESSIONAL ELECTIVES

YEAR	SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	V	Advanced Databases	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Semantic Web	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Advanced Data Structures	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Logic Programming	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Applications of Machine Learning In Industries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	VI	Green Computing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Game Programming	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Intelligent Transport Systems	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Parallel And Distributed Computing	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Case Based Reasoning	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
IV	VII	AI for Clinical Information System	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Game Theory	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Data Mining And Predictive Modelling	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
		Machine Intelligence for Network Sciences	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Intelligent Machining	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
		Genetic Algorithm	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
		Speech Processing	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Advanced Optimization Techniques	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Human Computer Interaction	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Cloud Computing Techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	VIII	Video Analytics	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Block chain Architecture Design	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Microsoft Bots Framework	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Business Intelligence	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Supply Chain Management	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Internet of Everything	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Ethics and AI	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Agile Software Development	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Brain Computer Interface	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Cognitive Systems	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓

SEMESTER – I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	4	3	1	0	4
3	PH1103	Engineering Physics **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	6	2	0	4	4
PRACTICALS								
7	GE1107	Python Programming Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	4	0	0	4	2
Total				**30**	**17**	**1**	**12**	**24**

SEMESTER - II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1251	Linear Algebra **(Common to AI-DS)**	BSC	4	3	1	0	4
3	PH1252	Physics for Information Science **(Common to CSE, AI-DS & IT)**	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
5	BE1251	Basic Electrical Electronics and Measurement Engineering **(Common to CSE, AI-DS & IT)**	ESC	3	3	0	0	3
6	CS1206	Programming in C **(Common to CSE, AI-DS & IT)**	PCC	3	3	0	0	3
PRACTICALS								
7	GE1207	Engineering Practices Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	4	0	0	4	2
8	CS1208	Programming in C Laboratory **(Common to CSE, AI-DS & IT)**	PCC	4	0	0	4	2
Total				**27**	**18**	**1**	**8**	**23**

SEMESTER – III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1354	Probability and Bayesian Inference	BSC	4	3	1	0	4
2	CS1302	Data Structures **(Common to CSE, AI-DS & IT)**	PCC	3	3	0	0	3
3	DS1303	Introduction to Artificial Intelligence **(Common to AI-DS)**	PCC	3	3	0	0	3
4	ML1301	Data Foundation	PCC	3	3	0	0	3
5	ML1302	Object Oriented Software Engineering (Lab Integrated)	PCC	5	3	0	2	4
6	ML 1303	Optimization for Machine Learning	PCC	3	3	0	0	3
PRACTICAL								
7	DS1307	Data Structures Laboratory using Python **(Common to AI-DS)**	PCC	4	0	0	4	2
8	DS1308	Artificial Intelligence Laboratory **(Common to AI-DS)**	PCC	4	0	0	4	2
9	HS1310	Professional Skills Laboratory **(Common to IT)**	HSMC	2	0	0	2	1
Total				**31**	**18**	**1**	**12**	**25**

SEMESTER – IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1454	Discrete Mathematics and Graph Theory	BSC	4	3	1	0	4
2	CS1401	Design and Analysis of Algorithms **(Common to CSE, AI-DS & IT)**	PCC	3	3	0	0	3
3	CS1402	Operating Systems **(Common to CSE, AI-DS & IT)**	PCC	3	3	0	0	3
4	CS1403	Database Design and Management (Lab Integrated) **(Common to CSE, AI-DS & IT)**	PCC	5	3	0	2	4
5	ML1401	Foundations of Machine Learning **(Common to AI-DS & IT)**	PCC	3	3	0	0	3
6	ML1402	Statistics for Machine Learning	PCC	3	3	0	0	3
PRACTICALS								
7	CS1407	Operating Systems Laboratory **(Common to CSE & IT)**	PCC	4	0	0	4	2
8	ML1408	Machine Learning Laboratory **(Common to AI-DS & IT)**	PCC	4	0	0	4	2
Total				**29**	**18**	**1**	**10**	**24**

SEMESTER – V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1501	Reinforcement Learning	PCC	3	3	0	0	3
2	DS1502	Advanced Artificial Intelligence **(Common to AI-DS)**	PCC	4	3	1	0	3
3	ML1502	Nature Inspired ComputingTechniques	PCC	3	3	0	0	3
4	ML1503	Web programming (Lab Integrated)	PCC	5	3	0	2	4
5		Open Elective-I	OEC	3	3	0	0	3
6		Professional Elective - I	PEC	3	3	0	0	3
PRACTICALS								
7	ML1507	Applied Reinforcement Laboratory	PCC	4	0	0	4	2
8	DS1508	Advanced Artificial Intelligence Laboratory **(Common to AI-DS)**	PCC	4	0	0	4	2
Total				**29**	**18**	**1**	**10**	**23**

SEMESTER – VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1601	Deep Learning	PCC	3	3	0	0	3
2	ML1602	Autonomous Mobile Robot (Lab Integrated)	PCC	5	3	0	2	4
3	ML1603	Probabilistic Graphical Models	PCC	3	3	0	0	3
4	ML1604	Big Data Analytics	PCC	3	3	0	0	3
5		Open Elective-II	OEC	3	3	0	0	3
6		Professional Elective-II	PEC	3	3	0	0	3
PRACTICALS								
7	ML1607	Deep Learning Laboratory	PCC	4	0	0	4	2
8	ML1608	Socially relevant Project	EEC	4	0	0	4	2
9		Value Added Course	EEC	3	1	0	2	2
10		Audit Course (Optional)	AC					2
Total				**31**	**19**	**0**	**12**	**23**

For Value Added Course, the grades earned by the students will be recorded in the Mark Sheet. However, the same shall not be considered for the computation of CGPA

SEMESTER – VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1701	Statistical Natural Language Processing	PCC	3	3	0	0	3
2	ML1702	Formal Languages and Automata Theory	PCC	3	3	0	0	3
3	ML1703	Image Processing and Vision Techniques	PCC	3	3	0	0	3
4	ML1704	Edge AI	PCC	3	3	0	0	3
5		Professional Elective-III	PEC	3	3	0	0	3
6		Professional Elective-IV	PEC	3	3	0	0	3
PRACTICALS								
7	ML1708	Capstone Project-Phase1	ECC	4	0	0	4	2
8	ML1709	Industrial AI Applications Laboratory	PCC	4	0	0	4	2
9	ML1710	Internship	EEC					1
10	CT1701	Credit Course on Advanced Data Management and Machine Intelligence by Cognizant **(Common to AI-DS & AI-ML)**	EEC	2	0	0	2	1
Total				**28**	**18**	**0**	**10**	**22**

* Two weeks summer internship carries one credit and it will be done during VI semester vacation and same will be evaluated in VII semester

* Credit Course -Evaluation is Fully Internal

SEMESTER - VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective-V	PEC	3	3	0	0	3
2		Professional Elective-VI	PEC	3	3	0	0	3
PRACTICALS								
3	ML1807	Capstone Project-Phase2	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

Total Credits: 180

HUMANITICS SCIENCE AND MANAGEMENT COURSES (HSMC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	HS1201	Professional English	HSMC	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	HS1310	Professional Skills Laboratory	HSMC	2	0	0	2	1

BASIC SCIENCE COURSES (BSC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	MA1102	Engineering Mathematics - I	BSC	4	3	1	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1251	Linear Algebra	BSC	4	3	1	0	4
6	PH1252	Physics for Information Science	BSC	3	3	0	0	3
7	MA1354	Probability and Bayesian Inference	BSC	4	3	1	0	4
8	MA1454	Discrete Mathematics and Graph Theory	BSC	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1251	Basic Electrical and Electronics Engineering	ESC	3	3	0	0	3
5	GE1207	Engineering Practice Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CS1206	Programming in C	PCC	3	3	0	0	3
2	CS1208	Programming in C Laboratory	PCC	4	0	0	4	2
3	CS1302	Data Structures	PCC	3	3	0	0	3
4	DS1303	Introduction to Artificial Intelligence	PCC	3	3	0	0	3
5	ML1301	Data Foundation	PCC	3	3	0	0	3
6	ML1302	Object Oriented Software Engineering (Lab Integrated)	PCC	5	3	0	2	4
7	ML 1303	Optimization for Machine Learning	PCC	3	3	0	0	3
8	DS1307	Data Structures Laboratory using Python	PCC	4	0	0	4	2
9	DS1308	Artificial Intelligence Laboratory	PCC	4	0	0	4	2
10	CS1401	Design and Analysis of Algorithms	PCC	3	3	0	0	3
11	CS1402	Operating Systems	PCC	3	3	0	0	3
12	CS1403	Database Design and Management (Lab Integrated)	PCC	5	3	0	2	4
13	ML1401	Foundations of Machine Learning	PCC	3	3	0	0	3
14	ML1402	Statistics for Machine Learning	PCC	3	3	0	0	3
15	CS1407	Operating Systems Laboratory	PCC	4	0	0	4	2
16	ML1408	Machine Learning Laboratory	PCC	4	0	0	4	2
17	ML1501	Reinforcement Learning	PCC	4	3	0	0	3
18	DS1502	Advanced Artificial Intelligence	PCC	4	3	1	0	3
19	ML1502	Nature Inspired Computing Techniques	PCC	4	3	0	0	3
20	ML1503	Web programming(Lab Integrated)	PCC	5	3	0	2	4
21	ML1507	Applied Reinforcement Laboratory	PCC	4	0	0	4	2

22	DS1508	Advanced Artificial Intelligence Laboratory	PCC	4	0	0	4	2
23	ML1601	Deep Learning	PCC	4	3	0	0	3
24	ML1602	Autonomous Mobile Robot (Lab Integrated)	PCC	4	3	0	2	4
25	ML1603	Probabilistic Graphical Models	PCC	4	3	0	0	3
26	ML1604	Big Data Analytics	PCC	4	3	0	0	3
27	ML1607	Deep Learning Laboratory	PCC	4	0	0	4	2
28	ML1701	Statistical Natural Language Processing	PCC	4	3	0	0	3
29	ML1702	Formal Languages and Automata Theory	PCC	4	3	0	0	3
30	ML1703	Image Processing and Vision Techniques	PCC	4	3	0	0	3
31	ML1704	Edge AI	PCC	4	3	0	0	3
32	ML1709	Industrial AI Applications Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSES (PEC)

PROFESSIONAL ELECTIVE – I (SEMESTER V)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1511	Advanced Databases	PEC	3	3	0	0	3
2	ML1512	Semantic Web	PEC	3	3	0	0	3
3	ML1513	Advanced Data Structures	PEC	3	3	0	0	3
4	ML1514	Logic Programming	PEC	3	3	0	0	3
5	ML1515	Applications of Machine Learning In Industries	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (SEMESTER VI)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1611	Green Computing	PEC	3	3	0	0	3
2	ML1612	Game Programming	PEC	3	3	0	0	3
3	ML1613	Intelligent Transport Systems	PEC	3	3	0	0	3
4	ML1614	Parallel and Distributed Computing	PEC	3	3	0	0	3
5	ML1615	Case Based Reasoning	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (SEMESTER VII)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1711	AI for Clinical Information System	PEC	3	3	0	0	3
2	ML1712	Game Theory	PEC	3	3	0	0	3
3	ML1713	Data Mining and Predictive Modelling	PEC	3	3	0	0	3
4	ML1714	Machine Intelligence for Network Sciences	PEC	3	3	0	0	3
5	ML1715	Intelligent Machining	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (SEMESTER VII)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1721	Genetic Algorithm	PEC	3	3	0	0	3
2	ML1722	Speech Processing	PEC	3	3	0	0	3
3	ML1723	Advanced Optimization Techniques	PEC	3	3	0	0	3
4	CS1725	Human Computer Interaction	PEC	3	3	0	0	3
5	ML1726	Cloud Computing Techniques	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (SEMESTER VIII)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1811	Video Analytics	PEC	3	3	0	0	3
2	ML1812	Block chain Architecture Design	PEC	3	3	0	0	3
3	ML1813	Microsoft Bots Framework	PEC	3	3	0	0	3
4	ML1814	Business Intelligence	PEC	3	3	0	0	3
5	MG1815	Supply Chain Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (SEMESTER VIII)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1821	Internet of Everything	PEC	3	3	0	0	3
2	ML1822	Ethics and AI	PEC	3	3	0	0	3
3	ML1823	Agile Software Development	PEC	3	3	0	0	3
4	ML1824	Brain Computer Interface	PEC	3	3	0	0	3
5	DS1821	Cognitive Systems	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES – I & II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
2	OBT104	Biosensors	OEC	3	3	0	0	3
3	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3
4	OCE102	Introduction to Geographic Information System	OEC	3	3	0	0	3
5	OCH101	Hospital Management	OEC	3	3	0	0	3
6	OEC103	Basics of Embedded Systems and IoT	OEC	3	3	0	0	3
7	OEE101	Basic Circuit Theory	OEC	3	3	0	0	3
8	OEE103	Introduction To Renewable Energy Systems	OEC	3	3	0	0	3
9	OEI102	Robotics	OEC	3	3	0	0	3
10	OMB101	Total Quality Management	OEC	3	3	0	0	3
11	OME104	Industrial Safety Engineering	OEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	ML1608	Socially relevant Project	EEC	4	0	0	4	2
2	ML1708	Capstone Project-Phase1	EEC	4	0	0	4	2
3	ML1807	Capstone Project-Phase2	EEC	20	0	0	20	10
4	CT1701	Advanced Data Management and Machine Intelligence	EEC	2	0	0	2	1
5		Value Added Course	EEC	3	1	0	2	2
6	ML1710	Internship	EEC					1

AUDIT COURSES (AC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	2
2	AD1002	Value Education	AC	2	2	0	0	2
3	AD1003	Pedagogy Studies	AC	2	2	0	0	2
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	2
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	2
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	2
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	2
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	2

* Registration for any of these courses is optional to students

VALUE ADDED COURSES

S.No.	COURSE CODE	COURSE TITLE
1	VAC001	Industrial Internet of Things
2	VAC002	Augmented Reality & Virtual Reality
3	VAC003	Ethical Hacking - Cyber Security
4	VAC004	Blockchain and Crypto currencies
5	VAC005	Industrial practices with DevOps
6	VAC006	Applied Machine Learning with Python

CREDIT SUMMARY

	I	II	III	IV	V	VI	VII	VIII	Total	PERCENTAGE OF CREDIT
HSMC	3	6	1						10	5.55
BSC	12	7	4	4					27	15.00
ESC	9	5							14	7.77
PCC		5	20	20	17	15	14		91	50.55
PEC					3	3	6	6	18	10.00
OEC					3	3			6	3.33
EEC						2	2	10	14	7.77
Total	24	23	25	24	23	23	22	16	180	100

Board Chairman	Dr. A Chandrasekar	
Dean Academics	Dr. G Sreekumar	
Principal	Dr. Vaddi Seshagiri Rao	

B. TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS SYLLABUS

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9
Reading-critical reading-finding key information in a given text – shifting facts from opinions - Writing -autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development-voices-Wh- Questions- asking and answering-yes or no questions-parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		CO1
UNIT II	GENERAL READING AND FREE WRITING	9
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening-long texts-TED talks- extensive speech on current affairs and discussions Speaking-describing a simple process- Asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context –use of sequence words.		CO2
UNIT III	GRAMMAR AND LANGUAGE DEVELOPMENT	9
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing-types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		CO3
UNIT IV	READING AND LANGUAGE DEVELOPMENT	9
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		CO4

UNIT V	**EXTENDED WRITING**	**9**
Reading: Reading for comparisons and contrast and other deeper levels of meaning -Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening - popular speeches and presentations - Speaking- impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
(Common for all Branches of B.E. /B. TECH Programmes)		3	1	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of single variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms		CO1
UNIT II	CALCULUS OF ONE VARIABLE	12
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		CO2
UNIT III	CALCULUS OF SEVERAL VARIABLES	12
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		CO3
UNIT IV	INTEGRAL CALCULUS	12
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		CO4
UNIT V	MULTIPLE INTEGRALS	12
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

UPON COMPLETION OF THE COURSE, STUDENTS WILL BE ABLE TO

CO1	Have a clear idea of matrix algebra pertaining Eigen values and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COS WITH POS AND PSOS

COS	PROGRAM OUTCOMES (POS)												PROGRAM SPECIFIC OUTCOMES (PSOS)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
(Common for all branches of B.E. /B. Tech Programmes)		3	0	0	3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity.
- Principles of laser and fiber optics and its various technological applications.
- Thermal conduction in solids, heat exchangers and its applications in various devices.
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques.

UNIT I	PROPERTIES OF MATTER	9
Elasticity - Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength - torsional stress and deformations - twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - Practical applications of modulus of elasticity- I shaped girders - stress due to bending in beams.		CO1
UNIT II	**LASER AND FIBER OPTICS**	**9**
Lasers : population of energy levels, Einstein's A and B coefficients derivation - resonant cavity optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser- Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) - losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system.		CO2
UNIT III	**THERMAL PHYSICS**	**9**
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity -Rectilinear flow of heat- conduction through compound media (series and parallel)- Lee's disc method: theory and experiment - Radial flow of heat- thermal insulation - applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		CO3
UNIT IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope- tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		CO4
UNIT V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal		CO5

systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults - growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press,2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers,2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India,2013.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley,2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman,2014.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young's modulus by various methods.
CO2	Principle of laser, Einstein's coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.
CO3	The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee's disc method and radial flow of heat.
CO4	The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunnelling electron microscopy and its applications.
CO5	The importance of various crystal structures, Miller indices and various growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

To make the student conversant with the

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non-conventional energy sources and energy storage device

UNIT I	**WATER AND ITS TREATMENT**	**9**
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) - Treatment of boiler feed water - Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment - Ion exchange process, Zeolite process - Desalination of brackish water by reverse Osmosis.		**CO1**
UNIT II	**SURFACE CHEMISTRY AND CATALYSIS**	**9**
Surface chemistry : Types of adsorption - Adsorption of gases on solids - Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography - Applications of adsorption in pollution abatement using PAC. **Catalysis**: Catalyst - Types of catalysis - Criteria - Contact theory - Catalytic poisoning and catalytic promoters - Industrial applications of catalysts - Catalytic convertor - Auto catalysis - Enzyme catalysis - Michaelis-Menten equation.		**CO2**
UNIT III	**PHASE RULE AND ALLOYS**	**9**
Phase rule: Introduction - Definition of terms with examples - One component system - Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems - Lead-silver system - Pattinson process. **Alloys**: Introduction - Definition - Properties of alloys - Significance of alloying - Functions and effect of alloying elements - Nichrome, Alnico, Stainless steel (18/8) - Heat treatment of steel - Non-ferrous alloys - Brass and bronze.		CO3
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction - classification of fuels - Comparison of solid, liquid, gaseous fuels - Coal - Analysis of coal (proximate and ultimate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - Cracking - Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) - Knocking - Octane number - Diesel oil - Cetane number - Compressed natural gas (CNG) - Liquefied petroleum gases (LPG) - Power alcohol and biodiesel. **Combustion of fuels**: Introduction - Calorific value - Higher and lower calorific values - Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature - Explosive range - Flue gas analysis by Orsat Method.		CO4
UNIT V	**NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear energy - Fission and fusion reactions - Differences - Chain reactions - Nuclear reactors - Classification of reactors - Light water nuclear reactor for power generation - Breeder reactor - Solar energy conversion - Solar cells - Wind energy - Fuel cells - Hydrogen-oxygen fuel cell . Batteries - Types of batteries - Alkaline batteries - Lead-acid, Nickel-cadmium and Lithium batteries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).

3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company (P) Ltd., Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, “Engineering Chemistry”, Firewall Media, New Delhi., (2010).
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

COURSE OUTCOMES

Upon completion of the course, the students should be

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file based program

UNIT I	**ALGORITHMIC PROBLEM SOLVING**	**9**
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**
UNIT II	**INTRODUCTION TO PYTHON**	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode; Introduction to colab , pycharm and jupyter idle(s) ,values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators; Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, , expressions, tuple assignment; Accepting input from Console, printing statements, Simple 'Python' programs.		**CO2**
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions, function definition and use, flow of execution, parameters and arguments; local and global scope, return values, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, List Manipulation, mutability, aliasing, cloning lists, list parameters; Lists as arrays, Tuples: tuple assignment, tuple as return value, Tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.		**CO4**
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions-open(), close(), read(), readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments. Errors and exceptions, handling exceptions, modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy file.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCE BOOKS

1. John V Guttag, ―Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO2	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO3	3	3	3	-	2	-	-	2	3	2	-	2	1	2	2
CO4	3	3	3	-	2	-	-	2	3	2	-	2	1	2	2
CO5	3	3	3	-	2	-	-	2	3	2	-	2	1	2	1

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	2	0	4	4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		1
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale -Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.

4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm, draw flowchart illustrating mail merge concept.	CO1
2. Write an algorithm , draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two dimensional arrays. • Transpose, addition, multiplication, scalar , determinant of a matrix	
5. Program to explore string functions and recursive functions.	CO2
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	CO3
11. Demonstrate Exceptions in Python.	
12. Applications: Implementing GUI using turtle, pygame.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Python 3 interpreter for Windows/Linux

REFERENCE BOOKS

1. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.

4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	3	2	-	2	2	-	-
CO2	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO3	3	3	3	-	2	-	-	2	3	2	-	2	2	-	1

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties , Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS - PHYSICS

Experiment	CO
(A minimum of 5 experiments to be performed from the given list)	
1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	CO1
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	CO1
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	CO2
4. Determination of dispersive power of prism using Spectrometer.	CO2
5. (a) Determination of wavelength and particle size using a laser. (b) Determination of numerical aperture and acceptance angle of an optical fibre. (c) Determination of width of the groove of compact disc using laser.	CO2
6. Determination of Young's modulus of the material of the given beam by uniform bending method.	CO1
7. Determination of energy band gap of the semiconductor.	CO2
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	CO2
DEMONSTRATION EXPERIMENT	
1. Determination of thickness of a thin sheet / wire – Air wedge method	CO1

LIST OF EXPERIMENTS - CHEMISTRY

Experiment	CO
(A minimum of 6 experiments to be performed from the given list)	
1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	CO5
2. Determination of total, temporary & permanent hardness of water by EDTA method.	CO5
3. Determination of DO content of water sample by Winkler's method.	CO5
4. Determination of chloride content of water sample by argentometric method.	CO3
5. Estimation of copper content of the given solution by Iodometry.	CO3
6. Determination of strength of given hydrochloric acid using pH meter.	CO3
7. Determination of strength of acids in a mixture of acids using conductivity meter.	CO4
8. Estimation of iron content of the given solution using potentiometer.	CO4
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	CO4
10. Conductometric titration of strong acid vs strong base.	CO4
DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).	CO3
2. Estimation of sodium and potassium present in water using flame	CO5

COURSE OUTCOMES **Upon completion of the course, the students should be**	
CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the procedure to estimate the amount of dissolved oxygen present in the water.
CO2	Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating. Able to understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.
CO3	Able to understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor. Able to understand the principle and procedure involved in the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of microscope and its applications in determining the moduli. Able to understand the concept of determining the emf values by using potentiometer.
CO5	Able to calculate the particle size of poly crystalline solids. Able to understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
(Common for all branches of B.E. /B. Tech Programmes)		3	0	0	3

OBJECTIVES

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	READING AND STUDY SKILLS	9
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process-Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs - easily confused words Language Development-impersonal passive voice, numerical adjectives.		CO1
UNIT II	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process-Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs – easily confused words Language Development- impersonal passive voice, numerical adjectives.		CO2
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening-listening to conversation-effective use of words and their sound aspects, stress, intonation & pronunciation- Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing- Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		CO3
UNIT IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking- expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application - cover letter -Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		CO4
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking -participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)- Writing reports- minutes of a meeting- accident and survey-Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and

Practice. Oxford University Press: New Delhi,2014.

2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	-	-	3
CO2	-	1	-	2	-	-	-	-	-	3	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	1	2	-	-	3	-	1
CO4	-	-	-	-	1	-	-	-	2	2	-	-	1	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	2	-	1

MA1251	LINEAR ALGEBRA	L	T	P	C
	(Common to AI-DS)	3	1	0	4

OBJECTIVES

- To test the consistency and solve the system of linear equations
- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To find orthonormal basis of inner product space and find least square approximation
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I	**MATRICES AND SYSTEM OF LINEAR EQUATIONS**	**12**
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordon method.		**CO1**
UNIT II	**VECTOR SPACES**	**12**
Vector spaces, Subspaces, Linear combinations, Linear independence and linear dependence, Bases and dimensions.		**CO2**
UNIT III	**LINEAR TRANSFORMATION**	**12**
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation.		**CO3**
UNIT IV	**INNER PRODUCT SPACES**	**12**
INNER product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation		**CO4**
UNIT V	**EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION**	**12**
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Friedberg S.H, Insel A.J. and Spence L, Linear Algebra, Fifth edition, Pearson, 2018
2. Burden R. and Faires J.D. Numerical Analysis, tenth edition, Brooks/Cole, 2015.
3. Strang G, Linear algebra for everyone, Wellesley Cambridge press, 2020.

REFERENCE BOOKS

1. Seymour Libschutz and Marc Lipson, Linear Algebra, Sixth edition, McGraw Hill Education India private limited, New Delhi, 2017.
2. Iyengar S.R.K. and Jain R.K., Numerical Methods, Third edition, New age international publications, 2012.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Bernard Kolman and David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, First Reprint, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Test the consistency and solve the system of linear equations
CO2	Find the basis and dimension of vector space
CO3	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors
CO4	Find orthonormal basis of inner product space and find least square approximation
CO5	Determine eigen values of a matrix using numerical techniques and perform matrix decomposition

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	-	-	1	1	3	3	3	3
CO2	3	3	2	3	2	2	1	-	-	-	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	3	3

PH1252	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
	(Common to CSE, AI-DS & IT)	3	0	0	3

OBJECTIVES

To make the student

- To acquire knowledge on the electron transport properties
- To understand the essential principles of semiconductor device
- To have the necessary understanding in optical properties of materials.
- To grasp the principles of magnetic materials and its applications.
- To understand the basics of Nano-electronic devices.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9
	Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - Electron effective mass - concept of hole - Applications of low resistive and high resistive materials.	CO1
UNIT II	**SEMICONDUCTOR PHYSICS**	**9**
	Intrinsic semiconductors - Energy band diagram - direct and indirect band gap semiconductors - carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n-type & p-type semiconductors - variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - carrier transport in semiconductors - Hall effect and devices - Ohmic contacts – Schottky diode - Semiconducting polymers.	CO2
UNIT III	**MAGNETIC PROPERTIES OF MATERIALS**	**9**
	Magnetism in materials - magnetic dipole moment - magnetic permeability and susceptibility - Microscopic classification of magnetic materials : diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - ferrimagnetism - Curie temperature - Domain Theory - M versus H behaviour - Hard and soft magnetic materials - examples and uses - Magnetic principle in computer data storage - Magnetic hard disc - Spintronics - GMR Sensor (Giant Magnetoresistance) - TMR (Tunnel Magnetoresistance)	CO3
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
	Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - p-i-n Photodiodes - Avalanche Photodiodes -Optical data storage techniques- Holography - applications.	CO4
UNIT V	**NANO DEVICES**	**9**
	Electron density in bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Ballistic transport - Carbon nanotubes: properties and applications - Material Processing by chemical vapour deposition and Laser ablation method - Graphene: properties and applications.	CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jasprit Singh, ¯ Semiconductor Devices: Basic Principles, Wiley 2012.
2. Donald Neaman, Dhrubes Biswas , Semiconductor Physics and Devices (SIE), 4th Edition, 2017
3. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., “Physics for Electronics Engineering and Information Science”, McGraw Hill Education (India) Private Limited, 2018.
4. Kasap, S.O. ¯ Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
5. Kittel, C. ¯ Introduction to Solid State Physics, Wiley, 2005.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. ¯Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. ¯Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. ¯Nanotechnology: Understanding small systems, CRC press, 2014

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Gain knowledge on classical and quantum electron theories and energy band structures.
CO2	Acquire knowledge on basics of semiconductor physics and its applications in various devices.
CO3	Get knowledge on magnetic properties of materials and their applications in data storage.
CO4	Have the necessary understanding on the functioning of optical materials for Optoelectronics.
CO5	Understand the basics of quantum structures and their applications in nano electronic devices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	2	2	3
CO3	3	3	1	1	2	2	1	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To study the inter relationship between living organisms and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	11
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection - Concept of an ecosystem - Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity -Consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity -Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act - Endangered and endemic species - Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.		CO1
UNIT II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - Solid waste management: causes, effects and control measures of municipal solid wastes - Problems of e-waste - Role of an individual in prevention of pollution - Pollution case studies - Disaster management - Floods, earthquake, cyclone, tsunami and landslides - Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		CO2
UNIT III	**NATURAL RESOURCES**	**9**
Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water - Dams: benefits and problems - Mineral resources: Uses and exploitation - Environmental effects of extracting and using mineral resources - Case studies - Food resources: World food problems - Changes caused by agriculture and overgrazing - Effects of modern agriculture: fertilizer-pesticide problems, water logging, salinity - Case studies - Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources -Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles - Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		CO3
UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**8**
From unsustainable to sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, watershed management - Resettlement and rehabilitation of people; its problems and concerns, case studies - Role of non-governmental organization - Environmental ethics - Issues and possible solutions - Climate change - Global warming -		CO4

Acid rain, Ozone layer depletion -Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation- Central and state pollution control boards- National Green Tribunal – Public awareness.	
UNIT V — **HUMAN POPULATION AND THE ENVIRONMENT**	**8**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS -COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2^{nd} edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hyderabad, (2015).
3. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd, Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies - From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, the students should be able

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to the environmental problems.
CO5	To understand the impact of environment on human population and human health.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

BE1251	BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
	(Common to CSE, AI-DS & IT)	3	0	0	3

OBJECTIVES

- To learn the fundamental laws, network theorems and analyse the electric circuits.
- To study the basic principles of electrical machines and their performance.
- To study the fundamentals of power systems.
- To learn the characteristics of various electron devices and Op Amp integrated circuit.
- To understand the principle and operation of measuring instruments and transducers.

UNIT I	ELECTRIC CIRCUITS ANALYSIS	9
Ohms Law, Kirchhoff's Law-Instantaneous power - Series and parallel circuit: analysis of resistive, capacitive and inductive network, star delta conversion, Nodal analysis and mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, superposition theorem and maximum power transfer theorem. Three phase ac supply -Instantaneous power, Reactive power and apparent power.		CO1
UNIT II	ELECTRICAL MACHINES	9
DC and AC ROTATING MACHINES: Types, Construction, principle, EMF and torque equation, application, Speed Control. Basics of Stepper Motor and Brushless DC motors. Transformers-Introduction, types and construction, working principle of Ideal transformer, EMF equation, All day efficiency calculation.		CO2
UNIT III	FUNDAMENTALS OF POWER SYSTEM	9
Structure of power system. Sources of electrical energy – Non-renewable, Renewable-Storage systems: Batteries-Ni-Cd, Pb -Acid and Li-ion, SOC (State of Charge), DOD (Depth of Discharge) Characteristics. Utilization of electrical power - DC and AC load applications. - Electric circuit Protection-need for earthing, fuses and circuit breakers.		CO3
UNIT IV	ELECTRON DEVICES AND INTEGRATED CIRCUITS	9
PN Junction-VI Characteristics of Diode, Zener diode, Rectifiers, Zener voltage regulator. Transistor configurations – CE amplifier - RC and LC oscillators. Op Amps – Basic characteristics and its applications.		CO4
UNIT V	MEASURING INSTRUMENTS AND TRANSDUCERS	9
Characteristic of measurement-errors in measurement – Principle and working of indicting instrument- Moving Coil meter, Moving Iron meter, Energy meter and watt meter, Cathode Ray Oscilloscope -- Transducers, thermo-electric, RTD, Strain gauge, LVDT, LDR, and piezoelectric transducer.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, fourth Edition, 2019
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCE BOOKS

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. S.Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, sixth edition,2017.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Ability to learn the fundamental laws, theorems of electrical circuits and to analyze them
CO2	Ability to understand the basic construction and operating principle of dc and ac machines.
CO3	Ability to understand the electrical power generation, energy storage and utilization of electric power.
CO4	Ability to understand the characteristics of various electronic devices and Op Amp integrated circuit
CO5	Ability to understand the principles and operation of measuring instruments and transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO2	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO3	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO4	3	3	3	3	1	1	1	3	3	3	1	3	3	1	3
CO5	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2

CS1206	PROGRAMMING IN C	L	T	P	C
	(Common to CSE, AI-DS & IT)	3	0	0	3

OBJECTIVES

- To develop C Programs using basic programming constructs
- To develop C programs using arrays, strings and functions
- To develop applications in C using pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT I	BASICS OF C PROGRAMMING	9
An overview of C: History of C; Compiler Vs. Interpreter, Structure of a C Program, Library and Linking, Compiling a C Program; Basic data types , Modifying the basic data types, Variables: Type qualifiers, Storage class specifiers; Constants: Enumeration Constants; Keywords; Operators: Precedence and Associativity; Expressions: Order of evaluation, Type conversion in expression, Casts; Input/Output statements; Assignment statements, Selection statements; Iteration statements; Jump statements; Expression statements; Pre-processor directives: Compilation process		CO1
UNIT II	**ARRAYS, STRINGS AND FUNCTIONS**	**9**
Introduction to Arrays: Declaration, Initialization, Single dimensional array, Two dimensional arrays, Array Manipulations; String operations: length, compare, concatenate, copy; Functions: General form of a function, Function Arguments, Built-in functions, return statement, Recursion		CO2
UNIT III	**POINTERS**	**9**
Pointers: Declaring and defining pointers, Pointer operators, Pointer expression; Pointer Assignment, Pointer Conversions, Pointer arithmetic, Pointer Comparisons; Pointers and Arrays: Array of pointers; Multiple Indirection; Pointers to function; Problems with Pointers; Parameter passing: Pass by value, Pass by reference.		CO3
UNIT IV	**STRUCTURES AND UNIONS**	**9**
Structure: Accessing Structure members, Structure Assignments; Nested structures; Pointer and Structures; Array of structures; Passing Structures to Functions: Passing structure member to function, Passing entire structure to functions; Arrays in Structures; Self-referential structures; Dynamic memory allocation ; typedef statement, , Union and Enumeration		CO4
UNIT V	**FILE PROCESSING**	**9**
File System Basics: File Pointer, Opening and Closing a File; Reading and Writing Character; Working with String: fputs() and fgets(); rewind(); ferror(); fread() and fwrite(); Erasing files; Types of file processing: Sequential access; Random access: fprintf() and fscanf(), fseek() and ftell(); Command line arguments.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, ¯The C Programming language‖, Second Edition, Pearson Education,2006.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel,¯C HowtoProgram‖,Seventh edition,Pearson Publication
2. Juneja, B.L andAnitaSeth,¯Programmingin C‖,CENGAGELearning India pvt.Ltd.,2011.
3. Pradip Dey,Manas Ghosh,¯FundamentalsofComputingandProgramming in C,First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, ¯Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia,2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education,1996.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C usingstructures and union.
CO5	Design applications using sequential and random-access fileprocessing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

GE1207	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13 **Buildings:** (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects. **Plumbing Works:** (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings. (b) Study of pipe connections requirements for pumps and turbines. (c) Preparation of plumbing line sketches for water supply and sewage works. **(d) Hands-on-exercise:** Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components. (e) Demonstration of plumbing requirements of high-rise buildings. **Carpentry using Power Tools only:** (a) Study of the joints in roofs, doors, windows and furniture. (b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.	**CO1**
II MECHANICAL ENGINEERING PRACTICE 18 **Welding:** (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding. (b) Gas welding practice **Basic Machining:** (a) Simple Turning and Taper turning (b) Drilling Practice **Sheet Metal Work:** (a) Forming & Bending: (b) Model making - Trays and funnels. (c) Different type of joints. **Machine assembly practice:** (a) Study of centrifugal pump (b) Study of air conditioner **Demonstration on:** (a) Smithy operations, upsetting, swaging, setting down and bending. Example -Exercise – Production of hexagonal headed bolt. (b) Foundry operations like mould preparation for gear and step cone pulley. (c) Fitting - Exercises - Preparation of square fitting and V - fitting models.	**CO2**

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.	**CO3**

5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.	CO4
IV ELECTRONICS ENGINEERING PRACTICE 16 1. Study of electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	CO5
	TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 sets
2.	Carpentry vice (fitted to work bench)	15 Nos
3.	Standard woodworking tools 15 Sets.	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	5 Nos
2.	Welding booth with exhaust facility.	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre lathe.	2 Nos
6.	Hearth furnace, anvil and smithy tools.	2 Sets
7.	Moulding table, foundry tools.	2 Sets
8.	Power Tool: Angle Grinder.	2 Nos
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	1 each
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	15 Sets
2.	Electrical measuring instruments.	10 Sets
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	1 each
4.	Megger (250V/500V).	1 No.
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	2 Nos
	ELECTRONICS	
1.	Soldering guns 10 Nos.	10 Nos.
2.	Assorted electronic components for making circuits 50 Nos.	50 Nos.

3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipments to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO2	3	2	3	-	-	3	-	-	-	-	-	3	3	3	3
CO3	3	1	2	-	-	2	-	-	-	-	-	3	3	3	3
C04	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
C05	3	2	2	-	-	2	-	-	-	-	-	3	2	2	2

CS1208	PROGRAMMING IN C LABORATORY	L	T	P	C
	(Common to CSE, AI-DS & IT)	0	0	4	2

OBJECTIVES

- To develop programs in C using basicconstructs.
- To develop applications in C using strings, pointers, functions,structures.
- To develop applications in C using fileprocessing

LIST OF EXPERIMENTS

Experiment	CO
1. C programming using simple statements and expressions.	CO1
2. Scientific problem-solving using decision making and looping.	
3. Generating different patterns using multiple control statements.	
4. Problems solving using one dimensional array.	
5. Mathematical problem solving using two dimensional arrays.	
6. Solving problems using string functions.	CO2
7. Solving problems with user defined functions.	
8. Solving problems using recursive function.	
9. Solving problems with dynamic memory allocation.	
10. Realtime application using structures and unions.	
11. Realtime problem solving using sequential and random-access file.	CO3
12. Solving problems with command line argument.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
1. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving string, functions, recursion, pointers, andstructures.
CO3	Design applications using sequential and random-access fileprocessing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

MA1354	PROBABILITY AND BAYESIAN INFERENCE	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in engineering applications.
- To acquaint the knowledge of testing of hypothesis for small and large samples, which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT	TITLE	PERIODS / CO
UNIT I	**PROBABILITY AND RANDOM VARIABLES**	**12**
Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		**CO1**
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**12**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables).		**CO2**
UNIT III	**RANDOM PROCESSES**	**12**
Classification - Stationary process - Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		**CO3**
UNIT IV	**TESTING OF HYPOTHESIS**	**12**
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.		**CO4**
UNIT V	**BAYESIAN INFERENCE**	**12**
Bayesian Inference for Discrete random variables - Bayesian Inference for Continous random variables – Bayesian Inference for Binomial proportions - Comparing Bayesian and Frequentist inferences for proportion.		**CO5**

TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Ibe, O.C., ¯Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Indian Reprint, 2014.
3. Bolstad, W. M., Curran, J. M. Introduction to Bayesian Statistics. : Wiley. (Unit V Chapter 6, 7, 8 and 9) , Wiley , 2016

REFERENCE BOOKS

1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2017.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014.
3. Papoulis, A. and Unnikrishna pillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.

4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4thEdition, Elsevier, 2009.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	The course gives exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	The course paves ideas to handle situations involving more than one random variable and functions of random variables.
CO3	The course gives an understanding and characterizes phenomena which evolve with respect to time in a probabilistic manner and modelling the real life phenomena.
CO4	Students will gain the knowledge on Large Samples and Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO5	Students will be able to do design of experiments, carry them out, and analyze the data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	3	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	3	2	3	3	2	1	-	-	-	2	2	3	2	1
CO5	3	3	2	3	2	2	1	-	-	-	1	2	2	1	1

CS1302	DATA STRUCTURES	L	T	P	C
(Common to CSE, AI-DS & IT)		3	0	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I	**LINEAR DATA STRUCTURES – LIST**	**9**
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists - applications of lists -Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		**CO1**
UNIT II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	**9**
Stack ADT - Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT - Operations - Circular Queue - Priority Queue - deQueue - applications of queues.		**CO2**
UNIT III	**NON LINEAR DATA STRUCTURES – TREES**	**9**
Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT -Threaded Binary Trees- AVL Trees - B-Tree - B+ Tree - Heap - Applications of heap.		**CO3**
UNIT IV	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**
Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal - Topological Sort - Bi-connectivity -Graph Algorithms - Shortest Path Algorithms: Dijkstra's Algorithm - All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort – Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, Data Structures Using C , Second Edition, Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3

DS1303	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	C
	Common to AI & DS	3	0	0	3

OBJECTIVES

- To impart basic knowledge about Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To learn to represent knowledge in solving AI problems
- To understand the concept of Planning in various situations
- To understand the application of AI namely Expert Systems

UNIT I	INTRODUCTION	9
Introduction–Definition - Foundation and History of AI - Future of Artificial Intelligence - Intelligent Agents- Environments - Structure of Agents - Typical Intelligent Agents		CO1

UNIT II	PROBLEM SOLVING METHODS	9
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning		CO2

UNIT III	KNOWLEDGE REPRESENTATION	9
First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering-Categories and Objects - Time and Event Calculus - Mental Events and Mental Objects - Reasoning Systems for categories - Reasoning with Default Information		CO3

UNIT IV	PLANNING	9
Planning - Introduction - Planning Problem - Planning with State Space Search - Partial Order planning - Construction and Use of Planning Graphs - Conditional Planning - Continuous Planning - Multi Agent Planning		CO4

UNIT V	EXPERT SYSTEMS	9
Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition - Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.

REFERENCE BOOKS

1. M. Tim Jones - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. Nils J. Nilsson - The Quest for Artificial Intelligence, Cambridge University Press,2009.
3. I. Bratko - Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
4. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement basic AI Algorithms
CO2	Use appropriate search algorithms to solve AI based problems
CO3	Represent a problem using first order and predicate logic
CO4	Design a simple agent system with associated planning technique.
CO5	Apply AI techniques to real-world problems to develop expert system

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3

ML1301	DATA FOUNDATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquire knowledge on Data science and its Foundations.
- To explore about the various data process and evaluation methods.
- To understand distinct analysis tools and practice ethical decision and actions.

UNIT I	INTRODUCTION	9
Overview of Data: Definition - Types of data – Quantitative and Qualitative (Nominal, Ordinal, Discrete and Continuous) Big Data: Structured, Unstructured and semi-structured - Metadata: Concepts of metadata – Types of metadata – Uses Data Source: Enterprise Data Source, Social Media Data Source, Public Data Source – Web Scrapping- Basic Concepts of Data Warehouse and Data Mining – Distributed File System		CO1

UNIT II	DATA PROCESS OVERVIEW	9
Defining Goals- Data Acquisition – Sources of acquiring the data - Data preprocessing- Imputation of Missing values - Data cleaning - Data Reduction, Data Transformation and Data Discretization. Exploratory Data Analysis (EDA) – Philosophy of EDA - The Data Science Process. Significance of EDA in data science - Basic tools (plots, graphs and summary statistics) of EDA.		CO2

UNIT III	DATA ORGANIZATION	9
Data Structures: Basics – stack, Queue, Linked List, Tree, Graph - Data Organizational Models- Centralized Model-Embedded Model- Hybrid Model-The Three-Layered structure- Centre of Excellence Model - Roles and Responsibilities- Data Governance Data Privacy-Data Quality- Data Extraction-Extraction and ETL (Extract, Load, Transform)-Types- Physical -Logical- Data extraction with SQL.		CO3

UNIT IV	DATA ANALYSIS AND VISUALIZATION	9
Spreadsheets: Data Manipulations- Sort, filter, remove duplicates-text and math functions-pivot table-lookup functions-Data visualizations for quantitative and qualitative data- charts-Excel Modelling- forecast models using advanced lookup and data validation tools. Tableau: Creating Visualizations in Tableau-Data hierarchies, filters, groups, sets, calculated fields-Map based visualizations-Build interactive dashboards-Data Stories.		CO4

UNIT V	ETHICS AND RECENT TRENDS	9
Data and Business Insights- Data Science Engineering: - Need of Data Science - Ethics – Doing good data science – Natural Language Processing – Machine Learning Model- Valuing Data privacy – Getting informed consent - The Five Cs - Diversity – Inclusion – Future Trends		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition,2016.
2. 2. Ethics and Data Science, D J Patil, Hilary Mason, Mike Loukides, O' Reilly, 1st edition, 2018

REFERENCE BOOKS

1. Introduction to Machine Learning with Python-A Guide for Data Scientists, by Andreas C. Mueller, Sarah Guido, O'Reilly; 1st edition, October 2016.
2. Getting Started with Tableau 2019.2 (Second Edition), Tristan Guillevin, Packt Publishing; 2nd edition June, 2019

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explore the fundamental concepts of Data science
CO2	Understand Data Science Process and Tools of EDA
CO3	Address how Organizational structure's influence efficiency and effectiveness.
CO4	Analyse and Validate data using Spreadsheets and Tableau.
CO5	Think through the ethics incorporating privacy, data sharing and decision-making and Build interactive dashboards for Business

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

<table>
<tr><td>ML1302</td><td colspan="2">OBJECT ORIENTED SOFTWARE ENGINEERING
(Lab Integrated)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="7">OBJECTIVES
• Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
• Design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
• To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.</td></tr>
<tr><td>UNIT I</td><td>JAVA FUNDAMENTALS-OBJECTS, CLASSES AND INTERFACES</td><td colspan="5">9+6</td></tr>
<tr><td colspan="2">Programming Language types and paradigms – Object Oriented Programming Concepts-History of Java - Java buzzwords- JVM architecture – Data Types and Literals in Java-Operators and Control Statements in Java - Array List - Strings and String Buffer - Working with Objects - Implementing Classes - Static Variables and Methods – Packages - Nested Classes – Abstract Class- Interfaces -Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes - Object Cloning.

LAB COMPONENT:

• Create an abstract class Shape with a abstract method area() to find the area of different shapes and a instance variable radius. Extends the Shape class by Cylinder and Cone class with appropriate members and methods to find the volume of cylinder and cone. Write a driver class ShapeDemo with main method in JAVA to implement the abstraction and display the volume of the shapes.
• Create a class named 'Rectangle' with two data members 'length' and 'breadth' and two methods to print the area and perimeter of the rectangle respectively. Its constructor having parameters for length and breadth is used to initialize length and breadth of the rectangle. Let class 'Square' inherit the 'Rectangle' class with its constructor having a parameter for its side (suppose s) calling the constructor of its parent class as 'super(s,s)'. Print the area and perimeter of a rectangle and a square. And repeat the above example to print the area of 10 squares.</td><td colspan="5">CO1</td></tr>
<tr><td>UNIT II</td><td>EXCEPTION, IO STREAMS AND CONCURRENT PROGRAMMING</td><td colspan="5">9+6</td></tr>
<tr><td colspan="2">Exception Handling - The Exception Hierarchy – Keywords – Checked and unchecked Exceptions – User defined Exceptions - Input/Output Streams- Byte Streams, Character Streams- Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads.

LAB COMPONENT:

• Write a Java program to count the number of characters, count, sentences, paragraphs, whitespaces in a file
• Deduce a Java program to perform the following tasks using three different threads. Each thread will be responsible for its own task only. Among these three threads one will find the average number of the input numbers, one will be responsible for finding the Maximum number from the input array of numbers, and one will be responsible for finding the Minimum number from the input array of numbers.</td><td colspan="5">CO2</td></tr>
<tr><td>UNIT III</td><td>PLANNING & SCHEDULING</td><td colspan="5">9+6</td></tr>
<tr><td colspan="2">Introduction to Software Engineering - Software Development process models – Agile</td><td colspan="5">CO3</td></tr>
</table>

<table>
<tr><td colspan="2">Development - Software Requirements Specification, Software prototyping - Software project planning - Scope - Resources - Software Estimation - Empirical Estimation Models – Planning – Risk Management - Software Project Scheduling - Object Oriented Estimation & Scheduling.
LAB COMPONENT:
To Perform Software Requirement Specification of the specified problem and draw a flow chart
1. Health Care
2. Airlines
3. Education</td><td></td></tr>
<tr><td>UNIT IV</td><td>ANALYSIS AND DESIGN</td><td>9+6</td></tr>
<tr><td colspan="2">Analysis Modeling - Data Modeling - Functional Modeling & Information Flow - Behavioral Modeling-Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behaviour Model, Design modelling with UML. Design Concepts & Principles - Design Process - Design Concepts - Modular Design - Design Effective Modularity - Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Object Oriented Design - System design process- Object design process - Design Patterns
.
LAB COMPONENT:
• Understanding different actors and use-cases in detail of the specified problem statement and draw it using StarUML
• To draw the structural view diagram: Class diagram of specified problem statement using StarUML
• To draw the Behavioral View diagram: State Chart diagram and Activity diagram , using StarUML
• To draw Component and Deployment diagram using StarUML</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td>IMPLEMENTATION, TESTING AND MAINTENANCE</td><td>9+6</td></tr>
<tr><td colspan="2">Top - Down, Bottom-Up, object oriented product Implementation & Integration. Software Testing methods-White Box, Basis Path-Control Structure - Black Box - Unit Testing - Integration testing - Validation & System testing - Testing Tools –JUNIT testing- Software Maintenance & Reengineering.

LAB COMPONENT:
• Implement the system as per the detailed design
• Write the test cases and create test plan document for the given system.
• Study of any Open Source Testing tool(Example Testlink)
• Study of Web testing tool(Example Selenium)
• Study of Bug tracking tool (Example bugzilla)
• Study of any Test Management tool (Example Testdirector)</td><td>CO5</td></tr>
<tr><td colspan="3" align="right">PRACTICALS: 30 PERIODS</td></tr>
<tr><td colspan="3" align="right">THEORY: 45 PERIODS</td></tr>
<tr><td colspan="3" align="right">TOTAL : 75 PERIODS</td></tr>
<tr><td colspan="3">TEXT BOOKS</td></tr>
<tr><td colspan="3">1. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
2. Roger. S. Pressman and Bruce R. Maxim, “Software Engineering – A Practitioner’s Approach”, seventh Edition, McGraw Hill, 2015.
3. Ian Sommerville, “Software Engineering”, eighth edition, Pearson Education, New Delhi, 2011.
4. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development (3rd Edition), Pearson Education, 2008.</td></tr>
</table>

REFERENCE BOOKS

1. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018
2. C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
   Grady Booch, James Rumbaugh, Ivar Jacobson - "the Unified Modeling Language User Guide" - Addison Wesley, 1999. 4. Ali Bahrami, “Object Oriented Systems Development” 1st Edition, The McGraw-Hill Company, 1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamental ideas behind the object oriented approach to programming .
CO2	A modern coverage of concurrent programming that focuses on high-level synchronization Constructs.
CO3	Understand software development process models
CO4	Perform overall design using various UML diagrams
CO5	Recognize the knowledge about testing methods and comparison of various testing techniques

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	-	-	1	1	1	1	2	1	1
CO2	1	1	1	1	1	1	-	-	1	1	1	1	2	1	1
CO3	1	2	2	1	1	1	-	-	2	1	2	1	1	1	1
CO4	1	2	2	1	2	1	1	1	2	1	2	1	1	1	1
CO5	1	1	1	1	2	-	1	1	2	1	2	1	1	1	1

ML1303	OPTIMIZATION FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To cover the core concepts of continuous optimization
- To learn about unconstrained and constrained optimization problems.
- To learn methods and algorithms for both convex and non-convex optimization settings

UNIT I	**INTRODUCTION TO OPTIMIZATION**	**9**
Mathematical optimization - Least-squares problem – Linear programming - Role of optimization, Convex optimization - Non-linear optimization - Local and global optimization - Convexity, Examples		**CO1**
UNIT II	**CONVEX SETS AND FUNCTIONS**	**9**
Affine and Convex sets - Operations that preserve convexity – Generalized inequalities - Separating hyper-plane theorem - Convex functions – Basic properties and examples - Conjugate function, conjugate sets.		**CO2**
UNIT III	**CONVEX OPTIMIZATION PROBLEMS**	**9**
Definition and examples - Optimization problems - Convex optimization - Linear optimization - Quadratic optimization problems - Geometric programming - Semi-definite programming - Generalized inequality constraints - Vector optimization.		**CO3**
UNIT IV	**DUALITY**	**9**
Duality theory - Lagrange dual function - Lagrange dual problem – Geometric Interpretation - Weak and strong duality – Saddle point interpretation- Interpretation of dual variables - KKT optimality conditions for non-convex and convex problems.		**CO4**
UNIT V	**METHODS AND ALGORITHMS**	**9**
Unconstrained minimization: Descent methods -Gradient descent method - Steepest descent method - Newton methods - Convergence Analysis.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Guanghui Lan, Lectures on Optimization - Methods for Machine Learning, 2019.
2. Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press, 2004.

REFERENCE BOOKS

1. Dimitri P. Bertsekas, Convex Analysis and Optimization, Athena-Scientific, 2003
2. Nesterov, Introductory Lectures on Convex Optimization: A Basic Course, Springer, 2003
3. Aharon Ben-Tal and Arkadi Nemirovski, Lectures on Modern Convex Optimization, 2001.
4. E.K.P Chong and S.H.Zak, An Introduction to Optimization, 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Know basic terminology and concepts in convex optimization.
CO2	Understand the foundations of classic continuous optimization problems, in particular identifying convexity, smoothness, feasible region, and dual reformulation.
CO3	Design and analyze optimization algorithms for convex optimization problems.
CO4	Use duality and decomposition for parallelization of optimization algorithms.
CO5	Solve standard convex optimization problems arising in various scientific and engineering applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	-	1	-	-	-	2	1	1	1	1	1	1
CO2	2	-	2	-	1	-	-	-	2	1	1	1	1	1	1
CO3	2	1	2	1	1	1	-	-	2	1	1	2	2	2	2
CO4	2	1	2	1	1	1	-	-	2	1	1	2	2	2	2
CO5	2	2	2	2	1	1	-	1	2	2	2	2	2	2	2

DS1307	DATA STRUCTURES LABORATORY USING PYTHON	L	T	P	C
Common for AI-DS		0	0	4	2

OBJECTIVES

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

LIST OF EXPERIMENTS

Experiment	CO
1. IMPLIMENTATION OF LIST Write Python programs to a) Array implementation of Stack ADTs. b) Array implementation of Queue ADTs.	CO1
2. **LIST ADT** Array implementation of List ADT.	
3. IMPLEMENTATION OF STACK AND QUEUE Write Python programs to a) Design and implement Single Linked List. b) Design and implement Stack and its operations using List. c) Design and implement Queue and its operations using List.	
4. APPLICATIONS OF LINEAR DATA STRUCTURE Write Python programs for the following: a) Design and implement polynomial ADT using list b) Uses Stack operations to convert infix expression into postfix expression. c) Uses Stack operations for evaluating the postfix expression.	CO2
5. APPLICATIONS OF TREE a) Write a Python program to Design and implement binary tree. b) Traverse the above binary tree recursively in pre-order, post-order & in-order.	
6. **IMPLEMENTATION OF TREE** Write a Python program to Design and implement binary search tree.	
7. IMPLEMENTATION OF ADVANCED TREE a) Design and Implement AVL tree using Templates. b) Design and Implement heap tree using Templates.	CO3
8. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS Write Python programs for the following: a) Design and Implement Dijkstra's algorithm b) Design and Implement Floyd Warshall algorithm.	CO3
9. IMPLEMENTATION OF MINIMUM SPANNING TREE Write Python programs for the following: a) Design and Implement Kruskal's algorithm. b) Design and Implement Prim's algorithm.	
10. GRAPH TRAVERSAL & APPLICATIONS Write Python programs to implement the following algorithms: a) Depth first search. b) Breadth first search. c) Topological Sorting.	

11. SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION a) Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order. i. Insertion sort ii. Selection sort iii. Quick sort iv. Merge sort b) Write Python programs for implement linear search and binary search. c) Write Python programs for implement Hashing – any two collision techniques	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Rance D. Necaise, Data Structures and Algorithms Using Python, Willy Student Edition, 2016.

WEB REFERENCES

1. https://cloudacademy.com/lab/python-lab-1/
2. https://www.python.org/downloads/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Write functions to implement linear and non-linear data structure operations
CO2	Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

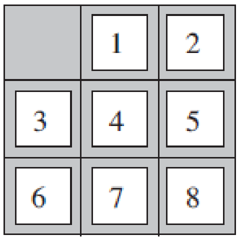
DS1308	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common to AI & DS	0	0	4	2

OBJECTIVES

- To get familiarized with the structure of agents
- To solve simple toy world problems
- To understand and develop solutions through search strategies.
- To develop solutions for constraint satisfaction problems.
- To increase the knowledge about real-world problems and how to plan and act in the real world and to get familiarized with expert systems

LIST OF EXPERIMENTS

1. Developed a simple reflex agent program in Python for the vacuum-cleaner world problem. This particular world has just two locations: squares A and B. The vacuum agent perceives which square it is in and whether there is dirt in the square. It can choose to move left, move right, suck up the dirt, or do nothing.
2. Solve the 8-puzzle problem, which consists of a 3×3 board with eight numbered tiles and a blank space. A tile adjacent to the blank space can slide into the space. The objective is to reach a specified goal state as given below. Find minimum number of steps required to reach the goal.



Goal State

3. Write a Python program to solve N Queen Problem using backtracking. The N Queen is the problem of placing N chess queens on an N×N chessboard so that no two queens attack each other.

CO1

4. Write a Python program for a path search problem to find a path from point A to point B using A* Search Algorithm.
5. Using Hill Climbing Search Algorithm, find the solution for a Travelling Salesman Problem, which has to find the shortest route from a starting location and back to the starting location after visiting all the other cities.
6. Given an undirected graph and a number m, determine if the graph can be coloured with at most m colours such that no two adjacent vertices of the graph are colored with the same color. Here coloring of a graph means the assignment of colors to all vertices.
7. Solve the cryptarithmetic puzzle SEND+MORE=MONEY using a Python program. Find digits that replace letters to make a mathematical statement true. Each letter in the problem represents one digit (0-9). No two letters can represent the same digit. When a letter repeats, it means a digit repeats in the solution.
8. Write a Python program to solve Sudoko. Given an initial 9x9 grid of cells containing numbers between 1 and 9 or blanks, all blanks must be filled with numbers. You win Sudoko if you find all values such that every row, column, and 3x3 sub square contains the numbers 1-9, each with a single occurrence.

CO2

9. A job shop consists of a set of distinct machines that process jobs. Each job is a series of tasks that require use of particular machines for known durations, and which must be completed in specified order. Implement the job shop scheduling problem to schedule the jobs on the machines to minimize the time necessary to process all jobs.
10. Demonstrate the use of MYCIN: a medical expert system. Implement a small example of an expert system; which defines a few contexts, parameters, and rules, and presents a rudimentary user interface to collect data about an infection in order to determine the identity of the infecting organism.

CO3

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS
Standalone desktops with Python 3 Interpreter for Windows/Linux 30 Nos.

REFERENCE BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.

WEB REFERENCES

1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm
2. https://www.edureka.co/blog/artificial-intelligence-with-python/

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Familiarized with the structure of agents, implement simple agents and develop solutions for simple toy world problems.
CO2	Implement and develop solutions for problems through different search strategies. Identify constraints of problems and develop solutions for constraint satisfaction problems.
CO3	Approach a real world problem, develop a plan and then solve those problems and use expert systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	3

HS1310	PROFESSIONAL SKILLS LAB	L	T	P	C
	(Common to IT)	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I	6
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills–Grooming as a professional with values–Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	CO1
UNIT II	6
Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic – answering questions – individual presentation practice–– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	CO2
UNIT III	6
Introduction to Group Discussion– Participating in group discussions - understanding group dynamics - brainstorming the topic -- questioning and clarifying -GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc	CO3
UNIT IV	6
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews-telephone/skype interview -one to one interview &panel interview -Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	CO4
UNIT V	6
Recognizing differences between groups and teams- managing time managing stress-networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes	CO5

TOTAL : 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

One Server
30 Desktop Computers
One Hand Mike
One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015

3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	2	1	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	1	2	-	-	-	-	2
CO4	-	-	-	-	1	-	-	-	2	2	-	-	-	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	2	2

MA1454	DISCRETE MATHEMATICS AND GRAPH THEORY	L	T	P	C
		3	1	0	4

OBJECTIVES

- To introduce Mathematical Logic, Inference Theory and proof methods.
- To provide fundamental principles on combinatorial counting techniques.
- To Demonstrate an understanding of relations and functions
- Be familiar with the most fundamental Graph Theory topics and results

UNIT I	LOGIC AND PROOFS	12
Propositional Logic - Propositional Equivalences - Normal Forms - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.		CO1
UNIT II	COMBINATORICS	12
Mathematical Induction - Strong Induction and Well Ordering - The Basics of Counting - The Pigeonhole Principle - Permutations and Combinations - Recurrence Relations -Generating Functions - Solving Linear Recurrence Relations Using Generating Functions- Inclusion - Exclusion - Principle and Its Applications.		CO2
UNIT III	SETS AND FUNCTIONS	12
Set -Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.		CO3
UNIT IV	GRAPHS	12
Graphs - Introduction - Isomorphism - Sub graphs – Walks, Paths, Circuits -Connectedness - Components – Euler graphs – Hamiltonian paths and circuits		CO4
UNIT V	TREES	12
Trees – Properties of trees – Distance and centers in tree – Rooted and binary trees. - Spanning and Minimal spanning trees.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Kenneth H. Rosen, “Discrete Mathematics and its Applications”, Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2011.
2. Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education, Fifth Edition, New Delhi, 2014.
3. Narsingh Deo, “Graph Theory: With Application to Engineering and Computer Science”, Prentice Hall of India, 2003.

REFERENCE BOOKS

1. Seymour Lipschutz and Mark Lipson,” Discrete Mathematics”, Schaum‘s Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
2. Thomas Koshy,” Discrete Mathematics with Applications”, Elsevier Publications, Boston, 2004.
3. Clark J. and Holton D.A, “A First Look at Graph Theory”, Allied Publishers, 1995.
4. Mott J.L., Kandel A. and Baker T.P. “Discrete Mathematics for Computer Scientists and Mathematicians” , Prentice Hall of India, 1996.
5. Liu C.L., “Elements of Discrete Mathematics”, Mc Graw Hill, 1985.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Construct proofs by using direct proof, proof by contraposition, proof by contradiction. Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositions. Logic helps in arriving inferences for any problem.
CO2	Solve problems such as permutation and combination and in generating functions. Prove mathematical theorems using mathematical induction. Demonstrate basic counting principles, compute and interpret the meaning in the context of the particular application. Helps to apply the combinatorial techniques in Algorithms and Data structure for analysis and design.
CO3	Specify and manipulate basic mathematical objects such as sets, functions, and relations verify simple mathematical properties.
CO4	Apply the graph theory concepts in data structures, data mining, image segmentation and in clustering
CO5	Analyze trees and spanning trees, Minimal Spanning Trees which are helpful in analysis of algorithms, compilation of algebraic expressions, theoretical models of computation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	1	0	0	1	1	2	2	1	1
CO2	3	3	2	2	1	1	1	0	0	1	1	2	2	1	1
CO3	3	3	2	2	1	1	1	0	0	1	1	2	2	1	1
CO4	3	3	2	2	1	1	1	0	0	1	1	2	2	1	1
CO5	2	2	2	2	1	1	1	0	0	1	1	2	2	1	1

CS1401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Common for CSE, IT, AI-DS and AI-ML	3	0	0	3

OBJECTIVES

- To learn the general framework for analyzing algorithm efficiency
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

UNIT I	**INTRODUCTION**	**9**
Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – The Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Non recursive and Recursive Algorithms – Empirical Analysis of Algorithms.		**CO1**
UNIT II	**DECREASE AND CONQUER AND DIVIDE-AND-CONQUER**	**9**
Decrease-and-Conquer- Insertion Sort – Binary Search – Computing a Median and the Selection Problem - Divide-and-Conquer - Merge Sort - Quicksort - The Closest -Pair and Convex -Hull Problems by Divide-and-Conquer.		**CO2**
UNIT III	**DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE**	**9**
The Knapsack Problem and Memory Functions - Optimal Binary Search Trees - Warshall's Algorithm - Floyd's Algorithm - Greedy Technique - Prim's Algorithm - Kruskal's Algorithm - Dijkstra'sAlgorithm – Huffman Trees and Codes.		**CO3**
UNIT IV	**ITERATIVE IMPROVEMENT**	**9**
Graphical Method - The Simplex Method - The maximum Flow Problem - Maximum Matching in Bipartite Graphs – The Stable Marriage Problem.		**CO4**
UNIT V	**BACKTRACKING, BRANCH-AND-BOUND AND APPROXIMATION ALGORITHMS**	**9**
P, NP, and NP- Complete Problems - Backtracking - n-Queens Problem - Hamiltonian Circuit Problem – Subset-Sum Problem – Branch-and-Bound – Assignment Problem – Knapsack Problem - TravelingSalesman Problem - Approximation Algorithms for the Traveling Salesman Problem and the KnapsackProblem.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education, 2011.
3. Donald E. Knuth, “Art of Computer Programming, Volume I - Fundamental Algorithms”, Third Edition, Addison Wesley, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to investigate an algorithm’s efficiency with respect to running time
CO2	Design and implement problems using algorithmic design techniques such as decrease and conquer and divide and conquer
CO3	Ability to understand the design techniques such as Dynamic programming and Greedy technique
CO4	Ability to understand the iterative design techniques
CO5	Understand the variations among tractable and intractable problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO2	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO3	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO4	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO5	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2

CS1402	OPERATING SYSTEMS	L	T	P	C
	(Common to CSE, AI-DS & IT)	3	0	0	3

OBJECTIVES

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I	OPERATING SYSTEM OVERVIEW	9
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.		CO1
UNIT II	**PROCESS MANAGEMENT**	**9**
Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		CO2
UNIT III	**STORAGE MANAGEMENT**	**9**
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Need for Page Replacement, Page Replacement Algorithm, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		CO3
UNIT IV	**FILE SYSTEMS AND I/O SYSTEMS**	**9**
Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.		CO4
UNIT V	**CASE STUDY**	**9**
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, ―Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS

1. RamazElmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems - Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, ―Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education
6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.
7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.
8. http://nptel.ac.in/.
9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Analyze various scheduling algorithms.
CO2	Understand deadlock, prevention and avoidance algorithms.
CO3	Compare and contrast various memory management schemes.
CO4	Understand the functionality of file systems.
CO5	Perform administrative tasks on Linux Servers and Compare iOS and Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1403	DATABASE DESIGN AND MANAGEMENT (Lab Integrated)	L	T	P	C
	(Common to CSE, AI-DS & IT)	3	0	2	4

OBJECTIVES

- To learn the fundamentals of data models, ER diagrams and to study SQL and relational database design.
- To familiarize relational model with Relational Database design and Normal Forms.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To understand the implementation techniques by learning file organization and Query Optimization.
- To understand the concepts of distributed databases, Object Oriented databases and XML databases.

UNIT I	INTRODUCTION TO RELATIONAL DATABASES	9 + 6
	Purpose of Database System – Views of data – Data Models – Database System Architecture Entity-Relationship model - E-R Diagrams - Enhanced-ER Model - ER-to-Relational Mapping- Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features **Lab Component** • Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements .Database Querying – Simple queries, Nested queries, Sub queries and Joins • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views, Synonyms, Sequences. • Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)	CO1
UNIT II	ER MODEL AND RELATIONAL DATABASE DESIGN	9 + 6
	Embedded SQL- Dynamic SQL - Functional Dependencies - Non-loss Decomposition - First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form - Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **Lab Component** • Simple Embedded SQL Program to demonstrate the concepts. • Database Design using normalization and Implementation for any application.	CO2
UNIT III	TRANSACTIONS	9 + 6
	Transaction Concepts - ACID Properties – Schedules – Serializability – Concurrency Control - Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery. **Lab Component** • Usage of Transaction control language commands like commit, rollback and save point. • Develop Programs using BEFORE and AFTER Triggers for INSERT,DELETE and UPDATE statements	CO3
UNIT IV	IMPLEMENTATION TECHNIQUES	9 + 6
	RAID – File Organization – Organization of Records in Files – Indexing and Hashing -Ordered Indices – B+ tree Index Files – B tree Index Files - Static Hashing – Dynamic Hashing. Query Processing Overview - Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation. **Lab Component** • Implementation of B tree and B+ Tree. • Develop programs to demonstrate hashing techniques.	CO4
UNIT V	ADVANCED TOPICS	9 + 6
	Distributed Databases: Architecture, Data Storage, Data Fragmentation - Replication and Allocation Techniques for Distributed Database Design. Distributed Databases: Architecture,	CO5

Data Storage, Transaction Processing - Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery.

Lab Component

- Database Connectivity with Front End Tools
- Case Study using real life database applications.

PRACTICALS: 30 PERIODS	THEORY: 45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson, Seventh Edition, Global Edition,2016
2. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill
3. Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, An Introduction to Cloud Databases,O'Reilly Media, Inc.,2019 ISBN: 9781492044840.

REFERENCE BOOKS

1. C.J.Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education,2004.
2. Guy Harrison, Next Generation Databases: NoSQL, NewSQL, and Big Data, Apress,2015.
3. https://dzone.com/articles/deep-dive-newsql-databases

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Map ER model to Relational model to perform database design effectively
CO2	Able to understand the various normal forms and to minimize the redundancy in the relations
CO3	Able to know the logic behind the transaction processing, concurrency control and to recover system from failures.
CO4	Able to organize, index the files and to optimize the given queries
CO5	Able to know the concepts of distributed databases, Object Oriented databases and XML databases

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

ML1401	FOUNDATIONS OF MACHINE LEARNING	L	T	P	C
	Common for IT, AI-DS & CSE	3	0	0	3

OBJECTIVES

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	**INTRODUCTION**	**9**
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory -Turning Data into Probabilities – The Bias-Variance Trade-off, FIND-S Algorithm, Candidate Elimination Algorithm		**CO1**
UNIT II	**SUPERVISED LEARNING**	**9**
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		**CO2**
UNIT III	**UNSUPERVISED LEARNING**	**9**
Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA)		**CO3**
UNIT IV	**GRAPHICAL MODELS**	**9**
Bayesian Networks – Conditional Independence – Markov Random Fields – Learning – Naive Bayes Classifiers – Markov Model – Hidden Markov Model.		**CO4**
UNIT V	**ADVANCED LEARNING**	**9**
Reinforcement Learning – Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines – Deep Learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, CRC Press, 2014.
4. Tom Mitchell, “Machine Learning”, McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
6. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Gain knowledge about basic concepts of machine learning techniques
CO2	Develop predictive model based on both input and output data
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Ability to address the problem of learning control strategies for autonomous agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

ML1402	STATISTICS FOR MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Be familiar with estimation theory and related concepts.
- Be provide basic applications of testing of hypothesis.
- To introduce correlation functions and ARIMA models.
- To provide fundamental applications on fourier analysis and SARIMA models.
- To demonstrate VC dimension

UNIT I	ESTIMATION THEORY	9
Introduction to estimation theory-Goodness of estimators-Fishers information -Properties of estimators; bias, variance, efficiency- C-R bound- consistency		CO1
UNIT II	BAYESIAN LEARNING	9
Regression -Maximum Likelihood Estimator-MAP Estimator -Evidence Function and Laplacian Approximator-Latent Variables-EM Algorithm.		CO2
UNIT III	ARMA MODELS	9
Auto- and cross-correlation functions- Partial correlation functions -Linear random processes-Auto-regressive-Moving average and ARMA models.		CO3
UNIT IV	ARIMA MODELS AND FOURIER ANALYSIS	9
Models for non-stationary processes-Trends, heteroskedasticity and ARIMA models -Fourier analysis of deterministic signals- DFT and periodogram.		CO4
UNIT V	STATISTICAL LEARNING THEORY	9
Computational Learning Theory-Introduction-General Framework for Concept Learning-PAC Learning Model-VC Dimension-Learning in the presence of noise.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Theodoridis, S, Machine Learning: A Bayesian and Optimization Perspective. United Kingdom: Elsevier Science,2020.
2. Kukar, M., Kononenko, I, Machine Learning and Data Mining. United Kingdom: ElsevierScience,2007.
3. Jonathan D.Cryer,Kung Sik Chan,Time Series Analysis,Springer,Second Edition,2008.
4. Robert H.Shumway,Time Series Analysis and its Applications,Springer,Fourth Edition,2016.
5. Jerome H.Friedman,Robert Tibshirani,The Elements of Statistical Learning,Springer.

REFERENCE BOOKS

1. Kevin Murphy,Machine Learning: A probabilistic perspective,MIT Press,2012
2. Spiegel. M.R., Schiller. J. and Srinivasan, R.A.,Schaum's Outline of Theory and Problems of Probability and Statistics, Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES Upon completion of the course, students will be able to

CO1	Analyze estimation theory and different types of estimators.
CO2	Apply testing of hypothesis related concepts.
CO3	Apply the cross-correlation functions and ARIMA models.
CO4	Specify and manipulate non-stationary processes and SARIMA models.
CO5	Apply the VC dimension in different problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1407	OPERATING SYSTEMS LABORATORY	L	T	P	C
	Common to CSE & IT	0	0	4	2

OBJECTIVES

- To learn basic Unix commands, shell programming and to implement various Process Management functions such as IPC and Scheduling.
- To implement Process Synchronization, Deadlock Detection and Avoidance and Memory Allocation methods.
- To implement Paging Techniques and File Management Techniques.

LIST OF EXPERIMENTS

Experiment	CO
1. Simulation of Unix Commands like cp, ls, grep, cd, mkdir, cat, rm etc.,	CO1
2. Implementation of Shell Programs.	
3. Implementation of CPU Scheduling Algorithms.	
4. Implementation of Producer Consumer problem using Semaphore.	
5. Implementation of Inter-process Communication using Shared memory.	
6. Implementation of Threading and Synchronization Applications.	CO2
7. Implementation of Bankers Algorithm for Deadlock Avoidance.	
8. Implementation of Deadlock Detection Algorithm.	
9. Implementation of Contiguous Memory Allocation.	
10. Implementation of Memory Management scheme using Paging.	CO3
11. Implementation of Page Replacement Algorithms.	
12. Implementation of Directory Structures.	
13. Implementation of File Allocation Strategies.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, ―Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications with shell programming and Scheduling mechanisms.
CO2	Design and develop applications for synchronization, deadlock avoidance and detection.
CO3	Develop applications for implementing Paging and File management concepts.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2

ML1408	MACHINE LEARNING LABORATORY	L	T	P	C
Common for IT, AI-DS & AI-ML		0	0	4	2

OBJECTIVES

- To make use of Data sets in implementing the machine learning algorithms
- To implement the machine learning concepts and algorithms in any suitable language of choice
- To understand the practical aspects of probabilistic graphical models.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV File	CO1
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.	CO1
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	CO2
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	CO2
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	CO2
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	CO3
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can useJava/Python ML library lasses/API	CO3
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library lasses/API in the program.	CO3
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	CO3
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	CO3

TOTAL : 60 PERIODS

REFERENCE BOOKS

3. Aurelien Geron , "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts,Tools, and Techniques to Build Intelligent Systems", Second Edition, O'Reilly Media
4. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018

3. Practical Machine Learning with Python: A Problem-Solver's Guide to Building Real-World IntelligentSystems" Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress, 2023.

WEB REFERENCES

1. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
2. Web Resources: https://www.anaconda.com/enterprise-machine-learning-getting-started/
3. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Update the general and specific boundary for each new example in concept learning
CO2	Develop supervised learning predictive model for general data set
CO3	Ability to apply knowledge representation and machine learning techniques to real world problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

ML1501	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course provides an introduction to some of the foundational ideas on which modern reinforcement learning is built, including Markov decision processes, value functions, Monte Carlo estimation, temporal difference learning, eligibility traces, function approximation& Q Learning.
- This course will develop an intuitive understanding of these concepts (taking the agent's perspective), while also focusing on the mathematical theory of reinforcement learning.
- This course will develop Programming assignments and projects will require implementing and testing complete decision making systems.

UNIT I	**INTRODUCTION TO RL**	**9**
Bandwidth optimalities-Epsilon greedy theory- Concentration bounds-Probably approximate correct (PAC) -Upper confidence bound theory (UCB)-Medium Elimination-Thomson Sampling theory –Thomson sampling with Gaussian reward- Policy search- Gradient Bandwidths- Contextual Bandwidth –returns- value functions.		**CO1**
UNIT II	**MARKOV DECISION PROCESSES & DYNAMIC PROGRAMMING**	**9**
Markov Decision Processes (MDP)- Introduction-Markov Property-MDP modelling- Bellman Equations - Bellman optimality equation- Cauchy sequence- Green's equation- Convergence Proof- LPI Convergence- Value iterations- policy iterations- Dynamic Programming - Monte Carlo (MC)- MC policy evaluation- MC control.		**CO2**
UNIT III	**MONTE CARLO & TEMPORAL DIFFERENCE METHODS**	**9**
OFF Policy Monte Carlo control – Temporal difference- Optimality of TD(0)- State-action- reward-state-action (SARSA) - TD(0) Control- Q Learning – Eligibility traces-Backward View of Eligibility traces- Eligibility trace control.		**CO3**
UNIT IV	**DEEP Q LEARNING**	**9**
Function Approximation – Linear Parameterization- State aggregation methods- LSTD and LSTDQ- LSPI and Fitted Q - Deep Q Network (DQN) – Fitted Q- Iteration- Actor Critic- Reinforce – Policy gradient with function approximation		**CO4**
UNIT V	**HIERARCHICAL RL**	**9**
Introduction- Types of optimality- Semi MDP- Learning with options- Hierarchical abstract machines- MAXQ- MAXQ value function decomposition- option discovery.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Richard S. Sutton and Andrew G. Barto. Introduction to Reinforcement Learning, 2nd Edition, MIT Press. 2017.
2. Neuro Dynamic Programming. Dimitri Bertsikas and John G. Tsitsiklis. Athena Scientific. 1996

REFERENCE BOOKS
1. Algorithms for Reinforcement Learning by Csaba Szepesvari, Morgan and Claypool, 1 edition (2010)
COURSE OUTCOMES **Upon completion of the course, students will be able to**

CO1	Build a Reinforcement Learning system for sequential decision making.
CO2	Understand the space of RL algorithms (Temporal- Difference learning, Monte Carlo, Sarsa, Q-learning, Policy Gradients, Dyna, and more).
CO3	Understand how to formalize your task as a Reinforcement Learning problem, and how to begin implementing a solution.
CO4	Understand how RL fits under the broader umbrella of machine learning, and how it complements deep learning, supervised and unsupervised learning
CO5	Understand a new perspective of Reinforcement Learning.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	1	1	1	1	2	2	2
CO2	2	2	2	2	2	-	-	-	1	1	1	1	2	2	2
CO3	2	2	2	2	2	-	-	-	1	1	1	1	2	2	2
CO4	2	2	1	2	2	-	-	-	1	1	1	1	2	2	2
CO5	2	2	2	2	2	-	-	-	1	1	1	1	2	2	2

DS1502	ADVANCED ARTIFICIAL INTELLIGENCE	L	T	P	C
	(Common to AI-DS)	3	1	0	3

OBJECTIVES

- To analyze Probabilistic Reasoning for knowledge
- To give understanding of main abstractions of decision making.
- To understand a wide variety of learning algorithms.
- To understand the different ways of designing software agents
- To understand the application of AI namely Robotics

UNIT I	UNCERTAINTY AND REASONING	9
Uncertainty - Basic Probability Notation - Axioms of Probability - Bayes Rule - Probabilistic Reasoning - Bayesian Networks - Semantics - Inference - Other Approaches to Uncertain Reasoning – Dempster Shafer Theory – Fuzzy sets and Fuzzy Logic		CO1
UNIT II	**DECISION MAKING**	**9**
Utility Theory - Utility Functions – Decision Networks – Value of Information – Decision Theoretic Expert Systems - Sequential Decision Problems – Value Iteration – Policy Iteration – Decision Theoretic Agents		CO2
UNIT III	**LEARNING METHODS**	**9**
Learning from Observations - Forms of Learning - Inductive Learning - Learning Decision Trees - Ensemble Learning - Explanation Based Learning - Learning with Complete Data - Naïve Bayes Models – Learning with Hidden Variables – The EM Algorithm – Neural Networks		CO3
UNIT IV	**SOFTWARE AGENTS**	**9**
Architecture for Intelligent Agents - Examples - Agent communication - KQML- KIF - FIPA ACL - Speech Acts - Argumentation among Agents - Trust and Reputation in Multi-agent systems		CO4
UNIT V	**ROBOTICS**	**9**
Robot Hardware - Robotic Perception - Planning to Move, Planning Uncertain Movements - Moving – Robotic Software Architectures – Application Domains		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, McGraw Hill- 2008.

REFERENCE BOOKS

1. Gerhard Weiss, - Multi Agent Systems , Second Edition, MIT Press, 2013
2. S. Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011
3. David L. Poole and Alan K. Mackworth, - Artificial Intelligence: Foundations of Computational Agents ,Cambridge University Press, 2010.
4. Nils J. Nilsson,- The Quest for Artificial Intelligence, Cambridge University Press,2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire theoretical knowledge about principles for logic-based representation and reasoning
CO2	Develop a decision making model that utilizes Artificial Intelligence.
CO3	Develop an understanding what is involved in learning models from data.
CO4	Select appropriately from a range of techniques when implementing intelligent systems
CO5	Gain knowledge on the functions of Robots

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3

ML1502	NATURE INSPIRED COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of nature inspired techniques which influence computing
- To study the Swarm Intelligence and Immuno computing techniques.
- To Learn fundamental concepts of fuzzy logic and artificial neural network

UNIT I	INTRODUCTION	9
From Nature to Nature Computing , Philosophy , Three Branches: A Brief Overview, Individuals, Entities and agents - Parallelism and Distributivity Interactivity ,Adaptation Feedback-Self-Organization-Complexity, Emergence and Reductionism, Bottom-up Vs Top-Down- Determination, Chaos and Fractals.		CO1
UNIT II	**SWARM INTELLIGENCE**	**9**
Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge, Particle Swarm Optimization (PSO).		CO2
UNIT III	**IMMUNOCOMPUTING**	**9**
Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction Immune Algorithms--Genetic Algorithms , Reproduction-Crossover, Mutation, Evolutionary Programming, Genetic Programming.		CO3
UNIT IV	**FUNDAMENTALS OF FUZZY LOGIC**	**9**
Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-union intersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems-Fuzzy inference.		CO4
UNIT V	**INTRODUCTION TO NEURAL NETWORKS**	**9**
Introduction – history-Applications-Biological inspiration -Neuron Model and Network Architecture: Objectives – notation – neuron model – Network Architectures – A layer of neurons – multiple layers of Neurons-recurrent networks – An Illustrative example - Perceptron Learning Rule Perceptron Learning Rule : Perceptron architecture -Perceptron learning rule - proof of convergence		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. George J Klir / Bo Yuan ," Fuzzy Sets and Fuzzy Logic Theory and Applications", Prentice Hall
3. Laurene Fausett- "Fundamentals of Neural Networks Architectures, Algorithms and Applications", Prentice Hall, First Edition.

REFERENCE BOOKS
1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008. 2. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006. 3. Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005

COURSE OUTCOMES Upon completion of the course, students will be able to understand	
CO1	The concepts of Natural systems and its applications.
CO2	Basic Natural systems functions(operations) and Natural design considerations.
CO3	The Integration of Hardware and software in Natural applications.
CO4	The basic concept of fuzzy sets, fuzzy logic & defuzzification
CO5	The basics of Artificial Neural Networks

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	-	-	1	1	1	1	2	2	2
CO2	2	2	2	2	1	1	-	-	1	1	1	1	2	2	2
CO3	2	2	2	2	1	1	-	-	1	1	1	1	2	2	2
CO4	2	2	2	2	1	1	-	-	1	1	1	1	2	2	2
CO5	2	2	2	2	1	1	-	-	1	1	1	1	2	2	2

<table>
<tr><td>ML1503</td><td>WEB PROGRAMMING (LAB INTEGRATED)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2"></td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">OBJECTIVES
• To understand and explore HTML, CSS and Java script
• To design interactive web pages using Scripting languages
• To understand the concepts of TypeScript and practice Angular JS Framework
• To work with Express, a Node.js web application framework
To develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management</td></tr>
<tr><td>UNIT I</td><td colspan="4">Web Essentials, HTML & CSS</td><td>9+6</td></tr>
<tr><td colspan="5">Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients-Web Servers - XHTML: Syntax and Semantics - HTML Basic Elements - HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance - Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions - Animations.
Lab Component
• Design a Webpage using all HTML elements
• Create a web page with all types of Cascading style sheets and CSS Selectors</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">Client-Side Scripting and HTML DOM</td><td>9+6</td></tr>
<tr><td colspan="5">Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers. DOM- Introduction to the Document Object Model DOM History and Levels-Intrinsic Event Handling- Modifying Element Style-The Document Tree-DOM Event Handling
Lab Component
Write Client Side Scripts for Validating Web Form Controls using DHTML Design the following using JavaScript and DOM
a. Include Image Slide Show and Digital clock
b. Develop a web application to implement online quiz system</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">WEB APPLICATIONS AND ANGULAR.JS</td><td>9+6</td></tr>
<tr><td colspan="5">Web Application Frameworks - MVC (Model-View-Controller) framework - Jumping into TypeScript - Learning the Different Types Understanding Interfaces - Implementing Classes - Implementing Modules - Understanding Functions - Why Angular? Understanding Angular - Adding Angular to Your Environment-Using the Angular CLI - Creating a Basic Angular Application Angular Components - Component Configuration - Building a Template-Injecting Directives – Expressions - Using Expressions - Using Pipes - Building a Custom Pipe
Lab Component
• Use built-in Angular directives to show and hide elements and display lists of data.
• Design a shopping cart application using AngularJS. Your shopping webpage should have the provisions for selecting the list of items from different category, Once the items are selected on clicking the submit button the items in the cart with its price should be displayed</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="4">INTRODUCTION TO NODE.JS</td><td>9+6</td></tr>
<tr><td colspan="5">Understanding Node.js - Event Model – Express Framework - Configuring Routes - Using Requests Objects - Using Response Objects - Handling POST Body Data Sending and Receiving Cookies - Implementing Sessions - Applying Basic HTTP Authentication - Implementing Session Authentication - Working with JSON - Processing URLs - Processing Query Strings and Form Parameters - Understanding Request, Response, and Server Objects
– Implementing HTTP Clients and Servers in Node.js - Creating a simple server, Rendering HTML, Rendering JSON Data- MongoDB-Manipulating and Accessing MongoDB Documents from Node.js
Lab Component
• Design an online super market using Express JS and MongoDB database a)</td><td>CO4</td></tr>
</table>

	Perform a search based on product id or name b) On retrieving the results , display the product details of different brands in table format with the Price field in sorted order using AngularJS • Serving JSON with Express.js	
UNIT V	**WEB FRAMEWORKS**	**9+6**
Implementing AJAX Frameworks - AJAX with JSON - Implementing Security and Accessibility in AJAX Applications - Secure AJAX Applications - Web Frameworks - Data store and access methods - Redux – Vuex - Stateless and Stateful – REST API - Declarative UI – Overview of React JS - Performance improvement through caching and server side rendering **Lab Component** To Build an a) AJAX Application b) Application using React.JS		**CO5**

PRACTICALS: 30 PERIODS	**THEORY: 45 PERIODS**	**TOTAL : 75 PERIODS**

TEXT BOOKS

1. BradDayley,Node.js,MongoDB,andAngularJSWebDevelopment;2edition,AddisonWesley,2017
2. JonDuckett, JavaScript and JQuery: Interactive Front - End Web Development, Wiley,2014
3. Zammetti, Frank, Modern Full- Stack Development, Apress, 2020

REFERENCE BOOKS

1. Nathan Rozentals, "Mastering TypeScript", April 2015
2. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016
3. Amol Nayak, "MongoDB Cookbook Paperback", November 2014
4. Krasimir Tsonev, "Node.js by Example Paperback", May 201
5. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2007

WEB REFERENCES

- https://javascript.info/
- https://www.typescriptlang.org/
- https://angular.io/
- https://nodejs.org/en/
- https://www.mongodb.com/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand web fundamentals
CO2	Create dynamic web pages using DHTML and java script that is easy to navigate and use
CO3	Implement Angular features and create component-based web pages using them
CO4	GeneratedynamicpagecontentusingNode.js,useJSONtopassAJAXupdatesbetween Client and Server and create application using Node .js with Mongo DB
CO5	Build scalable web apps quickly and efficiently using appropriate tool kits and framework

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	2	-	1	-	1	-	2	1	1	1	1	1	1
CO2	2	-	2	-	1	-	1	-	2	1	1	1	1	1	1
CO3	2	1	2	1	2	1	1	-	2	1	2	2	1	1	1
CO4	2	1	2	1	2	1	1	-	2	1	2	2	1	1	1
CO5	2	2	2	2	3	1	2	1	2	2	3	2	1	1	1

ML1507	APPLIED REINFORCEMENT LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

Reinforcement learning is a paradigm that aims to model the trial-and-error learning process that is needed in many problem situations where explicit instructive signals are not available. It has roots in operations research, behavioral psychology and AI. The goal of the course is to introduce the basic mathematical foundations of reinforcement learning, as well as highlight some of the recent directions of research

LIST OF EXPERIMENTS

1. Implement Epsilon Greedy algorithm with python	CO1
2. Implement Upper confidence bound theory (UCB) algorithm with python	CO1
3. Implement Thomson sampling algorithm with python	CO1
4. Implement Policy iteration algorithm with python	CO1
5. Implement Value Iteration code algorithm with python	CO2
6. Implement Monte Carlo control & MC Policy Evaluation algorithm with python	CO2
7. Implement TD(0) Prediction algorithm with python	CO2
8. Implement SARSA algorithm with python	CO3
9. Implement Q Learning algorithm with python	CO3

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Python 3 Interpreter for Windows/Linux 30 Nos

REFERENCE BOOKS

1. Li, Yuxi. "Deep reinforcement learning." arXiv preprint arXiv:1810.06339 (2018).
2. Wiering, Marco, and Martijn Van Otterlo. "Reinforcement learning." Adaptation, learning, and optimization 12 (2012): 3
3. David Silver’s course on Reinforcement Learning (link).

WEB REFERENCES

https://cse.iitkgp.ac.in/~adas/courses/rl
https://nptel.ac.in/content/syllabus_pdf/106106143.pdf

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand and apply basic RL algorithms for simple sequential decision making problems in uncertain conditions.
CO2	Evaluate the performance of the solution
CO3	Interpret state-of-the-art RL research and communicate their results

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

DS1508	ADVANCED ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	(Common to AI-DS)	0	0	4	2

OBJECTIVES

- To be able to reason under uncertainty of the real-world.
- To understand supervised learning techniques.
- To increase knowledge about learning with hidden variables.
- To understand how to use natural language processing.
- To get familiarized with basics of robotics.

LIST OF EXPERIMENTS

Experiment	CO
1. Implement a Python program of automatic Tic Tac Toe game using random number.	CO1
2. Apply Bayes' Rule to a scenario of drug screening, which is a mandatory testing for federal or many other jobs which promise a drug-free work environment.	CO1
3. Demonstrate the application of Bayesian Network for the Monty Hall Problem. The Monty Hall problem is a brain teaser, in the form of a probability puzzle. Assume that you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?	CO1
4. Write a Python program to create a fuzzy control system which models how you might choose to tip at a restaurant. When tipping, you consider the service and food quality, rated between 0 and 10. You use this to leave a tip of between 0 and 25%.	CO1
5. Formulate a decision tree, which is applicable in the field of medical sciences that will help predict whether or not a patient has diabetes.	CO2
6. Implement Adaptive Boosting in Python for a simple fruit classification problem. Consider classification of the fruits into oranges or apples. The characteristics that are provided for the fruits to be classified are weight and size (diameter). Classify a new fruit as either apple or orange just based on the data on the size and weights.	CO2
7. For a coin toss example with incomplete information, we have missing data and the problem of estimating θ, where θ is the probability of heads or tails is harder to solve. Apply Expectation Maximization (EM) Algorithm to start with a guess for θ, then calculate z, then update θ using this new value for z, and repeat till convergence. The label of the coin is indicated by z.	CO2
8. Perform text classification for a real-world example. Consider a model capable of predicting whether a given movie review is positive or negative. Use people's sentiments which are classified into different categories and based upon the text classification give either a positive review or a negative review.	CO3
9. Given a robot which can only move in four directions, UP (U), DOWN (D), LEFT (L), and RIGHT(R). Given a string consisting of instructions to move. Output the coordinates of a robot after executing the instructions. Initial position of robot is at origin (0, 0).	CO3
10. A robot moves in a plane starting from the original point (0, 0). The robot can move toward UP, DOWN, LEFT and RIGHT with a given steps. Write a program to compute the distance from current position after a sequence of movement and original point. If the distance is a float, then just print the nearest integer.	CO3

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Python 3 Interpreter for Windows/Linux 30 Nos.

REFERENCE BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008.

WEB REFERENCES
1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm 2. https://machinelearningmastery.com/uncertainty-in-machine-learning/ 3. https://learn-robotics.com/

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Approach a real world problem, which is uncertain and provide appropriate reasoning.
CO2	Develop solutions using supervised learning techniques and know how to deal with problems with hidden variables.
CO3	Use natural language processing and program basics of robotics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

ML1601	DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the fundamental concepts and principles of neural networks.
- To explore the basic concepts of deep learning.
- To familiarize with CNN and RNN models.
- To understand and develop deep learning architectures.
- To implement various applications using deep learning.

UNIT I	INTRODUCTION TO DEEP LEARNING	9
Basic Concept of Neurons - Perceptron Algorithm - Shallow Neural Networks - Non Linear Activation Functions - Gradient Descent and Backpropagation - Shallow and Deep Learning Networks		CO1
UNIT II	IMPROVING NEURAL NETWORKS	9
Overfitting – Regularization – Dropout – Vanishing and Exploding Gradients Problem - Mini Batch Gradient Descent - Weight Initialization Strategies - Nesterov Accelerated Gradient - Momentum – RMSProp – ADAM - Mitigation — Heuristics for Avoiding Bad Local Minima and Faster Training - Mini Batch Gradient Descent - Batch Normalization - Adversarial Training - Optimization for Training Deep Models.		CO2
UNIT III	CONVOLUTIONAL NEURAL NETWORKS	9
Convolution Operations – Pooling Layers – ResNets – CNN Architectures - Transfer Learning – Data Augmentation – Image Classification using Transfer Learning - Autoencoders – Deep Generative Models - Generative Adversarial Networks (GANs) - Evaluation GANs.		CO3
UNIT IV	SEQUENCE MODELS AND NATURAL LANGUAGE PROCESSING	9
Recurrent Neural Networks – Vanishing Gradients in RNNs - Gated Recurrent Units - Long Short Term Memory (LSTM) Networks – Bidirectional RNNs - Sequence Prediction – Transfer Learning – Language Models – Word Embeddings – Beam Search - Attention Models – Transformer Networks.		CO4
UNIT V	APPLICATIONS OF DEEP LEARNING	9
Image segmentation – Object Detection – Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision - Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks - Parsing and Sentiment Analysis using Recursive Neural Networks - Sentence Classification using Convolutional Neural Networks.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ian J. Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018

REFERENCE BOOKS

1. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
2. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press,2018.
3. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
4. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Know the importance of deep learning in machine learning applications.
CO2	Design and implement deep learning applications.
CO3	Design and implement CNN and RNN.
CO4	Understand the use of different deep learning models in image processing.
CO5	Explore the applications of deep learning in various domains.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	2	2	1	2	2	1	1	2	1	1	1	2	2	2	2
CO3	2	2	2	2	2	`1	1	2	1	1	1	2	2	2	2
CO4	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2

<table>
<tr><td>ML1602</td><td>AUTONOMOUS MOBILE ROBOT (Lab Integrated)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2"></td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">OBJECTIVES
• To enumerate and evaluate the foundational concepts of programming and robotics.
• Recognize, categorize, and evaluate the actions of various kinds of sensors and actuators.
• To acquaint pupils with the dynamics and kinematics of robotics.
• Learn the fundamentals of robotic sensing and vision.
• Gain familiarity with a variety of hardware-based robotic applications.
• Gain knowledge of the main categories of cognitive robots (vision, motor control, language, social skills), as well as the driving requirements (engineering operations, navigation, collaboration).</td></tr>
<tr><td>UNIT I</td><td colspan="4">FUNDAMENTAL CONCEPTS OF AUTONOMOUS MOBILE ROBOTICS</td><td>9+6</td></tr>
<tr><td colspan="5">Introduction to Robotics – Types - Robot features - Robotics' Software & hardware systems - Application areas – principals of Guidance of Autonomous vehicles - Problems of Mobile Autonomous Robots - Intelligence and embodiment – Analysis, Design of Autonomous Manipulation - Challenges of Autonomous Robots Manipulation - State of Robotics research and adoption.
Lab Component
➢ Quick overview of linear algebra (Matrices) commands of MATLAB and developing the model of a two link manipulator using vectors in MATLAB environment.
i) Write a MATLAB program that represents two links of the manipulator as vectors.
ii) Plot the 2-link vector from manipulator at any desired orientation of your own choice.
iii) Write a MATLAB program to plot the workspace of manipulator as a shaded region when robot arms are extended parallel to ground surface.</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">ROBOTICSENSORS AND VISION</td><td>9+6</td></tr>
<tr><td colspan="5">Use of Sensors and Sensor Based System in Robotics: Optical sensors and actuators - Mechanical Sensors and Actuators - Acoustic sensors and actuators - Performance characteristics of sensors and actuators – Vision: Images as two dimensional signals - From signals to information - Basic image operations - Feature extraction Uncertainty and Error Propagation.
Lab Component
➢ Given a set of joint angles, determine the position and orientation of a 3-DOF, 3R planar manipulator and verify the analytical solution using Corke MATLAB Robotics Toolbox.
➢ Determine the position and orientation of 5-DOF and four-fingered robot and verify analytical solution using Corke's Robotics MATLAB Toolbox and determine joint DH parameters.</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">LOCOMOTION AND MOBILE ROBOT KINEMATICS</td><td>9+6</td></tr>
<tr><td colspan="5">Locomotion and Manipulation: Introduction - Legged Mobile Robots- Wheeled Mobile Robots- Aerial Mobile Robots - Static and dynamic Stability - Degree of freedom - Mobile Robot Kinematics and Control: Introduction - Kinematic Models and Constraints -Mobile Robot Manoeuvrability - Mobile Robot Workspace - Motion Control (Kinematic Control).
Lab Component
➢ Determine the DH parameters of Humanoid robot and develop its kinematics model using Corke MATLAB toolbox.</td><td>CO3</td></tr>
</table>

UNIT IV	LOCALIZATION AND MAPPING	9+6
Introduction- The Challenge of Localization- Localization-Based Navigation Versus Programmed Solutions- Belief Representation- Map Representation- Probabilistic Map Based Localization- Examples of Localization Systems- Autonomous Map Building. **Lab Component** ➢ Collect the components from Lego components trolley as required to develop the prototype of the robotic vehicle mechanism. i) List of the components used. ii) Show the build-up with images of each step. iii) Final assembly of developed prototype. iv) Write the applications related to mechanism developed.		CO4
UNIT V	**PLANNING AND NAVIGATION**	**9+6**
Introduction- Planning and Reacting- Path Planning behaviour - Avoid Obstacle behaviour- Bug algorithm Vector field histogram- The bubble band technique- Curvature velocity techniques- Dynamic window approaches- The Schlegel approach to obstacle avoidance- Nearness diagram Gradient method Adding dynamic constraints- Navigation Architects. **Lab Component** ➢ Identify, depict, assess, and get the data ready for robots. ➢ Build the obstacle avoidance/path planning robot by utilizing learning techniques.		CO5

PRACTICALS: 30 PERIODS	THEORY: 45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Introduction to Autonomous Mobile Robots ,2nd edition 2011 Roland Siegwart, Illah R. Nourbakhsh, and DavideScaramuzza
2. Introduction to Autonomous Robots, 1stedition 2016 NikolausCorrell

REFERENCE BOOKS

1. Probabilistic robotics, MIT Press, Thrun, Burgards, and Fox. 2005
2. Computational Principles of Mobile Robotics. Gregory Dudek and Michael Jenkin. 2nd ed. Cambridge University Press, 2010.
3. Robot Modeling and Control. Mark W. Spong, Seth Hutchinson and M. Vidyasagar. John Wiley and Sons, 2006.
4. Computational Principles of Mobile Robotics, Gregory Dudek, Michael Jenkin, Cambridge University Press, 2010.
5. Autonomous Robots, George A. Bekey, MIT Press, 2005.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	• Identify, categorize, and evaluate the principles of mobile robotics. • Describe the design and operation of a mobile robot. • Acquire understanding of the principles governing the dynamics and motion control of robotic manipulators.
CO2	• Elucidate the functions of sensors, driving systems, and actuators in robotics. • Recognize, categorize, and evaluate the behaviour of various actuator and sensor types. • Apply computer vision control of robotic systems.
CO3	• Examine the dynamics and kinematics of the inverse manipulator. • Examine the approaches and hardware/software technologies for robotics applications and research. • Talk about the current state of the art in intelligent and cognitive robotics models and how it influences the creation of next robot applications.
CO4	• Examine the current status of the basic problem of mobile robot navigation. • Describe how a mobile robot can create a map of an unfamiliar place.

	• Examine the goal and put the localization and mapping method into practice
CO5	• Recognize the patterns in the planning and movement of robots. • Create controllers to monitor and manage mobile robots. • Tracking both stationary and moving objects.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

ML1603	PROBABILISTIC GRAPHICAL MODELS	L	T	P	C
		3	0	0	3

OBJECTIVES

To develop the knowledge and skills necessary to design implement and apply probabilistic graphical models to solve real problems

- To understand Bayesian networks, undirected graphical models and their temporal extensions.
- To introduce exact and approximate inference methods
- To learn estimation of the parameters and the structure of graphical models.

UNIT I	**REPRESENTATION**	**9**
Representation - Bayesian network representation - independencies in graphs, distributions to graphs, Undirected Graphical Models - parameterization, Markov network independencies, Bayesian to Markov networks, partially directed models		**CO1**
UNIT II	**LOCAL PROBABILISTIC AND TEMPORAL MODELS**	**9**
Local probabilistic Models - Tabular conditional probability distributions (CPDs), deterministic CPDs, context specific CPDs, independence of causal influence, continuous variables, conditional Bayesian networks, Template based representations - temporal models, directed models, undirected models, structural uncertainty - Gaussian network models.		**CO2**
UNIT III	**INFERENCE**	**9**
Inference - Variable elimination, conditioning, inference with structured CPDs, exact inference - clique trees, message passing, inference as optimization, exact inference as optimization, propagation-based approximation, propagation with approximate messages, Particle-Based Approximate Inference - likelihood weighting and importance sampling, Markov chain Monte Carlo methods, collapsed particles, Deterministic search methods.		**CO3**
UNIT IV	**MAXIMUM A POSTERIORI(MAP)**	**9**
MAP Inference - variable elimination for MAP, Max product in clique trees, Max-product belief propagation in loopy cluster graphs, MAP as a linear optimization problem, graph cuts for MAP, Inference in temporal models - Inference in hybrid networks - variable elimination in Gaussian networks - non-linear dependencies - inference in temporal models		**CO4**
UNIT V	**LEARNING**	**9**
Learning - Learning Graphical Models - learning as optimization, learning tasks, Parameter estimation - learning with shared parameters, Bayesian networks, Structure learning in Bayesian network - constraint based approaches, structure scores, structure search.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Daphne Koller, Nir Friedman, Probabilistic Graphical Models - Principles and Techniques, The MIT Press, 2009.

REFERENCE BOOKS
1. Kiren R Karkera, Building Probabilistic Graphical Models with Python, Packt, 2014 2. Adnan Darwiche, Modeling and Reasoning with Bayesian networks, First edition, Cambridge University Press, 2014 3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Second edition, Springer,2011 4. Kevin P. Murphy, Machine Learning: a Probabilistic Perspective, MIT Press, 2012

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Explore the various representations of Probabilistic Graphical Models.
CO2	Understand different Local Probabilistic and Temporal Models.
CO3	Apply inference as an optimization tool in various Probabilistic Graphical Models.
CO4	Understand MAP inference techniques and inference in temporal models.
CO5	Apply learning as an optimization tool for decision making.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	3	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	1	-	-	2	2	2	3	2	2
CO4	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	2	2

ML1604	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

To understand the basics of big data and analytics.

- To explore the frameworks for working with big data
- To learn about stream computing.
- To learn about recommender systems and data analytics methods in R.

UNIT I	**INTRODUCTION TO BIG DATA AND HADOOP**	**9**
Types of Digital Data - Characteristics of Data - Evolution of Big Data - Definition of Big Data - Challenges with Big Data - Vs of Big Data - Non Definitional traits of Big Data - Business Intelligence vs. Big Data - Understanding Big Data Storage - Examples of Big Data in Real Life - Big Data Applications - History of Hadoop, Apache Hadoop, Analysing Data with Hadoop - Hadoop Streaming		**CO1**
UNIT II	**BIG DATA FRAMEWORK AND NOSQL**	**9**
Hadoop Ecosystem - Overview of: Apache Spark, Pig, Hive, HBase, Sqoop - What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores - Mongo DB: Introduction - Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.		**CO2**
UNIT III	**MAP REDUCE**	**9**
MapReduce: The Map Tasks - Grouping by Key - The Reduce Tasks – Combiners - Details of MapReduce Execution - Coping With Node Failures - Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce – Relational Algebra Operations - Computing Selections by MapReduce - Computing Projections by MapReduce – Union – Intersection and Difference by MapReduce - Computing Natural Join by MapReduce - Grouping and Aggregation by MapReduce - Matrix Multiplication - Matrix Multiplication with One MapReduce Step - Illustrating use of MapReduce with use of real life databases and applications.		**CO3**
UNIT IV	**STREAM MEMORY**	**9**
Introduction to Streams Concepts - Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform(RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics		**CO4**
UNIT V	**RECOMMENDATION SYSTEM AND REVIEW OF BASIC DATA ANALYTIC METHODS USING R**	**9**
Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation - Hybrid Recommendation Approaches -Introduction to R - Exploratory Data Analysis – Statistical methods for evaluation.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Seema Acharya, Subhasini Chellappan, "Big Data Analytics - 2nd Edition" Wiley 2019. 2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets - 3rd Edition", Cambridge University Press, 2020. 3. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction - 2nd Edition", Cambridge University Press, 2015. 4. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
REFERENCE BOOKS
1. Kyle Banker, Piter Bakkum, Shaun Verch, “MongoDB in Action - 2nd Edition”, Manning Publications, 2016. 2. Tom White, “HADOOP: The definitive Guide - 4th Edition”, O Reilly 2015. 3. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing 2013
COURSE OUTCOMES Upon completion of the course, students will be able to

CO1	Learn Big Data and Hadoop
CO2	Learn NoSQL databases and management.
CO3	Learn MapReduce
CO4	Perform analytics on data streams
CO5	Learn recommendation systems for large volumes of data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	-	-	-	1	1	2	2	2
CO2	1	2	2	1	2	1	1	-	-	-	1	1	2	2	2
CO3	2	2	2	2	1	`1	1	-	-	-	1	1	2	2	2
CO4	2	2	2	2	2	1	1	-	-	-	1	1	2	2	2
CO5	2	2	2	2	2	1	1	-	-	-	1	1	2	2	2

ML1607	DEEP LEARNING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.
- Have a working knowledge of neural networks and deep learning
- Understand the characteristics and types of artificial neural network and remember working of Artificial Neural Network.
- Apply learning algorithms on perceptron and apply back propagation learning on Neural Network.
- Design Convolutional Neural Network and classification using Convolutional Neural Network.

LIST OF EXPERIMENTS

Experiment	CO
1. To write a program to implement Perceptron.	CO1
2. To write a program to implement Classification using Back propagation	
3. Create Simple Sequence Classification Network Using Deep Network Designer	
4. Implement and demonstrate the new deep neural network for classification and regression	
5. Write a program to Resize, rotate, or preprocess images for training or prediction	
6. Create deep learning networks for sequence and time series data.	CO2
7. Implement and demonstrate how to Detect and recognize objects in images	
8. Write a program to Classify text data using CNN	
9. Write a program to Train on CPU, GPU, multiple GPUs, in parallel on your desktop or on clusters in the cloud, and work with data sets too large to fit in memory	
10. Create a Deep Learning Toolbox Model for AlexNet Network, VGG, ResNet	
11. Create a Deep Learning Toolbox Model for ImageNet, GoogleNet, Recurrent Neural Network	CO3
12. Create Simple Sequence Classification Network Using Deep Network Designer	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Python 3 Interpreter for Windows/Linux 30 Nos.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the implementation procedures for the Deep learning algorithms.
CO2	Design MatLab/Python programs for various Learning algorithms.
CO3	To learn data science and design and implement various convolutional Neural Networks

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	2	2	2	3	3	3
CO2	3	3	3	3	2	1	1	1	1	2	2	2	3	3	3
CO3	3	3	3	3	2	1	1	1	1	2	2	2	3	3	3

ML1608	SOCIALLY RELEVANT PROJECT	L	T	P	C
		0	0	4	2

Choose any project of solving social problems

- Team Project with a maximum of two in a team
- Need to concentrate on software development methodologies
- Documentation is based on the standards
- Evaluation pattern is like Lab examination,
- Need to submit a report, presentation with demo.

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MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

ML1701	STATISTICAL NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of natural language processing
- To understand POS tagging and parsing.
- To understand the concepts of Information retrieval
- To understand the role of machine learning for natural language processing
- To acquire knowledge about applications in natural language processing

UNIT I	INTRODUCTION	9
What is NLP-History of NLP- Challenges and Applications of NLP - Ambiguity and Uncertainty in Language - NLP Phases - Language Modelling- Various Grammar-based Language Models- Statistical Language Model- N-gram Language Models – Markov Process- Estimating parameters and smoothing - Evaluating language models- Regular Expression-Text Normalization -Minimum Edit Distance.		CO1
UNIT II	**PART OF SPEECH TAGGING AND SYNTACTIC PARSING**	**9**
POS Tagging- Named Entities and Named Entity Tagging- Conditional Random Fields (CRFs)- Evaluation of Named Entity Recognition- HMM Part-of-Speech Tagging-Trigram Hidden Markov Models- Decoding with HMMs: the Viterbi Algorithm- Syntactic Parsing- Efficient parsing for context-free grammars (CFGs)- Semantic Parser - Semantic Role Labelling		CO2
UNIT III	**INFORMATION RETRIEVAL**	**9**
Design Features of Information Retrieval systems - Information Retrieval Models - Classical Information Retrieval Models - Non-classical models of IR -Alternative Models of IR - Evaluation of the IR System- Natural Language Processing in IR -Relation Matching - Knowledge-based Approaches - Conceptual Graphs in IR -Cross-lingual Information Retrieval.		CO3
UNIT IV	**MACHINE LEARNING FOR NLP**	**9**
Vocabulary & Feature Extraction - Bag of Words Model - ML for NLP: Logistic Regression, Naïve Bayes, Neural Networks - Error Analysis - Vector Space models - Language Modelling with Sequential Models - Embeddings for Words and Documents - Word2Vec - Cosine Similarity - 1D Convolutions - Attention Mechanism – Transformers – Recursive Neural Networks		CO4
UNIT V	**APPLICATIONS IN NLP**	**9**
Question Answering with SQuAD - Dependency Parsing - Machine Translation - Coreference Resolution – Text Summarization		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Second Edition, Pearson Publication, 2014
2. Christopher Manning, “Foundations of Statistical Natural Language Processing”, MIT Press, 2009
3. Nitin Indurkhya and Fred J. Damerau, “Handbook of Natural Language Processing”, Second Edition, Chapman & Hall/CRC Press, 2010.

REFERENCE BOOKS

1. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, First Edition, OReilly Media, 2009
2. Breck Baldwin, “Natural Language Processing with Java and LingPipe Cookbook”, Atlantic Publisher, 2015.
3. Richard M Reese, ”Natural Language Processing with Java”, First Edition, Packt Publishing,2015.

4. Yoav Goldberg, Graeme Hirst, “Neural Network Methods for Natural Language Processing - Synthesis Lectures on Human Language Technologies”, Morgan and Claypool Life Sciences, 2017.
5. DeeptiChopra, Nisheeth JoshiIti Mathur, “Mastering Natural Language Processing with Python”, First Edition, Packt Publishing Limited, 2016
6. Mohamed Zakaria Kurdi “Natural Language Processing and Computational Linguistics 1: Speech, Morphology and Syntax”, First Edition, ISTE Ltd. Wiley, 2016
7. Atefeh Farzindar, DianaInkpen, “Natural Language Processing for Social Media, Second Edition, Morgan and Claypool Life Sciences, 2015

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the fundamentals of natural language processing
CO2	Understand POS tagging and parsing
CO3	Understand the concepts of Information retrieval
CO4	Understand the role of machine learning for natural language processing
CO5	know about applications involving natural language processing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	-	-	-	1	1	2	2	2	2	1	2
CO2	1	2	1	1	-	-	-	1	1	2	2	2	2	2	2
CO3	1	2	1	1	-	-	-	1	1	2	2	2	2	2	2
CO4	1	2	1	1	-	-	-	1	1	2	2	2	2	2	2
CO5	1	2	1	1	-	-	-	1	1	2	2	2	2	2	2

ML1702	FORMAL LANGUAGES AND AUTOMATA THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand a finite automaton for a given language.
- To understand the relation between grammar and language
- To understand the basic principles of working of a compiler
- To study about the Parsers during the compilation
- To understand the Storage Organization Code Generation

UNIT I	**AUTOMATA**	**9**
Alphabets, Strings and Languages - Regular expression (RE) Definition Automata and Grammars,-Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions- Regular expression to FA, DFA to Regular expression- Equivalence and minimization of Automata		**CO1**
UNIT II	**CONTEXT FREE GRAMMAR AND PUSH DOWN AUTOMATA**	**9**
Context-Free Grammar (CFG) – Parse Trees – Ambiguity in grammars and languages – Definition of the Pushdown automata – Languages of a Pushdown Automata – Equivalence of Pushdown automata and CFG– Deterministic Pushdown Automata- Normal forms for CFG – simplification of CFG- Pumping Lemma for CFL – Closure Properties of CFL		**CO2**
UNIT III	**INTRODUCTION TO COMPILERS AND LEXICAL ANALYSIS**	**9**
Compilers – Translators – Compilation and Interpretation - Language processors - Analysis of source program – Phases of a compiler – Grouping of phases – Compiler construction tools – Lexical Analyzer : Token Specification – Token Recognition – A language for Specifying lexical analyzer		**CO3**
UNIT IV	**SYNTAX ANALYSIS**	**9**
Parsing-role of parser- classes of parsing, top down parsing - backtracking - recursive descent parsing - predictive parsers - LL(1) grammars - Top down parser- Table implementation of Predictive Parser – Bottom up Parser : SLR(1) Parser – Parser generators.		**CO4**
UNIT V	**RUN-TIME ENVIRONMENT AND CODE GENERATION**	**9**
Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Basic blocks and flow graphs - Issues in Code Generation - Design of a simple Code Generator.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory, Languages and Computations”, Second Edition, Pearson Education, 2007.
2. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, “Compilers :Principles, Techniques and Tools”, Second Edition, Pearson Education,2008.

REFERENCE BOOKS

1. J.Martin, “Introduction to Languages and the Theory of computation” Third Edition, Tata Mc Graw Hill, 2007
2. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A Dependencebased Approach”, Morgan Kaufmann Publishers, 2002.
3. Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
4. Muneeswaran. K, “Compiler Design”, Oxford University Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design a finite automaton for a specific language.
CO2	Design context free grammar and Pushdown Automata.
CO3	Select appropriate grammar for the implementation of compiler phases and Design a lexical analyzer
CO4	Apply different parsing algorithms to develop the parsers for a given grammar.
CO5	Write a simple code generator

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	2	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	2	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	2	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	2	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	2	-	2	2	2	3	3	2

ML1703	IMAGE PROCESSING AND VISION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To review image processing techniques for computer vision.
- To outline the image enhancement in the Spatial and Frequency Domain.
- To understand Image Restoration and Image Compression.
- To understand three-dimensional image analysis.
- To study some applications of computer vision algorithms

UNIT I	IMAGE PROCESSING FOUNDATION	9
Introduction- Components of Image Processing Systems-Image Processing Operations-Image Sensing and Acquisition- Elements of Visual Perception-Image Formation Model-Image Sampling and Quantization, Relationship between pixels		CO1
UNIT II	**IMAGE ENHANCEMENT**	**9**
Enhancement by point Processing-Histogram Processing- Arithmetic/ Logic Operations- Image Averaging-Spatial Filters for Smoothing and Sharpening-Frequency domain filters for Smoothing and Sharpening- Image Degradation & Restoration Model- Noise Models, Inverse Filtering-Geometric Mean Filter		CO2
UNIT III	**IMAGE SEGMENTATION AND COLOUR IMAGE PROCESSING**	**9**
Detection of Discontinuities-Edge Linking and boundary Detection, Threshold – Region Based Segmentation-Coding Redundancy-Inter pixel Redundancy-Image Compression model-Error Free Compression-Variable Length Coding-Lossy Compression- Colour Models-Pseudo Colour Image Processing-Colour Transformations-Smoothing and Sharpening-Segmentation based on Colour.		CO3
UNIT IV	**3D VISION**	**9**
Methods for 3D Vision - 3D reconstruction – Image based rendering, Image Recognition – Object Detection – Space, Instance and Category Recognition – Recognition Databases and test sets.		CO4
UNIT V	**APPLICATION**	**9**
Automated Visual Inspection: Process- Types- Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application- In-vehicle vision system: locating roadway – road markings – road signs – locating pedestrians		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Rafael C Gonzalez, Richard E Woods, “Digital Image Processing”, Pearson, 2nd Edition, 2022.
2. Anil K Jain, “Fundamentals of Digital Image Processing”, Pearson, 2022.

REFERENCE BOOKS

1. Kenneth R Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C Gonzalez, Richard E Woods, Steven Eddins, “Digital Image Processing Using MATLAB”, Pearson Education, Inc., 2011.
3. S Sridhar, “Digital Image Processing”, 2nd Edition, Oxford University, 2016.
4. William K Pratt, “Digital Image Processing”, John Wiley, New York, 2002.
5. Milan Sonka, Roger Boyle, Vaclav Hlavac, “Image Processing, Analysis and Machine Vision”, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Explain the fundamentals of digital image processing, such as digitization, sampling, quantization
CO2	Apply the techniques of smoothing, sharpening domain and enhancement in both spatial and frequency
CO3	Identify the segmentation methods and apply in suitable image processing applications
CO4	Apply 3D vision for Image Rendering and Detection
CO5	Apply Visual Inspection for suitable applications

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

ML1704	EDGE AI	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the foundation of Edge Computing and AI
- To apply AI knowledge to develop Edge Artificial Intelligent Systems.
- To gain knowledge in Artificial Intelligence for Optimizing Edge
- To gain knowledge In Mobile Edge AI
- To understand the AI application on Edge

UNIT I	INTRODUCTION TO EDGE COMPUTING AND AI	9
Fundamentals of Edge Computing: Introduction, Need, Key Techniques, Benefits, Systems Paradigms of Edge computing, Edge Computing Frameworks, Value Scenarios for Edge Computing. Edge computing system architectures. Industrial Applications of Edge Computing, Intelligent Edge and Edge Intelligence, Challenges and opportunities in Edge Computing.: Case Study: Home Edge Computing architecture (HEC)		CO1
UNIT II	**INFERENCE AND TRAINING IN EDGE AI**	**9**
Artificial Intelligence Inference in Edge: Optimizing AI models in Edge: General method, Edge device, Overview of TensorFlow Lite (TFLite) format and its benefits, Introduction to Open Neural Network Exchange (ONNX) format and its advantages, Understanding NVIDIA TensorRT format and its optimizations for inference Segmentation of AI Model, Segmentation of AI Model, Early Exit of Inference (EEoI), Sharing of AI Computation. Artificial Intelligence Training at Edge: Distributed Training at Edge, Federated Learning (FL) at Edge, Security-Enhanced FL, Case Study: Machine Learning Inference at the Edge.		CO2
UNIT III	**ARTIFICIAL INTELLIGENCE FOR OPTIMIZING EDGE**	**9**
AI for Adaptive Edge Caching: use cases DNNs and DRL, Optimizing Edge Task Offloading, Edge Management and Maintenance: Communication, security, joint Edge optimization. Case Study: Artificial intelligence for edge service optimization in the Internet of Vehicles.		CO3
UNIT IV	**MOBILE EDGE AI**	**9**
Overview, Edge inference: On-device inference, Computation offloading, Server-based edge inference, Device-edge joint inference, Edge training: Data partition-based, Model partition-based, Coded computing Case Study: Energy-Efficient Mobile Edge Computing under Delay Constraints.		CO4
UNIT V	**ARTIFICIAL INTELLIGENCE APPLICATIONS ON EDGE**	**9**
Real-time Video Analytic, Autonomous Internet of Vehicles (IoVs), Intelligent Manufacturing, Smart Home and City, Urban Healthcare, Urban Energy Management, Manufacturing, Transportation and traffic. Case study: Edge AI solution for people's data privacy and security.		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Wang, X., Han, Y., Leung, V. C., Niyato, D., Yan, X., & Chen, X.," Edge AI: Convergence of edge computing and artificial intelligence", Singapore: Springer,2020, ISBN 978-981-15-6185-6
2. Jie Cao, Quan Zhang, Weisong Shi "Edge Computing: A Primer", Springer International Publishing
3. "Mobile Edge Artificial Intelligence Opportunities and Challenges By Yuanming Shi, Kai Yang, Zhanpeng Yang, Yong Zhou 2021, ISBN - 9780128238172, 0128238178, Elsevier Science publication

REFERENCE BOOKS

1. Liu, Deyin; Chen, Xu; Zhou, Zhi; Ling, Qing (2020). HierTrain: Fast Hierarchical Edge AI Learning With Hybrid Parallelism in Mobile-Edge- Cloud Computing. IEEE Open Journal of the Communications Society, 1(), 634-645. doi:10.1109/OJCOMS.2020.2994737

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the relation of AI and Edge Computing
CO2	Understand the computing tools and technologies of Edge AI
CO3	Apply segmentation techniques to improve efficiency of AI models and develop secured distributed Edge applications
CO4	Apply knowledge of AI for optimizing Edge application
CO5	Design and Develop edge application

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	3	2	2
CO3	3	3	2	3	2	-	-	-	-	2	3	2	3	3	2
CO4	3	3	2	3	2	-	-	-	-	2	2	2	2	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

ML1708	CAPSTONE PROJECT- PHASE I	L	T	P	C
		0	0	4	2

The purpose of this course is to apply the concept of Mathematics, Science and Engineering Fundamentals and an Engineering Specialization to solve complex engineering Problem.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	P O1	P O2	P O3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

ML1709	INDUSTRIAL AI APPLICATIONS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To understand the ROS2 package.
- To understand the concepts of image and video processing.
- To gain the knowledge in speech recognition and computer vision

LIST OF EXPERIMENTS

Experiment	CO
1. To setup a basic ROS2 Package with a Node in python and execute it using ROS2 Command line tools.	CO1
2. To install the RoARM Manipulator ROS2 package and launch the Rviz and joint_state_publisher_gui tool to control the joints of the robot manipulator.	
3. To create a web-server using docker container, build it and instatiate the container	
4. To perform image processing operations such as converting to grayscale, blurring, and edge detection using OpenCV in Python.	
5. To perform video processing operations using OpenCV and apply simple filters or transformations to each frame of the video stream.	CO2
6. To write a python code to build a Multi-layer perceptron using Pytorch framework and train a model to perform image classification, convert the model into ONNX (Open-Neural Network) format.	
7. To perform Speech to Text conversion using Word2Vec and pytorch framework and input a .wav audio file to convert to text data.	
8. To perform Transfer Learning using Pytorch framework on ResNet18 pertained model to fit CIFAR-10 dataset and evaluate the model.	CO3
9. To perform Quantization on MobileNet V2 Model using fbgemm quantization method using Pytorch framework and evaluate.	
10. To perform L1 structured Pruning on ResNet18 model using pytorch framework and evaluate.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

- Python
- Google web speech API
- Make: HP 280G3MT Processor-Intel(R) Core i7-7700 @3.00 GHz RAM – 8GB RAM, HDD-1TB, Keyboard, Mouse, Monitor OS: Windows 10 Pro and Ubuntu.

REFERENCE BOOKS

1. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition 2/e

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain the practical knowledge in ROS2 package.
CO2	Understand the real time implementation of image and video processing.
CO3	Identify and understand the concept of speech recognition and vision techniques.

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	3	3	2

ML1807	CAPSTONE PROJECT- PHASE II	L	T	P	C
		0	0	20	10

The purpose of this course is to apply the concept of Mathematics, Science and Engineering Fundamentals and an Engineering Specialization to solve complex engineering Problem.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

PROFESSIONAL ELECTIVE – I (SEMESTER V)

ML1511	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explore the features of Parallel and Distributed databases
- Be familiar with a commercial relational database system (Oracle) by writing SQL using the system
- To provide knowledge about XML Databases
- To know about Temporal and Spatial Databases
- Be familiar with the relational database theory, and be able to write relational algebra expressions for queries

UNIT I	PARALLEL AND DISTRIBUTEDDATABASES :	9
Database System Architectures: Centralized and Client-Server Architectures-Server System Architectures -Parallel Systems Distributed Systems -Parallel Databases: I/O Parallelism -Interquery Parallelism - Intraquery Parallelism – Intraoperation Parallelism Interoperation Parallelism -Distributed Databases: -Homogeneous and Heterogeneous Databases - Distributed Data Storage -Distributed Transactions -Commit Protocols – Concurrency Control in Distributed Databases -Distributed Query Processing.		CO1
UNIT II	**OBJECTAND OBJECT RELATIONAL DATABASES**	**9**
Object-Based Databases: Complex Data Types-Structured Types and Inheritance in SQL - Table Inheritance -Array and Multiset Types in SQL -Object Identity and Reference Types in SQL -Implementing O-R Features – Persistent Programming Languages – Object-Oriented versus Object -Relational.		CO2
UNIT III	**ANALYTICAL MODELING OF PARALLEL PROGRAMS**	**9**
XML: Motivation -Structure of XML Data -XML Document Schema -Querying and Transformation – Application Program Interfaces to XML -Storage of XML Data -XML Applications.		CO3
UNIT IV	**SPATIAL AND TEMPORAL DATABASES**	**9**
Spatial and Temporal Data and Mobility: Time in Databases -Spatial and Geographic Data Mobility and Personal Databases.		CO4
UNIT V	**MULTIMEDIA DATABASES**	**9**
Multidimensional Data Structures: k-d Trees - Point Quadtrees - MXQuadtree - R-Tree - Image Databases: Representing Image DBs with Relations -Representing Image DBs with R-Trees -Text/Document Databases: TV Trees - Video Databases – Audi o Databases.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS
1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, McGraw-Hill International Edition, Sixth Edition, 2011. 2. V. S. Subramanian, “Principles of Multimedia Database Systems”, Elsevier Publishers, 2001 3. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, Pearson Education, Seventh Edition, 2016.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand Parallel Databases and Distributed Databases
CO2	Apply query evaluation techniques and query optimization techniques
CO3	Develop transaction processing systems with concurrency control.
CO4	Understand Temporal and Spatial Databases
CO5	Design and develop a database application system as part of a team

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	-	-	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	-	-	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	-	-	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	-	-	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	-	-	1	1	1	2	2	2

ML1512	SEMANTIC WEB	L	T	P	C
		3	0	0	3

OBJECTIVES

1. To understand the concepts of Semantic Web.
2. To build and implement a small ontology that is semantically descriptive of your chosen problem domain
3. To implement applications that can access, use and manipulate the ontology, represent data from a chosen problem in XML with appropriate semantic tags
4. To design and implement a web services application that "discovers" the data and/or other web services via the semantic web
5. To discover the capabilities and limitations of semantic web technology for different applications

UNIT I	Foundation of Semantic Web Technologies	9
Introduction to the Syntactic web and Semantic Web – Evolution of the Web – The visual and syntactic web - Levels of Semantics - Metadata for web information - The semantic web architecture and technologies –Contrasting Semantic with Conventional Technologies -Semantic Modeling -Potential of semantic web solutions and challenges of adoption		CO1
UNIT II	ONTOLOGICAL ENGINEERING	9
Ontologies – Taxonomies –Topic Maps – Classifying Ontologies - Terminological aspects: concepts, terms, relations between them - Complex Objects -Subclasses and Sub-properties definitions -Upper Ontologies - Quality - Uses - Types of terminological resources for ontology building - Methods and methodologies for building ontologies - Multilingual Ontologies -Ontology Development process and Life cycle - Methods for Ontology Learning - Ontology Evolution - Versioning		CO2
UNIT III	STRUCTURING AND DESCRIBING WEB RESOURCES	9
Structured Web Documents - XML – Structuring - Namespaces - Addressing - Querying - Processing - RDF - RDF Data Model - Serialization Formats- RDF Vocabulary - Inferencing -RDFS - basic Idea - Classes - Properties- Utility Properties - RDFS Modelling for Combinations and Patterns- Transitivity		CO3
UNIT IV	WEB ONTOLOGY LANGUAGE	9
OWL - Sub-Languages - Basic Notions -Classes- Defining and Using Properties - Domain and Range – Describing Properties - Data Types – Counting and Sets- Negative Property Assertions – Advanced Class Description - Equivalence – Owl Logic.		CO4
UNIT V	SEMANTIC WEB TOOLS AND APPLICATIONS	9
Development Tools for Semantic Web – Jena Framework – SPARL –Querying semantic web - Semantic Desktop - Semantic Wikis -Semantic Web Services - Application in Science – Business		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Liyang Yu, A Developer's Guide to the Semantic Web, Springer; 1st Edition. Edition,2011
2. John Hebeler, Matthew Fisher, Ryan Blace and Andrew Perez-Lopez, Semantic Web Programming, Wiley; 1 edition, 2009.
3. Grigoris Antoniou, Frank van Harmelen, A Semantic Web Primer, Second Edition (Cooperative Information Systems) (Hardcover), MIT Press, 2008

REFERENCE BOOKS

1. Robert M. Colomb, Ontology and the Semantic Web: Volume 156 Frontiers in Artificial Intelligence and Applications (Frontier in Artificial Intelligence and Applications), IOS Press, 2007.
2. Dean Allemang and James Hendler, Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL, Morgan Kaufmann; 2 edition, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss about basic of semantic web and search engine
CO2	Explain RDFS and its process
CO3	Explain owl and its operation
CO4	Explain semantic issue and prototype system.
CO5	Explain various semantic web services and its design

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1

ML1513	ADVANCED DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

UNIT I	ROLE OF ALGORITHMS IN COMPUTING	9
Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation - Standard Notations and Common Functions- Recurrences: The Substitution Method - The Recursion-Tree Method		CO 1
UNIT II	**HIERARCHICAL DATA STRUCTURES**	**9**
Binary Search Trees: Basics - Querying a Binary search tree - Insertion and Deletion-Red-Black trees: Properties of Red-Black Trees - Rotations - Insertion - Deletion -B-Trees: Definition of B-trees - Basic operations on B-Trees - Deleting a key from a B-Tree-Fibonacci Heaps: structure - Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.		CO 2
UNIT III	**GRAPHS**	**9**
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree - Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm - Single-Source Shortest paths in Directed Acyclic Graphs - Dijkstra‘s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication - The FloydWarshall Algorithm		CO 3
UNIT IV	**ALGORITHM DESIGN TECHNIQUES**	**9**
Dynamic Programming: Matrix-Chain Multiplication - Elements of Dynamic Programming - Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem - Elements of the Greedy Strategy- Huffman Codes.		CO 4
UNIT V	**NP COMPLETE AND NP HARD**	**9**
NP-Completeness: Polynomial Time - Polynomial-Time Verification - NP- Completeness and Reducibility - NP-Completeness Proofs - NP-Complete Problems		CO 5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ALGORITHMS, Fourth Edition, Pearson Education.
3. S.Sridhar, Design and Analysis of Algorithms, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.

REFERENCE BOOKS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Upon the completion of the course the students should be able to:
CO2	Design data structures and algorithms to solve computing problems
CO3	Design algorithms using graph structure and various string matching algorithms to solve real-life problems
CO4	Apply suitable design strategy for problem solving
CO5	Understand the applications of NP Complete and NP Hard Concepts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	2	2	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3

ML1514	LOGIC PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- To learn the basics and advanced concepts of Prolog
- To explain the basic concepts of knowledge representation
- To explain the fundamentals of expert systems and knowledge representation with uncertainty
- To represent a problem using constraint and inductive logic programming.
- To understand the relation between prolog, modal and temporal logic.

UNIT I	THE PROLOG LANGUAGE	9
Introduction to Prolog : Defining Relations - facts - rules - Recursive Rules - Syntax and Meaning of Prolog Programs – Data Objects – Matching – Declarative meaning of Prolog programs – Procedural Meaning – Example – Order of clauses and goals – Relation between Prolog and logic - Lists - Operators - Arithmetic - Using Structures: Eight Queen Problems		CO1
UNIT II	PROGRAMMING STYLE AND TECHNIQUE	9
Input and Output: Communication with files – Processing files of terms – Manipulating characters – Constructing and decomposing atoms – Reading programs - Built-in Predicates: Terms - Testing – Constructing and decomposing – Equality and comparison -Database manipulation - control facilities - Operations on Data Structures: Sorting lists - Representing sets by binary trees - Binary Dictionary - Insertion and deletion-Displaying trees - Graphs		CO2
UNIT III	PROLOG IN ARTIFICIAL INTELLIGENCE	9
Basic Problem-Solving Strategies: Depth first search - Breadth first search - Analysis of basic search techniques - Best First Heuristic Search -Best first search - Eight Puzzle - Scheduling – Space saving techniques for best first search- Problem Decomposition and AND/OR Graphs		CO3
UNIT IV	CONSTRAINT AND INDUCTIVE LOGIC PROGRAMMING	9
Constraint satisfaction and logic programming – CLP - real numbers – Scheduling- A simulation programs-finite domains - Knowledge Representation and Expert Systems - Functions& structure: expert system -if then rules -Rule based system - Forward and backward chaining - An Expert System Shell- Knowledge representation format -Designing the inference engine – Inductive Logic Programming		CO4
UNIT V	MODAL AND TEMPORAL LOGIC	9
Modal logic – Basic Concepts – Relational Structures – Modal Languages -Models and frames – General Frames -Modal Consequence Relations – Normal Modal Logics - Temporal Logic - Basic concepts and notion of logics-Logical Languages - Semantics - Formal System - Creating AI Characters for Fighting Games Using Genetic Programming		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ivan Bratko, “PROLOG Programming for Artificial Intelligence”, Addison -Wesley, Pearson Education, Third Edition, 2001
2. 2. Patrick Blackburn, Maarten de Rijke, Yde Venema, “Modal Logic “,Cambridge University Press 2001

REFERENCE BOOKS

1. Fred Kroger, Stephen Merz,“Temporal Logic and State Systems”, Springer 2008
2. I. Kononenko and N. Lavrac,”Prolog Through Examples”, Sigma press,1989
3. Ulf Nilsson and Jan Maluszynski,”Logic Programming and Prolog(2ED)”, John Wiley & Sons Ltd,2000
4. Stuart Russell and Peter Norvig, “Artificial Intelligence A Modern Approach”, Pearson Education, Third Edition,2010
5. Antoni Niederlinski,” A Quick and Gentle Guide to Constraint Logic Programming via Eclipse” ,Gliwice 2011

6. Svorenova, M; Cerna, I.; Belta, C, "Optimal Temporal Logic Control for Deterministic Transition Systems with Probabilistic Penalties", IEEE Trans. Autom. Control, vol. 60, issue: 6, pp.1528 - 1541 ,2015
7. Giovanna Martinez-Arellano, Richard Cant and David Woods, “Creating AI Characters for Fighting Games Using Genetic Programming”, IEEE Transactions on Computational Intelligence and AI in Games, vol. 9, No. 4,pp.423-434, 2017.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Develop prolog programs for simple application
CO2	Implement control structures in Prolog programs
CO3	Use Prolog for problem solving in artificial intelligence
CO4	Implement the expert systems satisfying various constraints
CO5	Develop simple applications using modal and temporal logic

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	2	2	1	2	2	1	1	2	1	1	1	2	2	2	2
CO3	2	2	2	2	2	`1	1	2	1	1	1	2	2	2	2
CO4	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2

ML1515	APPLICATIONS OF MACHINE LEARNING IN INDUSTRIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concept of Machine Learning.
- Familiarize with applications of Machine Learning in Banking sectors.
- Appreciate the various applications in Communication and Education sectors.
- Identify the applications in Health care and Government sectors.
- Recognize the applications in Manufacturing, Transportation and Logistics sectors.

UNIT I	**MACHINE LEARNING IN BANKING AND SECURITIES**	**9**
Introduction to Machine learning in banking sector- Use of AI in banking and finance- Fraud detection- Risk modelling- Customer data management - Machine learning algorithms in banking and security- ML based Fraud prevention and detection systems- Anomaly detection - Case study: Credit Card fraud prediction, Loan default prediction		**CO1**
UNIT II	**MACHINE LEARNING IN COMMUNICATION, MEDIA, HEALTHCARE AND LIFE SCIENCE**	**9**
Introduction to Machine learning in communication, media and entertainment: Real-time data analytics and its Usage- Machine learning techniques for customer sentiment analysis- Sentiment analysis with L S T M networks, Deep learning for social media analytics - Recommendations engines - Collaborative filtering- Deep learning techniques on recommender systems. Applications of ML in healthcare and life sciences - Role of Machine learning in genetics and genomics – Case Study: Pneumonia Segmentation, Genetic Variant Classification		**CO2**
UNIT III	**MACHINE LEARNING IN EDUCATION, MANUFACTURING AND PETROLEUM INDUSTRIES**	**9**
Introduction to Machine learning in education- Learning Analytics Process - Educational data mining - Personalized adaptive learning - Case study. Introduction to Applications of machine learning in manufacturing industry, Deep learning for smart manufacturing - Quality control in manufacturing, Case study: Predicting undesirable events in oil wells.		**CO3**
UNIT IV	**MACHINE LEARNING IN GOVERNMENT ADMINISTRATION AND INSURANCE INDUSTRIES**	**9**
Introduction to Risk and compliance- Type of government problems appropriate for AI applications- AI for citizen services use cases: Answering questions, Routing requests, Translation, Drafting documents, Chat bots for communication. Importance of machine learning in insurance- Personalized marketing in insurance industry, Predictive model for insurance underwriting- Case study: Travel insurance prediction, Chatbot with LLMs for Insurance		**CO4**
UNIT V	**MACHINE LEARNING IN RETAIL AND SUPPLY CHAIN, TRANSPORTATION AND LOGISTICS, ENERGY AND UTILITIES**	**9**
Introduction to Inventory management - Predictive analytics: Weathering demand, analysing buying patterns, Analysing traffic patterns, Assortment planning- Benefits of predictive analytics to retailers. Applications of machine learning in transport: aviation and public transportation, logistics. Predictive logistics, Predictive risk management, ML powered customer experience, Limitations of AI techniques in transportation- Computation complexity. Introduction, Smart grid, Smart grid technologies, Key characteristics of smart grid, Machine learning applications in smart grid: renewable energy generation, Forecasting. Case study: Demand Forecasting for retail, Energy usage forecasting.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
Machine Learning Techniques and Industry Applications. IGI Global, 2024

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the concept of Machine Learning.
CO2	Familiarize with applications of Machine Learning in Banking sectors.
CO3	Appreciate the various applications in Communication and Education sectors.
CO4	Identify the applications in Health care and Government sectors.
CO5	Recognize the applications in Manufacturing, Transportation and Logistics sectors.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	2	1	1	1	2	2	2	2
CO2	2	2	1	2	2	1	1	2	1	1	1	2	2	2	2
CO3	2	2	2	2	2	`1	1	2	1	1	1	2	2	2	2
CO4	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	1	1	2	1	1	1	2	2	2	2

PROFESSIONAL ELECTIVE – II (SEMESTER VI)

ML1611	GREEN COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquire knowledge to adopt green computing practices
- To minimize negative impacts on the environment, skill in energy saving practices in their use of hardware, examine technology tools that can reduce paper waste and carbon footprint by user
- To understand how to minimize equipment disposal requirements

UNIT I	**FUNDAMENTALS**	**9**
Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.		**CO1**
UNIT II	**GREEN ASSETS AND MODELING**	**9**
Green Assets: Buildings, Data Centers, Networks, and Devices - Green Business Process Management: Modeling, Optimization, and Collaboration - Green Enterprise Architecture - Environmental Intelligence - Green Supply Chains - Green Information Systems: Design and Development Models.		**CO2**
UNIT III	**GRID FRAMEWORK**	**9**
Virtualizing of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting - Materials recycling - Best ways for Green PC - Green Data center - Green Grid framework.		**CO3**
UNIT IV	**GREEN COMPLIANCE**	**9**
Socio-cultural aspects of Green IT - Green Enterprise Transformation Roadmap - Green Compliance: Protocols, Standards, and Audits - Emergent Carbon Issues: Technologies and Future.		**CO4**
UNIT V	**CASE STUDIES**	**9**
The Environmentally Responsible Business Strategies (ERBS) - Case Study Scenarios for Trial Runs - Case Studies - Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhuvan Unhelkar, “Green IT Strategies and Applications-Using Environmental Intelligence”, CRC Press, June 2011
2. Woody Leonhard, Katherrine Murray, “Green Home computing for dummies”, August 2009.

REFERENCE BOOKS

1. Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shoff/IBM rebook, 2011.
2. John Lamb, "The Greening of IT", Pearson Education, 2009.
3. Jason Harris, "Green Computing and Green IT- Best Practices on regulations & industry", Lulu.com, 2008.
4. Carl speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), "Green computing: Large Scale energy efficiency", CRC Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
CO2	Enhance the skill in energy saving practices in their use of hardware.
CO3	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.
CO4	Understand the ways to minimize equipment disposal requirements.
CO5	Learn about various case studies

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	1	2	1	1	2	3	2	2
CO2	3	3	3	1	1	1	1	1	2	1	1	2	3	2	2
CO3	3	3	3	1	1	1	1	1	2	1	1	2	3	2	2
CO4	3	3	3	1	1	1	1	1	2	1	1	2	3	2	2
CO5	3	3	3	1	1	1	1	1	2	1	1	2	3	2	2

ML1612	GAME PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concepts of Game design and development.
- Learn the processes, mechanics and issues in Game Design.
- Be exposed to the Core architectures of Game Programming.
- Know about Game programming platforms, frame works and engines.
- Learn to develop games.

UNIT I	3D GRAPHICS FOR GAME PROGRAMMING	9
3D Transformations, Quaternions, 3D Modeling And Rendering, Ray Tracing, Shader Models, Lighting, Color, Texturing, Camera And Projections, Culling And Clipping, Character Animation, Physics-Based Simulation, Scene Graphs.		CO1
UNIT II	**GAME ENGINE DESIGN**	**9**
Game Engine Architecture, Engine Support Systems, Resources And File Systems, Game Loop And Real-Time Simulation, Human Interface Devices, Collision And Rigid Body Dynamics, Game Profiling.		CO2
UNIT III	**GAME PROGRAMMING**	**9**
Application Layer, Game Logic, Game Views, Managing Memory, Controlling The Main Loop, Loading And Caching Game Data, User Interface Management, Game Event Management.		CO3
UNIT IV	**GAMING PLATFORMS AND FRAMEWORKS**	**9**
2D And 3D Game Development Using Flash, DirectX, Java, Python, Game Engines - DX Studio, Unity		CO4
UNIT V	**GAME DEVELOPMENT**	**9**
Developing 2D And 3D Interactive Games Using DirectX Or Python - Isometric And Tile Based Games, Puzzle Games, Single Player Games, Multi-Player Games.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Mike Mc Shaffrfy And David Graham, “Game Coding Complete”, Fourth Edition, Cengage Learning, PTR, 2012.
2. Jason Gregory, “Game Engine Architecture”, CRC Press / A K Peters, 2009
3. David H. Eberly, “3D Game Engine Design, Second Edition: A Practical Approach toReal-Time Computer Graphics” 2nd Editions, Morgan Kaufmann, 2006.
4. Ernest Adams And Andrew Rollings, “Fundamentals of Game Design”, 2nd EditionPrentice Hall / New Riders, 2009.

5. Eric Lengyel, “Mathematics For 3D Game Programming and Computer Graphics”, 3rdEdition, Course Technology PTR, 2011.
6. Jesse Schell, The Art of Game Design: A Book Of Lenses, 1st Edition, CRC Press, 2008.

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COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss the concepts of Game design and development.
CO2	Design the processes, and use mechanics for game development.
CO3	Explain the Core architectures of Game Programming
CO4	Use Game programming platforms, frame works and engines
CO5	Create interactive Games.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1613	INTELLIGENT TRANSPORT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- Fundamentals of intelligent transport systems
- Concepts of ATIS and its operations
- Basics of predictive route guidance system
- Concepts of APTS and its operations
- General issues related to ITS and environment

UNIT I	**ITS FUNDAMENTALS**	**9**
Introduction to Intelligent Transportation Systems (ITS) - Definition of ITS and Identification of ITS Objectives - Historical Background - Benefits of ITS - ITS Data collection techniques – Detectors - Automatic Vehicle Location (AVL) - Automatic Vehicle Identification (AVI)		**CO1**
UNIT II	**ADVANCED TRAVELLER INFORMATION SYSTEMS**	**9**
Basic concepts - Models - Simulation - LOS of transportation systems - Static, real time and dynamic information - Value of information - Topology - Where and When to receive data - Information flows - Travel support – Dynamic routing.		**CO2**
UNIT III	**PREDICTIVE ROUTE GUIDANCE**	**9**
ITS - Applications - Issues- Information types - Impact on route guidance - Case studies.		**CO3**
UNIT IV	**ADVANCED PUBLIC TRANSPORTATION SYSTEMS (APTS)**	**9**
Scope - Components of APTS - Advantages- Limitations of APTS - Case studies - Issues		**CO4**
UNIT V	**ITS AND ENVIRONMENT**	**9**
ITS and Flexibility - ITS and Customer-centricity - ITS and the Environment - General issues and Case studies - Overview of ITS implementations in developed countries.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Pradip Kumar Sarkar, Amit Kumar Jain, "Intelligent Transport Systems", Paperback, PHI Learning, 2018

REFERENCE BOOKS

1. Paolo Baggano, "Intelligent transport Systems Good practices to standards", CRC press,2016.
2. ITS Hand Book 2000: Recommendations for World Road Association (PIARC)by Kan Paul Chen, John Miles.
3. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
4. National ITS Architecture Documentation, US Department of Transportation, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze the various types of traffic and suggesting ITS.
CO2	Plan and design the ATIS.
CO3	Plan the predictive route guidance system
CO4	Analyze the traffic data and able to suggest suitable APTS.
CO5	Manage the issues arising out of introduction of ITS.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1614	PARALLEL AND DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explore the features of Parallel Programming Platforms
- To learn the concepts of CUDA programming Model
- To provide knowledge about Analytical Modeling Of Parallel Programs
- To know about dense matrix algorithms
- To explore different search algorithms

UNIT I	**PARALLEL PROGRAMMING PLATFORMS**:	9
Introduction: Scope , issues, applications and challenges of Parallel and Distributed Computing Parallel Programming Platforms: Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms, Physical Organization, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, GPU, co-processing. Principles of Parallel Algorithm Design: Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing.		CO1
UNIT II	**CUDA PROGRAMMING MODEL**	9
Overview of CUDA, Isolating data to be used by parallelized code, API function to allocate memory on parallel computing device, to transfer data, Concepts of Threads, Blocks, Grids, Developing a kernel function to be executed by individual threads, Execution of kernel function by parallel threads, transferring data back to host processor with API function		CO2
UNIT III	**ANALYTICAL MODELING OF PARALLEL PROGRAMS**	9
Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time		CO3
UNIT IV	**DENSE MATRIX ALGORITHMS**	9
Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Bubble Sort and Variants, Quick Sort, Other Sorting Algorithms Graph Algorithms: Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths, Transitive Closure, Connected Components, Algorithms for Sparse Graph		CO4
UNIT V	**SEARCH ALGORITHMS FOR DISCRETE OPTIMIZATION PROBLEMS**	9
Sequential Search Algorithms, Parallel Depth-First Search, Parallel Best-First Search, Speedup Anomalies in Parallel Search Algorithms		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. A Grama, AGupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003.
2. C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 2008.
3. J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming. Morgan Kaufmann Publishing and Elsevier, 2013
4. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley Professional, 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explore the features of Parallel Programming Platforms
CO2	Understand the concepts of CUDA programming Model
CO3	Analyze about Analytical Modeling Of Parallel Programs
CO4	Explore dense matrix algorithms
CO5	Explore different search algorithms for optimization problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1615	CASE BASED REASONING	L	T	P	C
		3	0	0	3

OBJECTIVES

- understand the basic elements of case based reasoning
- understand the case representation and similarity measures.
- understand apply case retrieval, indexing and adaptation process
- Develop case based reasoning systems.
- implement case based reasoning for managing complex knowledge sources

UNIT I	**BASIC CASE BASED REASONING ELEMENTS**	9
Case-Based Reasoning- Experiences and Cases -Parts of a Case -Problems - Solution Types – Case Representations - Case Bases - Similarity and Retrieval -Reuse and Adaptation -Models of CBR.		CO1
UNIT II	**CASE REPRESENTATION AND SIMILARITY MEASURES**	9
Representation Layers - Completeness and Efficiency -Flat Attribute-Value Representation-Complex Representations in General. Similarity and Case Representations -Types of Similarity Measures -The Local-Global Principle for Similarity Measures - Virtual Attributes- Similarity Measure to Use. Complex Similarities: Graph Representations and Graph Similarities- Largest Common Subgraphs Taxonomic Similarities- Similarities for Object-Oriented Representations- Many-Valued Attributes Similarity for Processes and Workflows		CO2
UNIT III	**CASE RETRIEVAL AND INDEXING**	9
The Retrieval Task - Retrieval Errors-Basic Retrieval Methods: Query Generation-Filtering Sequential Retrieval -Two-Level Retrieval -Geometric Methods - Voronoi Diagrams and k-Nearest Neighbours -Geometric Approximation - Geometric Filtering-Index-Based Retrieval - kd- Trees Integration with Decision Trees. Case Indexing- Traditional Indexing Method-Case Indexing Using a Bayesian Model, Prototype-Based Neural Network and Three-Layered Back Propagation Neural Network.		CO3
UNIT IV	**CASE ADAPTATION AND CASE-BASE DEVELOPMENT**	9
Rules - Adaptation Types -The Adaptation Process - Adaptation Using Several Cases – Adaptations Using the Solution Process - Quality Issues - Knowledge in the Adaptation Container. Case Based Development-Problem Formulation -Finding and Getting Data, Preprocessing - Case Acquisition Prototypes and Evaluation The Knowledge Containers - Systematic Development of CBR Systems Implementation Aspects -Combining CBR with Other Techniques-Maintenance		CO4
UNIT V	**COMPLEX KNOWLEDGE SOURCES AND KNOWLEDGE MANAGEMENT**	9
Textual CBR- Images- Sensor Data and Speech - Conversational CBR Knowledge Management Case-Based Reasoning and Knowledge Management- CBR ImplementingKM Cycles.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael M. Richter and Rosina O. Weber, Case-based reasoning: a textbook, Springer, 2013.
2. S. Simon, P. Sankar, ¯Foundations of Soft Case-Based Reasoning, 1st ed. Wiley-Inderscience, 2004.

REFERENCE BOOKS
1. J. Kolodner, ¯Case-Based Reasoning, San Mateo, CA: Morgan Kaufmann Publishers; 1993 2. I.Watson, Applying Case-Based Reasoning: Techniques for Enterprise Systems. San Francisco, CA: Morgan Kaufmann Inc. 1997.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Knowledge the basic elements of case based reasoning
CO2	Knowledge the case representation and similarity measures.
CO3	Ability to apply case retrieval, indexing and adaptation process
CO4	Ability to develop case based reasoning systems.
CO5	Ability to implement case based reasoning for managing complex knowledge sources

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO 2	PS O3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

PROFESSIONAL ELECTIVE – III (SEMESTER VII)

ML1711	AI for CLINICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES

1. The objective of this course is to gain insight and situational experience with clinical information systems.
2. To examine the effective use of data and information technology to assist in the migration away from paper-based systems
3. To Explain the principles of health care data exchange and standards.
4. To understand Human interaction system in Health care
5. To gain insights and understanding of the impacts placed on patients and health care providers.

UNIT I	INTRODUCTION TO CLINICAL INFORMATION SYSTEM	9
Introduction to clinical information systems - contemporary issues in healthcare - workflow and related tools for workflow design - electronic health records databases - Healthcare IT & portable technology		CO1
UNIT II	ARTIFICIAL INTELLIGENCE IN HEALTH CARE	9
Artificial intelligence in health care: Use of AI, The healthcare industry, Electronic medical records,Clinical decision support systems		CO2
UNIT III	MACHINE LEARNING IN HEALTH CARE SYSTEM	9
Machine learning for natural language, Machine learning for vision, Human-computer interaction		CO3
UNIT IV	BIOETHICS AND CHALLENGES	9
Bioethics and challenges to deployment, Grand challenges in clinical decision support		CO4
UNIT V	BIG DATA ANALYTICS IN HEALTH CARE	9
Data mining in health care, Big data analytics in health care, IBM Watson, Issues in sustainability and interoperability		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Sittig & Ash, Clinical Information Systems – Overcoming Adverse Consequences, Jones &Bartlett Learning Publishers, 2009.
2. Edward H. Shortliffe; Leslie E. Perreault, Medical Informatics – Computer Applications in Healthcare and Biomedicine, Springer-Verlag New York Inc. Publishers, 2014.

REFERENCE BOOKS

1. Arnold, M. (2016). Digital health news update: Machine learning meets health search. Decision Resources Group.
2. Blenner, S. R., Kollmer, M., Rouse, A. J., Daneshvar, N., Williams, C., Andrews, L. B. (2016) Privacy Policies of Android Diabetes Apps and Sharing of Health Information. JAMA, 315(10), 1051

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basics of clinical information systems.
CO2	To learn how to apply information technology and related tools in workflow design.
CO3	To explore the “benefits and barriers” associated with electronic health records.
CO4	Explain strategies to minimize major barriers to the adoption of electronic health records.
CO5	Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1

ML1712	GAME THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the sequential moves.
- To familiarize with Simultaneous moves.
- To solve strategic games between two and more agents in non-cooperative scenario.
- To solve both simultaneous and sequential move games.
- To learn different methods to solve games

UNIT I	**INTRODUCTION AND GENERAL PRINCIPLES**	**9**
Basic Ideas and Examples- Decisions versus Games- Classifying games terminology and background assumptions the uses of game theory- Games with sequential moves - game trees solving games by using trees adding more players -Evidence concerning rollback-Strategies in the survivor game		**CO1**
UNIT II	**SIMULTANEOUS-MOVE GAMES**	**9**
Games with Simultaneous-Move Games with Pure Strategies : Nash Equilibrium - Dominance-Best-Response Analysis - The Minimax Method For Zero-Sum Games - Three Players - Multiple Equilibria In Pure Strategies -No Equilibrium In Pure Strategies-Discrete Strategies-Simultaneous-Move Games with Pure Strategies - Continuous Strategies Pure Strategies That Are Continuous Variables Requirements of Rationality for Nash Equilibrium - Rationalizability		**CO2**
UNIT III	**BROAD CLASSES OF GAMES AND STRATEGIES**	**9**
Uncertainty and Information -Imperfect Information: Dealing With Risk-Asymmetric Information: Basic Ideas-Direct Communication-Adverse Selection, Signaling and Screening -Equilibria In Signaling Games -The Prisoners' Dilemma And Repeated Games -The Basic Game - Solutions -Repetition -Penalties And Rewards - Leadership -Asymmetric Information -Experimental Evidence -Real-World Dilemmas		**CO3**
UNIT IV	**VARIANTS AND EXTENSIONS**	**9**
Strictly Competitive Games and Max minimization: Max Minimization-Max minimization and Nash Equilibrium-Strictly Competitive Games -Max minimization and Nash Equilibrium in Strictly Competitive Games-Max minimization: Some History-Empirical Tests: Experiments, Tennis, and Soccer. Rationalizability- Iterated Elimination of Strictly Dominated Actions- Iterated Elimination of Weakly Dominated Actions- Dominance		**CO4**
UNIT V	**APPLICATION**	**9**
Voting-Voting Rules, Paradoxes, Strategic Manipulation -Bidding strategy and Auction Design -Bargaining: Nash Bargaining Solution, Ultimatum game, Alternating- offers game, Threat Points, Bargaining Shares		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Avinash K. Dixit , David H. Reiley Jr. , Susan Skeath “Games of Strategy” , W. W. Norton & Company, Fourth International Student Edition, 2015.
2. Martin J. Osborne, “An Introduction to Game Theory”, Oxford University Press, Illustrated Reprint, 2003

REFERENCE BOOKS

1. Martin J. Osborne and Ariel Rubinstein, “A course in game theory”, MIT Press, 1994.
2. Joel Watson, “Strategy: An Introduction to Game Theory” Hardcover, W. W. Norton &Company, Third Edition,2013.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Create game tree for any application.
CO2	Use different strategies for simultaneous-move games
CO3	Analyze strategic games between two and more agents in non - cooperative scenario
CO4	Apply Equilibrium and Rationalizability for games
CO5	Deploy game strategy in various applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1713	DATA MINING AND PREDICTIVE MODELLING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Recognize the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
- Compare and contrast the underlying predictive modelling techniques.
- Select appropriate predictive modelling approaches to identify particular cases.
- Appreciate the nuances of Support Vector Machines and clustering techniques.
- Apply predictive modelling approaches using a suitable package such as SPSS Modeler

UNIT I	**DATA UNDERSTANDING & PREPARATION**	**9**
Identifying business objectives, translating business objectives to data mining goals, reading data from various sources – Database/ Excel/ Text/others, data visualization – tabular & graphic, distributions and summary statistics, field reordering, Reclassify data.		**CO1**
UNIT II	**DATA TRANSFORMATIONS**	9
Data quality issues, Data Audit, anomalies, relationships among variables, Extent of Missing Data, Segmentation, Outlier detection, Variable transformations, Variable derivation, Variable selection, Automated Data Preparation, combining data files, data restructuring, Aggregation, Duplicates removal, Sampling cases, Data Caching, Partitioning data, Missing Value replacement.		**CO2**
UNIT III	**MODELING TECHNIQUES – I**	**9**
Partitioning The Data - Training, Validation & Testing, Model selection, Model development techniques - Linear regression, Logistic regression, Discriminant analysis, Bayesian networks, Neural networks, Rule Induction.		**CO3**
UNIT IV	**MODELING TECHNIQUES – II**	**9**
Support vector machines, Cox regression, Time series analysis, Decision trees, Clustering, Association Rules, Sequence Detection, Which Technique to use when.		**CO4**
UNIT V	**MODEL EVALUATION & DEPLOYMENT**	**9**
Model Validation, Determining Model Accuracy, Rule Induction Using CHAID, Automating Models for Categorical Targets, Automating Models for Continuous Targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, Using Propensity Scores, Meta-Level Modeling, Error Modeling, Deploying Model, Exporting Model Results, Assessing Model Performance, Updating A Model.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

Data Mining & Predictive Modeling (IBM ICE Publications).

REFERENCE BOOKS
1. Data Mining and Predictive Analytics (Wiley Series on Methods and Applications in Data Mining) 2nd Edition, Kindle Edition

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Recognize the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
CO2	Compare and contrast the underlying predictive modeling techniques.
CO3	Select appropriate predictive modeling approaches to identify particular cases.
CO4	Appreciate the nuances of Support Vector Machines and clustering techniques.
CO5	Apply predictive modeling approaches using a suitable package such as SPSS Modeler

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	2	-	-	2	2	2	2	2	1
CO2	3	3	3	3	2	-	2	-	-	2	2	2	2	2	1
CO3	3	3	3	3	2	-	2	-	-	2	2	2	2	2	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	2	2	1

ML1714	MACHINE INTELLIGENCE FOR NETWORK SCIENCES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of web social networks.
- To learn visualization of social networks.
- To understand about graphs and node embeddings
- To learn the concepts in Graph Neural Networks models
- To understand the concepts in Generative Graph Models

UNIT I	WEB SOCIAL NETWORKS	9
Development of Social Network Analysis - Key concepts and measures in network analysis - Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks – Evaluating Communities – Methods for Community Detection and Mining – Applications of Community Mining Algorithms – Tools for Detecting Communities – Social Network Infrastructure and Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities		CO1
UNIT II	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS**	**9**
Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Covert networks - Community welfare - Collaboration networks - Co-Citation networks.		CO2
UNIT III	**MACHINE LEARNING ON GRAPHS**	**9**
Introduction - Machine Learning on Graphs - Traditional Approaches - Graphs Statistics and Kernal Methods - Node Embeddings - Encoder Decoder - Factorization based approaches - Random walk embeddings – Shallow Embeddings - Limitations		CO3
UNIT IV	**GRAPH NEURAL NETWORKS**	**9**
Graph Neural Network Model - Neural Message Passing – Generalized Neighborhood Aggregation – Generalized Update Methods – Edge Features and Multi-relational GNNs – Graph Pooling – Graph Neural Network in Practice		CO4
UNIT V	**GENERATIVE MODELLING**	**9**
Generative Graph Models - Traditional Generation Approaches - Deep Generative Models for Graphs- Machine Learning for Graph Generation - Graph RNN - Evaluating Graph Generation – Molecule Generation		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Network sciences by Albert-Laszlo Barabasi, Cambridge University Press
2. Graph Representation Learning Book by William L. Hamilton. McGill University
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg, Cambridge University Press (2010)

REFERENCE BOOKS

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2. Borko Furht, Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To know basic notation and terminology used in network science.
CO2	To visualize social networks and analyze their properties.
CO3	To understand node embeddings in graphs
CO4	To understand Graph Neural Network Models
CO5	To learn Generative Graph models and Deep Generative Models

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2
CO3	1	1	2	2	2	1	1	1	1	1	1	1	2	2	2
CO4	1	1	2	2	2	1	1	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	1	1	1	1	1	1	1	2	2	2

ML1715	INTELLIGENT MACHINING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of Artificial Intelligence
- To learn the fundamentals of Intelligent machining, sensors and machining process
- To understand the design and representation of Intelligent Systems and RTOS
- To understand the computational methods and optimization in machining
- To understand the impact of Artificial Intelligence in various real-time applications

UNIT I	INTRODUCTION	9
Introduction to Artificial Intelligence and it's techniques- Problem Solving with Artificial Intelligence - AI Models - Data acquisition and learning aspects of AI - Problem Solving - Problem Solving Process - Formulating Problems - Problem types and Characteristics Problem Space and Search - Agents - Types of Agents – Intelligent Agent		CO1

UNIT II	EVOLUTION AND COMPONENTS OF INTELLIGENT MACHINING SYSTEMS	9
Introduction Intelligent Machining – Basics - Open Architecture Machine Control - Manufacturing Automation Protocol - The Evolution of Intelligent Machining - MOSAIC - NGC - OSACA - SERCOS - Components of Intelligent Machining - Introduction sensors - Machining Process Sensing and Monitoring - Signal Processing - Transforming Data into Information - Examples Machining Process Control - Practical Uses of Machine Learning - Machine Learning Process Control – Strategies		CO2

UNIT III	INTELLIGENT SYSTEM REPRESENTATION AND RTOS FUNDAMENTALS	9
Representation of Intelligent systems - An Object-Oriented Approach - Tools and Techniques for Conceptual Design - Design Compilers - Labelled Interval Calculus - Knowledge Representations for Design Improvisation - A knowledge-based Framework for Design - Introduction to RTOS - Hardware Components - Design Principles of RTOS - Interrupt Processing - task Management		CO3

UNIT IV	COMPUTATIONAL METHODS AND OPTIMIZATION IN MACHINING	9
Computational methods and optimization - Neural Network Modelling - Fuzzy set theory - Machining Optimization - Objective Functions and Constraints - Optimization Techniques - Reasoning about physical system - Temporal Qualitative Analysis		CO4

UNIT V	CASE STUDIES	9
Autonomous Vehicle (Driver Less Car) - Defect Prediction - Wear and Tear Prediction in Mechanical devices - Flying Drones - Cogito - Alexa, SIRI - Smarter Home robots - Application of AI in CAD/CAM .		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Farid Meziane, Sunil Vadera, Khiary Kobbacy and Nathan Proudlove, "Intelligent Systems in Manufacturing: Current Developments and Future Prospects"
2. How Netflix Uses Analytics To Select Movies, Create Content, and Make Multimillion Dollar Decisions Author: Zach Bulygo
3. Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith
4. Machining: Fundamentals and Recent Advances, J. Paulo Davim, Springer.
5. Artifical Intelligent in Engineering Design: Volume 2 , Gerard Meurant, Springer

REFERENCE BOOKS

1. Artifical Intelligent in Engineering Design: Volume 1, Gerard Meurant, Springer
2. K.C.Wang, " Embedded and Real-Time Operating Systems
3. Sam Siewert, John Pratt," Real-Time Embedded Components and Systems with Linux and RTOS", David Pallai Publisher, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of the fundamentals of Artificial Intelligence and its problem-solving approaches
CO2	Gain knowledge of the fundamentals of Intelligent Machining and machining processes
CO3	Acquire knowledge on the design of Intelligent Systems and RTOS
CO4	Acquire knowledge on computational methods and optimization in machining
CO5	Apply knowledge to various AI based real-time applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	2	-	-	2	2	2	3	3	3	3
CO2	2	2	2	3	3	2	-	-	2	2	2	3	3	3	3
CO3	2	2	2	3	3	2	-	-	2	2	2	3	3	3	3
CO4	2	2	2	3	3	2	-	-	2	2	2	3	3	3	3
CO5	2	2	2	3	3	2	-	-	2	2	2	3	3	3	3

PROFESSIONAL ELECTIVE – IV (SEMESTER VII)

ML1721	GENETIC ALGORITHM	L	T	P	C
		3	0	0	3

OBJECTIVES

1. To understand the concepts of Genetic algorithm scientific models
2. To build and implement a computer implementation of genetic algorithm
3. To survey of the many aspects of evolutionary algorithms (EAs), in particular GA,GP, ES, technique
4. To know about Advance operators and techniques in genetic Search
5. To understand data mining using genetic algorithm dearch in industrial application

UNIT I	INTRODUCTION TO GENETIC ALGORITHMS IN SCIENTIFIC MODELS	9
Introduction: A brief history of evolutionary computation, Elements of Genetic Algorithms, Asimple genetic algorithm, Applications of genetic algorithms **Genetic Algorithms in Scientific models:** Evolving computer programs, data analysis andprediction, evolving neural networks, Modelling interaction between learning and evolution, modelling sexual selection, measuring evolutionary activity.		CO1
UNIT II	THEORETICAL FOUNDATION OF GENETIC ALGORITHM	9
Theoretical Foundation of genetic algorithm: Schemas and Two-Armed and k-armed problem, royal roads, exact mathematical models of simple genetic algorithms, Statistical- Mechanics Approaches. Computer Implementation of Genetic Algorithm: Data structures, Reproduction, crossover and mutation, mapping objective functions to fitness form, fitness scaling, coding, a multiparameter, mapped, fixed point coding, discretization and constraints		CO2
UNIT III	APPLICATIONS OF GENETIC ALGORITHMS	9
Some applications of genetic algorithms: The risk of genetic algorithms, De Jong and function optimization, Improvement in basic techniques, current application of genetic algorithms		CO3
UNIT IV	ADVANCED OPERATORS AND TECHNIQUES IN GENETIC SEARCH	9
Advanced operators and techniques in genetic search: Dominance, duplicity, and abeyance, inversion and other reordering operators. Other micro operators, Niche and speciation, multi objective optimization, knowledge-based techniques, genetic algorithms and parallel processors.		CO4
UNIT V	INDUSTRIAL APPLICATION OF GENETIC ALGORITHMS	9
Industrial Application Of Genetic Algorithms: Data mining using genetic Algorithms Search in data mining Genetic algorithms for game playing eg TIC TAC TOE		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Genetic algorithms in search, optimization and Machine Learning by David E. Goldberg, Pearson Education

REFERENCE BOOKS
1. An introduction to genetic algorithms by Melanle Mitchell, PHI. 2. The simple genetic algorithm foundations and theory by Michael D. Vose, PHI

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Discuss about basic of Genetic algorithm
CO2	Apply Evolutionary Computation Methods to find solutions to complex problems
CO3	Analyze and experiment with parameter choices in the use of Evolutionary Computation
CO4	Summarize current research in Genetic Algorithms and Evolutionary Computing
CO5	Explain Industrial application of Genetic algorithm

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	2	-	2	2	2	2	2	1
CO2	3	3	3	3	2	-	-	2	-	2	2	2	2	2	1
CO3	3	3	3	3	2	-	-	2	-	2	2	2	2	2	1
CO4	3	3	3	3	2	-	-	2	-	2	2	2	2	2	1
CO5	3	3	3	3	2	-	-	2	-	2	2	2	2	2	1

ML1722	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of the speech processing
- Explore the various speech models
- Gather knowledge about the phonetics and pronunciation processing
- Perform wavelet analysis of speech
- To understand the concepts of speech recognition

UNIT I	**INTRODUCTION**	**9**
Introduction - knowledge in speech and language processing - ambiguity - models and algorithms - language - thought - understanding - regular expression and automata - words & transducers - N grams		CO1
UNIT II	**SPEECH MODELLING**	**9**
Word classes and part of speech tagging - hidden markov model - computing likelihood: the forward algorithm - training hidden markov model - maximum entropy model - transformation-based tagging – evaluation and error analysis – issues in part of speech tagging – noisy channel model for spelling		CO2
UNIT III	**SPEECH PRONUNCIATION AND SIGNAL PROCESSING**	**9**
Phonetics - speech sounds and phonetic transcription - articulatory phonetics - phonological categories and pronunciation variation - acoustic phonetics and signals - phonetic resources - articulatory and gestural phonology		CO3
UNIT IV	**SPEECH IDENTIFICATION**	**9**
Speech synthesis - text normalization - phonetic analysis - prosodic analysis - diphone waveform synthesis - unit selection waveform synthesis - evaluation		CO4
UNIT V	**SPEECH RECOGNITION**	**9**
Automatic speech recognition – architecture – applying hidden markov model – feature extraction: mfcc vectors - computing acoustic likelihoods - search and decoding - embedded training – multipass decoding: n-best lists and lattices- a* (‗stack‘) decoding – context-dependent acoustic models: triphones - discriminative training - speech recognition by humans		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Daniel Jurafsky and James H. Martin, ― Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Person education,2013.
2. Kai-Fu Lee, ―Automatic Speech Recognition, The Springer International Series in Engineering and Computer Science, 1999.

3. Himanshu Chaurasiya, Soft Computing Implementation of Automatic Speech Recognition, LAP Lambert Academic Publishing, 2010.
4. Claudio Becchetti, Klucio Prina Ricotti, ¯Speech Recognition: Theory and C++ implementation,Wiley publications 2008.
5. Ikrami Eldirawy , Wesam Ashour, ¯Visual Speech Recognition, Wiley publications , 2011

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Create new algorithms with speech processing
CO2	Derive new speech models
CO3	Perform various language phonetic analysis
CO4	Create a new speech identification system
CO5	Generate a new speech recognition system

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1723	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the nonlinear problem.
- Know about multi-objective problem.
- To create awareness of meta heuristic algorithms

UNIT I	DECISION ANALYSIS	9
Decision Trees, Utility theory, Game theory, MCDM – Goal programming, AHP and ANP; Markov Decision processes		CO1
UNIT II	**NON-LINEAR OPTIMIZATION - I**	**9**
Types of Non-linear programming problems, Unconstrained optimization, KKT conditions for constrained optimization, Quadratic programming		CO2
UNIT III	**NON-LINEAR OPTIMIZATION - II**	**9**
Separable programming, Convex programming, Non-convex programming, Geometric programming, Stochastic programming		CO3
UNIT IV	**META-HEURISTICS OPTIMIZATION**	**9**
Principles, Parameters, and working - Genetic Algorithms, Simulated annealing, Tabu search, Ant Colony Optimization – Particle swarm Optimization – Applications.		CO4
UNIT V	**NON-TRADITIONAL OPTIMIZATION**	**9**
Neural network based optimization, Optimization of Fuzzy systems		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Hillier and Liberman, "Introduction to Operations Research", TMH, 2000.
2. Singiresu S Rao, "Engineering Optimization", Wiley, 1998.
3. Kalyanmoy Deb, "Optimization for Engineering Design", PHI, 2000.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Perform decision analysis
CO2	Solve a nonlinear problem through its linear approximation.
CO3	Solve a multi-objective problem through weighted and constrained methods.
CO4	Apply various direct and indirect search methods
CO5	Apply different techniques to solve various optimization problems arising from engineering areas.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

CS1725	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know how to analyze and consider user's need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human - machine interaction

UNIT I	**INTRODUCTION**	**9**
Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework - Perception and Representation - Attention and Memory Constraint - Knowledge and Mental Model - Interface Metaphors - Input - Output		**CO1**
UNIT II	**DESIGN PROCESS**	**9**
Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centered Design - Methods for User-Centered Design		**CO2**
UNIT III	**IMPLEMENTATION AND EVALUATION PROCESS**	**9**
Implementation issues - Implementation Support - Evaluation techniques - Universal Design - User Support		**CO3**
UNIT IV	**MODELS**	**9**
Cognitive models - Communication and collaboration models: Models of the system - Models of the System - Modeling Rich Interaction		**CO4**
UNIT V	**APPLICATIONS**	**9**
Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, ―Human Computer Interaction‖, Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. ―Human - Computer Interaction‖, Second edition, Prentice Hall,1998

REFERENCE BOOKS

1. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. ―Human – Computer Interaction‖, Addison Wesley, 1994.
2. John M.Carrol, ―Human Computer Interaction in the New Millenium, Pearson Education, 2002.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To develop good design for human machine interaction system
CO2	Analyze the user's need in interaction system
CO3	To design new interaction model to satisfy all types of customers
CO4	Evaluate the usability and effectiveness of various products
CO5	To know how to apply interaction techniques for systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	3	3	2	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2

ML1726	CLOUD COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

On Completion of the course, the students should be able to:

- recognize the main concepts, types, deployment models, advantages and disadvantages of cloud computing.
- learn the cloud architecture and virtualization techniques
- appreciate the key concepts of cloud application programming.
- understand cloud resource management and security
- understand cloud platforms and new developments

UNIT I	INTRODUCTION TO CLOUD COMPUTING	9
Introduction to Cloud Computing – Move to Cloud Computing – Types of Cloud – Working of Cloud Computing - Cloud deployment models: public, private, hybrid, community –Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance – Pros and Cons of cloud computing		CO1
UNIT II	**CLOUD ARCHITECTURE AND VIRTUALIZATION**	**9**
Cloud Computing Architecture : The cloud reference model – Architecture, Infrastructure and hardware as a service, Platform as a service, Software as a service, Characteristics of virtualized environments – Increased security, Managed execution, Portability, Taxonomy, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples – Xen, VMware, Microsoft Hyper-V		CO2
UNIT III	**CLOUD APPLICATION PROGRAMMING**	**9**
Aneka – Framework, Anatomy of Aneka container, building Aneka clouds, cloud programming and management, Programming applications with threads, Multithreading with Aneka, Programming applications with Aneka threads, Task computing, Task based application models, Aneka task-based programming		CO3
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**9**
Inter Cloud Resource Management - Resource Provisioning and Resource Provisioning Methods - Global Exchange of Cloud Resources - Security Overview - Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards		CO4
UNIT V	**CLOUD PLATFORMS AND DEVELOPMENTS**	**9**
Amazon web services – Compute, Storage, Communication and Additional services - Google App Engine – Architecture and core concepts, Application life cycle, Cost model – Microsoft Azure - SQL Azure, Windows Azure platform appliance, Scientific applications, - Healthcare, Biology, Geoscience, Business and consumer applications – CRM and ERP, Productivity, Social networking, Media applications, Multiplayer online gaming		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012
2. Ritting house, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ‾Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

REFERENCE BOOKS
1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009. 2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009

COURSE OUTCOMES **Upon completion of the course, students will be able**	
CO1	To know basic concepts, types and deployment models of cloud computing.
CO2	To learn cloud architecture and virtualization techniques.
CO3	To understand the key concepts of cloud application programming
CO4	To understand cloud resource management and security
CO5	To learn cloud platforms and new developments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	1	1	1	2	1	2	3	2	2	2
CO2	2	2	2	2	3	1	1	1	2	1	2	3	2	2	2
CO3	2	1	2	2	3	1	1	1	2	1	2	3	2	2	2
CO4	2	1	2	2	3	1	1	1	2	1	2	3	2	2	2
CO5	2	2	2	2	3	1	1	1	2	1	2	3	2	2	2

PROFESSIONAL ELECTIVE – V (SEMESTER VIII)

ML1811	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- To know the fundamental concepts of big data and analytics
- To learn various techniques for mining data streams
- To acquire the knowledge of extracting information from surveillance videos.
- To learn Event Modelling for different applications.
- To understand the models used for recognition of objects in videos

UNIT I	INTRODUCTION TO BIG DATA & DATA ANALYSIS	9
Introduction to Big Data Platform – Challenges of Conventional systems – Web data- Evolution of Analytic scalability- analytic processes and tools- Analysis Vs Reporting- Modern data analytic tools Data Analysis: Regression Modeling- Bayesian Modeling- Rule induction		CO1
UNIT II	**MINING DATA STREAMS**	**9**
Introduction to Stream concepts- Stream data model and architecture – Stream Computing-Sampling data in a Stream- Filtering Streams- Counting distinct elements in a Stream- Estimating moments Counting oneness in a window- Decaying window- Real time Analytics platform(RTAP) applications case studies.		CO2
UNIT III	**VIDEO ANALYTICS**	**9**
Introduction- Video Basics - Fundamentals for Video Surveillance- Scene Artifacts- Object Detection and Tracking: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.		CO3
UNIT IV	**BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION**	**9**
Event Modelling- Behavioral Analysis- Human Activity Recognition-Complex Activity Recognition Activity modelling using 3D shape, Video summarization, shape-based activity models-Suspicious Activity Detection.		CO4
UNIT V	**HUMAN FACE RECOGNITION & GAIT ANALYSIS**	**9**
Introduction: Overview of Recognition algorithms – Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
2. Michael Berthold, David J.Hand, Intelligent Data Analysis, Springer, 2007.

REFERENCE BOOKS

1. Rama Chellappa, Amit K.Roy-Chowdhury, Kevin Zhou.S, “Recognition of Humans and their Activities using Video”, Morgan & Claypool Publishers, 2005.
2. Yunqian Ma, Gang Qian, “Intelligent Video Surveillance: Systems and Technology”, CRC Press (Taylor and Francis Group), 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Work with big data platform and its analysis techniques
CO2	Design efficient algorithms for mining the data from large volumes.
CO3	Work with surveillance videos for analytics.
CO4	Design of optimization algorithms for better analysis and recognition of objects in a scene.
CO5	Model a framework for Human Activity Recognition

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1812	BLOCKCHAIN ARCHITECTURE DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand Blockchain's fundamental components, and examine decentralization using blockchain.
- To explain how cryptocurrency works, from when a transaction is created to when it is considered part of the Blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics of Hyperledger and Web
- To know about alternative Blockchains and Blockchain projects in different domains.

UNIT I	INTRODUCTION TO BLOCKCHAIN	9
Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms		CO1
UNIT II	**CONSENSUS**	**9**
Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains		CO2
UNIT III	**HYPERLEDGER FABRIC**	**9**
Hyperledger Fabric (A): Decomposing the consensus process , Hyperledger fabric components, Chaincode Design and Implementation Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool		CO3
UNIT IV	**EXPLORING BLOCKCHAIN APPLICATIONS**	**9**
Use case 1: Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc		CO4
UNIT V	**BLOCKCHAIN SOLUTIONS FOR GOVERNMENT**	**9**
Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems BlockchainCryptography, Privacy and Security on Blockchain		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the technology components of Blockchain and how it works behind the scenes.
CO2	Identify different approaches to developing decentralized applications.
CO3	Understand Bitcoin and its limitations by comparing with other alternative coins.
CO4	Understand and use Hyperledger and its development framework
CO5	Track alternative Blockchains and emerging trends in Blockchain.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	2	2	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	2	2	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	2	2	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	2	2	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	2	2	1	1	2	2	2

ML1813	MICROSOFT BOTS FRAMEWORK	L	T	P	C
		3	0	0	3

OBJECTIVES

- Develop various real-world intelligent BOTs from scratch using Microsoft Bot Framework.
- Understand the components of Bot Architecture
- Build Bots to parse the text and voice
- Create intelligent Bots using APIs
- Integrate BOTSs with most popular conversation platforms

UNIT I	**BOT INTRODUCTION & BUILDING CONVERSATION**	**9**
Overview -Exploring BOT framework architecture -BOT chat benefits -Visualizing chatbots ,connector -overview of channels -Bot connector services-characteristics of chatbot- chatbot communication-steps to build chatbot creating Bot framework project -examining default code -initial testing with Emulator -Publishing and registering chatbot-Game Bot- conversation state Management -participating in conversations-using custom message activity - fine tuning chat bot -Handling activities -Advanced conversation messages		CO1
UNIT II	**BOT BUILDER**	**9**
Building dialogs -Introducing wine Bot -implementing dialog class -dialog conversation fl ow- dialog prompt options -calling dialog -- using Form Flow- basic form flow chat -enhancing form flow conversations - advanced templates and patterns -customizing Form Flow-configuring property -message method and common parameters.		CO2
UNIT III	**NATURAL LANGUAGE PROCESSING WITH LUIS**	**9**
Learning essential LUIS concepts -creating models -building intents -introducing winebotLuis -handling entities - Managing advanced conversation -managing dialog stack -navigating to other dialogs-managing conversations with chaining -wine bot chain program -LINQ to dialog -formatting text output		CO3
UNIT IV	**CHANNELS AND GUI**	**9**
Attaching cards -Music chat BOT overview -building blocks-working with attachments -displaying cards - adaptive cards -layout with containers -using controls -handling actions -configuring channels -creating email, SMS and Web Bots		CO4
UNIT V	**APIS INTEGRATION AND VOICE**	**9**
Coding custom channels - overview of console channel -starting conversation - sending activities - ending conversation - integrating cognitive services -searching with Bing-interpreting image -translating text – Bui l ding FAQ Chat Bots - adding voice services-adding speech to activities specifying input Hints.		CO5

TOTAL : 45 PERIODS

TEXT BOOK
1. Joe Mayo,"Programming the Microsoft BOTS framework : A multiple Approach to building chatbots" ,Pearson Education Inc.,2018
REFERENCE BOOKS
1. Kishore Gaddam, " Building bots with Microsoft BOTS framework" , 2017, Packt Publishing Ltd 2. Srikanth Machiraju, Ritesh Modi,"Developing Bots with Microsoft Bots Framework: Create Intelligent Bots using MS Bot Framework and Azure Cognitive Services",A Press,2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the architecture of Bot and build the conversation
CO2	Build dialogs and form flow
CO3	Identify the intent of a text with the help of LUIS
CO4	Analyze the issues of channels and create Email , SMS and Web Bot
CO5	Understand the APIs and integrate cognitive services &voice services

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1814	BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

On Completion of the course, the students should be able to:

- Be exposed with the basic rudiments of business intelligence system
- understand the modeling aspects behind Business Intelligence
- understand of the business intelligence life cycle and the techniques used in it
- Be exposed with different data analysis tools and techniques

UNIT I	BUSINESS INTELLIGENCE	9
Business intelligence: Effective and timely decisions, Data, information and knowledge, The role of mathematical models, Business intelligence architectures, Ethics and business intelligence Decision support systems: Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system		CO1
UNIT II	**MATHEMATICAL MODELS FOR DECISION MAKING**	**9**
Mathematical models for decision making: Structure of mathematical models, Development of a model, Classes of models Data mining: Definition of data mining, Representation of input data , Data mining process, Analysis methodologies Data preparation: Data validation, Data transformation, Data reduction		CO2
UNIT III	**CLASSIFICATION**	**9**
Classification: Classification problems, Evaluation of classification models, Bayesian methods, Logistic regression, Neural networks, Support vector machines. Clustering: Clustering methods, Partition methods, Hierarchical methods, Evaluation of clustering models		CO3
UNIT IV	**BUSINESS INTELLIGENCE APPLICATIONS**	**9**
Business intelligence applications: Marketing models: Relational marketing, Sales force management Logistic and production models: Supply chain optimization, Optimization models for logistics planning, Revenue management systems. Data envelopment analysis: Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices		CO4
UNIT V	**KNOWLEDGE MANAGEMENT**	**9**
Knowledge Management: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Activities, Approaches to Knowledge Management, Information Technology (IT) In Knowledge Management, Knowledge Management Systems Implementation, Roles of People in Knowledge Management. Artificial Intelligence and Expert Systems: Concepts and Definitions of Artificial Intelligence, Artificial Intelligence Versus Natural Intelligence, Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems, Knowledge Engineering, Development of Expert Systems		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Carlo Vercellis ,Business Intelligence: Data Mining and Optimization for Decision Making, Wiley 1st,2009

REFERENCE BOOKS

1. Efraim Turban, Ramesh Sharda, Dursun Delen ,Decision support and Business Intelligence Systems, Pearson,Edition 9th,2011
2. Grossmann W, Rinderle-Ma,Fundamental of Business Intelligence, Springer,Edition 1st, 2015

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain the fundamentals of business intelligence.
CO2	Link data mining with business intelligence And Apply various modeling techniques.
CO3	Explain the data analysis and knowledge delivery stages.
CO4	Apply business intelligence methods to various situations.
CO5	Decide on appropriate technique.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

MG1815	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To help understand the importance of and major decisions in supply chain management for gaining competitive advantage.

UNIT I	INTRODUCTION	9
Supply Chain – Fundamentals, Evolution, Role in Economy, Importance, Decision Phases, Enablers & Drivers of Supply Chain Performance; Supply chain strategy; Supply Chain Performance Measures.		CO1
UNIT II	**SUPPLY CHAIN NETWORK**	**9**
Distribution Network Design – Role in supply chain, influencing factors, design options, online sales and distribution network, Distribution Strategies; Network Design in supply chain – Role, influencing factors, framework for network design, Impact of uncertainty on Network Design.		CO2
UNIT III	**PLANNING DEMAND, INVENTORY AND SUPPLY**	**9**
Managing supply chain cycle inventory and safety inventory - Uncertainty in the supply chain , Analyzing impact of supply chain redesign on the inventory, Risk Pooling, Managing inventory for short life-cycle products, multiple item -multiple location inventory management; Pricing and Revenue Management		CO3
UNIT IV	**LOGISTICS**	**9**
Transportation – Role, Modes and their characteristics, infrastructure and policies, transport documentation, design options, trade-offs in transportation design, intermodal transportation. Logistics outsourcing – catalysts, benefits, value proposition. 3PL, 4PL, 5PL, 6PL; International Logistics -objectives, importance in global economy, Characteristics of global supply chains, Incoterms		CO4
UNIT V	**SUPPLY CHAIN INNOVATIONS**	**9**
Supply Chain Integration, SC process restructuring, IT in Supply Chain; Agile Supply Chains, Legible supply chain, Green Supply Chain, Reverse Supply chain; Supply chain technology trends – AI, Advanced analytics, Internet of Things, Intelligent things, conversational systems, robotic process automation, immersive technologies, Block chain.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Sunil Chopra, Peter Meindl and DharamVirKalra, Supply Chain Management-Strategy Planning and Operation, Pearson Education, Sixth Edition, 2016.
2. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 2009
3. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5thEdition, 2007.
4. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the SupplyChain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
5. Pierre David, International Logistics, Biztantra, 2011.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understanding of supply chain fundamentals
CO2	Ability to design supply chain networks to enhance supply chain performance
CO3	Ability to plan demand based on inventory and supply
CO4	Understanding the role of logistics in supply chain performance
CO5	Awareness of innovations for sustainable supply chains

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

PROFESSIONAL ELECTIVE – VI (SEMESTER VIII)

ML1821	INTERNET OF EVERYTHING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the fundamental concepts and applications of IoT
- To enumerate the enabling technologies for IoT
- To study ,analyze and design evolving standards of IoT
- To explore IpV6 technologies for IoT
- To learn python programming for designing IoT applications

UNIT I	IOT INTRODUCTION AND APPLICATIONS	9
Overview and Motivations -IPv6 Role -IoT Definitions -Observations - ITU-T Views -Working Definition - IoT Frameworks - Basic Nodal Capabilities – Physical Design of IoT - Logical Design of IoT - Applications Examples -Smart Metering/Advanced Metering Infrastructure -e- Health/Body Area Networks - City Automation - Automotive Applications - Home Automation - Smart Cards -Tracking (Following and Monitoring Mobile Objects) - Over-The-AirPassive Surveillance/Ring of Steel -Control Application Examples		CO1
UNIT II	FUNDAMENTAL MECHANISMS AND KEY TECHNOLOGIES	9
Identification of IoT Objects and Services -Structural Aspects of the IoT - Environment Characteristics - Traffic Characteristics – Scalability – Interoperability -Security and Privacy - Open Architecture - Key IoT Technologies - Device Intelligence -Communication Capabilities - Mobility Support - Device Power - Sensor Technology - RFID Technology - Satellite Technology - IoT Enabling Technologies		CO2
UNIT III	EVOLVING IOT STANDARDS	9
IETF IPv6 Routing Protocol for RPL Roll – Constrained Application Protocol (CoAP) - Representational State Transfer (REST) - ETSI M2M - Third-Generation Partnership Project Service Requirements for Machine-Type Communications - CENELAC – IETF IPv6 Over Lowpower WPAN (6LoWPAN) - ZigBee IP (ZIP) - IP in Small Objects (IPSO) - WPAN Technologies for IoT/M2M -Cellular and Mobile Network Technologies for IoT/M2M		CO3
UNIT IV	IPV6 TECHNOLOGIES FOR THE IOT	9
Motivations - Address Capabilities -IPv6 Protocol Overview -IPv6 Tunneling - IPsec in IPv6 - Header Compression Schemes - Quality of Service in IPv6 - Migration Strategies to IPv6 - Protocol Details - Generic Mechanisms - New IPv6 Protocol - Message Types - Destination Option - Modifications to IPv6 Neighbor Discovery - Requirements for Various IPv6 Nodes - Correspondent Node Operation - HA Node Operation - Mobile Node Operation Relationship to IPV4 Mobile IPv4 (MIP) - IPv6 Over Low-Power WPAN - Goals - Transmission of IPv6 Packets Over IEEE 802.15.4		CO4
UNIT V	IPV6 DESIGN METHODOLOGY	9
Purpose and Requirements Specification - Process Specification - Domain Model Specification - Information Model Specification - Service Specifications - IoT Level Specification - Functional View Specification - Operational View Specification - Device & Component Integration - Application Development - Case Study on IoT System for Weather Monitoring – Logical Design using Python - Python Packages of Interest for IoT - IoT Physical Devices and Endpoints - Raspberry Pi - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - WAMP : AutoBahn for IoT - Xively Cloud for IoT - Python Web Application Framework (Django) - Designing a RESTful Web API - Amazon Web Services for IoT - SkyNet IoT Messaging Platform		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Wiley Publications, First Edition, 2013.

REFERENCE BOOKS
1. ArshdeepBagha, Vijay Madisetti, Internet of Things: A Hands on Approach, Elsevier Publications, 2014 2. Jean-Philippe Vasseur , Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Elsevier Publications, 2010 3. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley Publications, First Edition, 2013

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the applications of IoT
CO2	Apply key technologies for IoT objects and services
CO3	Interpret various IoT standards
CO4	Assemble IpV6 technologies that suits IoT applications
CO5	Design IoT applications using Python

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

ML1822	ETHICS AND AI	L	T	P	C
		3	0	0	3

OBJECTIVES

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT I	**INTRODUCTION**	**9**
Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet- Impact on trust. Case Study of ethical initiatives in healthcare, autonomous vehicles and defense.		**CO1**
UNIT II	**ETHICAL INITIATIVES IN AI**	**9**
International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles. Warfare and weaponization. Identification on optimization in AI affecting ethics.		**CO2**
UNIT III	**AI STANDARDS AND REGULATION**	**9**
Model Process for Addressing Ethical Concerns During System Design Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems. Case study on ontology where ethics is at stake.		**CO3**
UNIT IV	**ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS**	**9**
Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.		**CO4**
UNIT V	**AI AND ETHICS-CHALLENGES AND OPPORTUNITIES**	**9**
Challenges Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner. Ruth Larbey, Emma Weitkamp and Alan Winfield "The ethics of artificial intelligence: Issues and initiatives". EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 March 2020

2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics. The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCE BOOKS

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations. Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Learn about morality and ethics in AI
CO2	Acquire the knowledge of real time application ethics, issues and its challenges.
CO3	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
CO4	Understand the concepts of Roboethics and Morality with professional responsibilities.
CO5	Learn about the societal issues in AI with National and International Strategies on AI

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	3	3	1	-	-	-	1	2	1	1	3	1	1
CO2	2	1	1	2	1	-	-	-	1	2	1	1	3	3	1
CO3	2	3	1	1	3	-	-	-	2	1	2	2	3	2	2
CO4	3	1	3	3	2	-	-	-	2	2	1	1	2	1	3
CO5	3	1	1	3	3	-	-	-	2	3	3	3	1	3	3

ML1823	AGILE SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I	**AGILE METHODOLOGY**	**9**
Theories for Agile Management - Agile Software Development - Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management - Agile Team Interactions - Ethics in Agile Teams - Agility in Design, Testing - Agile Documentations - Agile Drivers, Capabilities and Values		**CO1**
UNIT II	**AGILE PROCESSES**	**9**
Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview - Lifecycle - Work Products, Roles and Practices.		**CO2**
UNIT III	**AGILITY AND KNOWLEDGE MANAGEMENT**	**9**
Agile Information Systems – Agile Decision Making – Earl_S Schools of KM – Institutional Knowledge Evolution Cycle - Development, Acquisition, Refinement, Distribution, Deployment , Leveraging - KM in Software Engineering - Managing Software Knowledge - Challenges of Migrating to Agile Methodologies - Agile Knowledge Sharing - Role of Story-Cards - Story-Card Maturity Model (SMM).		**CO3**
UNIT IV	**AGILITY AND REQUIREMENTS ENGINEERING**	**9**
Impact of Agile Processes in RE-Current Agile Practices - Variance - Overview of RE Using Agile - Managing Unstable Requirements - Requirements Elicitation - Agile Requirements Abstraction Model - Requirements Management in Agile Environment, Agile Requirements Prioritization - Agile Requirements Modeling and Generation - Concurrency in Agile Requirements Generation.		**CO4**
UNIT V	**AGILITY AND QUALITY ASSURANCE**	**9**
Agile Product Development - Agile Metrics - Feature Driven Development (FDD) - Financial and Production Metrics in FDD - Agile Approach to Quality Assurance - Test Driven Development - Agile Approach in Global Software Development.		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.
2. Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.
3. Craig Larman, "Agile and Iterative Development: A Managers Guide", Addison-Wesley, 2004.
4. Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", ButterworthHeinemann, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Realize the importance of interacting with business stakeholders in determining the requirements for a software system
CO2	Perform iterative software development processes: how to plan them, how to execute them.
CO3	Develop techniques and tools for improving team collaboration and software quality.
CO4	Perform Software process improvement as an ongoing task for development teams.
CO5	Show how agile approaches can be scaled up to the enterprise level.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

ML1824	BRAIN COMPUTER INTERFACE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the basic concepts of brain computer interface
- Study the various signal acquisition methods
- Learn about the signal processing methods used in BCI
- Understand the various machine learning methods of BCI.
- Learn the various applications of BCI

UNIT I	INTRODUCTION TO BCI	9
Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.		CO1
UNIT II	**BRAIN ACTIVATION**	**9**
Brain activation patterns – Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials – Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.		CO2
UNIT III	**FEATURE EXTRACTION METHODS**	**9**
Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction – Phase synchronization and coherence		CO3
UNIT IV	**MACHINE LEARNING METHODS FOR BCI**	**9**
Classification techniques -Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's, Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis.		CO4
UNIT V	**APPLICATIONS OF BCI**	**9**
Case Studies – Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rajesh.P.N.Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practice, Oxford University Press, USA, Edition 1, January 2012.

REFERENCE BOOKS

1. Ella Hassianien, A & Azar.A.T (Editors), Brain-Computer Interfaces Current Trends and Applications, Springer, 2015.
2. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch, A survey of signal Processing algorithms in brain-computer interfaces based on electrical brain signals Journal of Neural Engineering, Vol.4, 2007, PP.32-57
4. Arnon Kohen, Biomedical Signal Processing, Vol I and II, CRC Press Inc, Boca Rato, Florida.
5. Bishop C.M., Neural networks for Pattern Recognition, Oxford, Clarendon Press, 1995.
6. Andrew Webb, Statistical Pattern Recognition, Wiley International, Second Edition, 2002.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Comprehend and appreciate the significance and role of this course in the present contemporary world.
CO2	Evaluate concept of BCI.
CO3	Assign functions appropriately to the human and to the machine.
CO4	Select appropriate feature extraction methods
CO5	Use machine learning algorithms for translation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

DS1821	COGNITIVE SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an understanding of the central challenges in realizing aspects of human cognition.
- To provide a basic exposition to the goals and methods of human cognition.
- To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
- To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

UNIT I	**INTRODUCTION TO COGNITIVE SCIENCE**	**9**
Understanding Cognition, IBM's Watson, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical system approach to cognition.		**CO1**
UNIT II	**MODELS**	**9**
Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics.		**CO2**
UNIT III	**COGNITIVE MODELING**	**9**
modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.		**CO3**
UNIT IV	**INDUCTIVE GENERALIZATION**	**9**
Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks.		**CO4**
UNIT V	**APPLICATION**	**9**
DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Formal Approaches in Categorization by Emmanuel M. Pothos, Andy J. Wills, Cambridge University Press,2012.
2. Cognition, Brain and Consciousness: Introduction to Cognitive Neuroscience by Bernard J. Bears, Nicole M. Gage, Academic Press,2013.
3. Cognitive Computing and Big Data Analytics by Hurwitz, Kaufman, and Bowles, Wiley,2012.
4. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press,2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand what cognitive computing and it's models
CO2	Understand how it differs from traditional approaches.
CO3	Plan and use the primary tools associated with cognitive computing.
CO4	Plan and execute a project that leverages cognitive computing.
CO5	Understand and develop the business implications of cognitive computing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2

OPEN ELECTIVES – I& II

OBT101	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

UNIT I	OVERVIEW OF THE CELL	9
Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.		CO1
UNIT II	MICROBIAL GROWTH: PURE CULTURE TECHNIQUES	9
Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures. Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.		CO2
UNIT III	MANAGEMENT OF WASTE	9
Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting		CO3
UNIT IV	BIOREMEDIATION	9
Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex- situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.		CO4
UNIT V	BIOENERGY AND BIOMINING	9
Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,

REFERENCE BOOKS
1. Environmental Biotechnology - Allan Stagg.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	2	2	4	2	1	1	1	2	1	1
CO2	2	1	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	3	3	2	1	1	2	4	3	1	2	4	5	1	2	2
CO4	3	3	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	4	5	2	4	3	2	1	2	3	1	1	2	2

OBT104	BIOSENSORS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	PROTEIN BASED BIOSENSORS	9
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		CO1
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		CO2
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**
Detection in biosensors - Fluorescence - Absorption - Electrochemical. Integration of various techniques - Fiber optic biosensors		CO3
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		CO4
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bio nanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004

REFERENCE BOOKS

1. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
2. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT I	BASICS OF NANOTECHNOLOGY	9
Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.		CO1
UNIT II	**DIFFERENT CLASSES OF NANOMATERIALS**	**9**
Classification based on dimensionality-Quantum Dots, Wells and Wires- Carbon based nano materials (buckyballs, nanotubes, grapheme)- Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		CO2
UNIT III	**SYNTHESIS OF NANOMATERIALS**	**9**
Chemical Methods: Metal Nanocrystals by Reduction -Sol - gel processing -Solvothermal Synthesis-Photochemical Synthesis - Chemical Vapor Deposition (CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		CO3
UNIT IV	**CHARACTERIZATION OF NANOSTRUCTURES**	**9**
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)- Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)- Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		CO4
UNIT V	**APPLICATIONS**	**9**
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices -Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, KamaliKannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt.Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	Develop an ability to critically evaluate the promise of a nanotechnology device.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	1

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
	(COMMON TO AIDS, AIML, CSE, ECE, IT)	3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data models.
- To know the details of data input and topology
- To know the knowledge on data management and output processes
- To know the data quality and standards

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems - Definitions - History of GIS - Components of a GIS - Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		CO1
UNIT II	SPATIAL DATAMODELS	9
Database Structures - Relational, Object Oriented - ER diagram - spatial data models - Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.		CO2
UNIT III	DATA INPUT AND TOPOLOGY	9
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping		CO3
UNIT IV	DATA ANALYSIS	9
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models -3D data collection and utilization		CO4
UNIT V	APPLICATIONS	9
GIS Applicant – Natural Resource Management – Engineering – Navigation – Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - TsungChang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition,2011.
2. Ian Heywood, Sarah Cornelius, SteveCarver,Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2ndEdition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers,2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Have basic idea about the fundamentals of GIS
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO2	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2
CO3	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO4	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO5	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration and management.
- To know the market related research process and its HRM
- To understand the recruitment and training processes in hospitals
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I	OVERVIEW OF HOSPITAL ADMINISTRATION	9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		CO1
UNIT II	**HUMAN RESOURCE MANAGEMENT IN HOSPITAL**	**9**
Principles of HRM – Functions of HRM – Profile of HRD Manager -Human Resource Inventory – Manpower Planning.		CO2
UNIT III	**RECRUITMENT AND TRAINING**	**9**
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		CO3
UNIT IV	**SUPPORTIVE SERVICES**	**9**
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		CO4
UNIT V	**COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL**	**9**
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and issues in supporting departments of hospitals
CO5	Understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1

OEC103	BASICS OF EMBEDDED SYSTEMS AND IOT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IOT

UNIT I	**INTRODUCTION TO EMBEDDED SYSTEM**	**9**
Complex systems and microprocessors- Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques-Design example: Model train controller.		**CO1**
UNIT II	**BASICS OF ARM ARCHITECTURE AND PERIPHERAL INTERFACING**	**9**
ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU		**CO2**
UNIT III	**EMBEDDED PROGRAMMING CONCEPTS**	**9**
Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing		**CO3**
UNIT IV	**INTRODUCTION TO IOT**	**9**
Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT - Passive and active sensors - Different applications of sensors - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.		**CO4**
UNIT V	**COMMUNICATION PROTOCOLS FOR EMBEDDED AND IOT**	**9**
Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - Wi-Fi, Bluetooth, ZigBee.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. ArshdeepBahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons", Inc, USA, 2013

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons Ltd, UK, 2014
2. Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd, UK, 2015.
3. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi" , 1st Edition, Apress Publishers, USA, 2013.
4. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017

COURSE OUTCOMES:
By the end of this course, the student should be able to:

CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	-	2	1	2	-	1	2	2	3	3	2
CO2	3	3	2	3	-	3	1	2	-	1	2	2	3	3	2
CO3	3	3	2	3	3	3	1	2	1	1	2	2	3	3	2
CO4	3	3	3	3	-	2	1	2	-	1	2	2	3	3	2
CO5	3	3	3	3	2	3	1	2	1	1	2	2	3	3	2

OEE101	BASIC CIRCUIT THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I	**BASIC CIRCUITS ANALYSIS**	**9**
Resistive elements - Resistors in series and parallel circuits; Ohm's Law; Kirchoffs laws – methods of analysis-Mesh current and node voltage.		**CO1**
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS**	**9**
Network reduction- voltage and current division, source transformation, star delta conversion; Network theorems- Thevenins and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO2**
UNIT III	**ANALYSIS OF AC CIRCUITS**	**9**
Introduction to AC circuits- Inductive reactance, Capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor; RL, RC , RLC networks; Network reductions- voltage and current division, source transformation; Mesh and node analysis; Network theorems- Thevenins and Norton Theorems, Superposition Theorem , Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO3**
UNIT IV	**THREE PHASE CIRCUITS**	**9**
A.C. circuits – Average and RMS value, Phasor Diagram, Power, Power Factor and Energy; Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced; phasor diagram of voltages and currents; power measurement in three phase circuits.		**CO4**
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance – frequency response, Quality factor and Bandwidth; Self and mutual inductance; Coefficient of coupling; Tuned circuits – Single tuned circuits.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd.,New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",McGraw Hill, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to introduce electric circuits and its analysis
CO2	Ability to impart knowledge on solving circuit equations using network theorems
CO3	Ability to introduce the phenomenon of resonance in coupled circuits.
CO4	Ability to introduce Phasor diagrams and analysis of three phase circuits
CO5	Ability to impart knowledge on resonance and coupled circuits

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEE103	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

UNIT I	INTRODUCTION	9
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.		CO1
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Reference theory fundamentals-principle of operation and analysis: IG and PMSG		CO2
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers		CO3
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Standalone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system		CO4
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan, “Non-conventional Energy Sources”, Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCE BOOKS

1. Muhammad H. Rashid, "Power Electronics Hand Book", Third Edition, Butterworth-Heinemann, 2015.
2. Ion Boldea, "Variability Speed Generators", Second Edition, CRC Press, 2015.
3. Rai. G.D, "Non- conventional Energy Sources", Khanna Publishers, 2004.
4. Gray, L. Johnson, "Wind Energy Systems", Prentice Hall, 2006.
5. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", Third Edition, WileyIndia Pvt. Ltd, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to understand and analyze power system operation, stability, control and protection.
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization.
CO3	Ability to understand the stand alone and grid connected renewable energy systems.
CO4	Ability to design of power converters for renewable energy applications.
CO5	Ability to acquire knowledge on wind electrical generators and solar energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	FUNDAMENTALSOF ROBOT	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.		CO1
UNIT II	**ROBOT DRIVE SYSTEMS ANDEND EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers,Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		CO2
UNIT III	**SENSORS AND MACHINEVISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, ImageProcessing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		CO3
UNIT IV	**ROBOT KINEMATICS AND ROBOTPROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		CO4
UNIT V	**IMPLEMENTATION ANDROBOTECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill,2001.

REFERENCE BOOKS

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education,2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co.,1994.
3. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co.,1992.
4. Fu.K.S., Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill,1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company,2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd.,1991.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functions of the basic components of a Robot.
CO2	Study the use of various types of End of Effectors and Sensors
CO3	Understand Sensors and Machine Vision of Robot
CO4	Understand Robot Kinematics and Robot Programming
CO5	Understand the Implementation of Robots in Industries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	2	3	2	1	2
CO2	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO3	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO4	3	2	1	2	2	-	-	-	-	2	2	3	3	2	2
CO5	2	2	1	2	2	-	-	-	-	2	2	3	2	2	2

OMB101	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the quality philosophies and tools in the managerial perspective.

UNIT I	INTRODUCTION	9
Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		CO1
UNIT II	**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**	**9**
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology		CO2
UNIT III	**STATISTICAL PROCESS CONTROL**	**9**
Meaning and significance of statistical process control (SPC) - construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts - definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) - principles, applications, reengineering process, benefits and limitations.		CO3
UNIT IV	**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**	**9**
Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) - requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.		CO4
UNIT V	**QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**	**9**
Introduction to IS/ISO 9004:2000 - quality management systems - guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – SacreHermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.

REFERENCE BOOKS

1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.
2. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005.
3. PoornimaM.Charantimath, Total Quality Management, Pearson Education, First Indian Reprint 2003.
4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able:

CO1	To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.
CO2	To understand the principles of business process improvement
CO3	To understand and apply the concepts of statistical process control
CO4	To apply the tools and techniques used for quality management
CO5	To understand the methods in organizing and implementation of quality systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948
- To familiarize students with powers of inspectorate of factories
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.
- To prepare onsite and offsite emergency plan.

UNIT I	FACTORIES ACT – 1948	9
Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948		CO1
UNIT II	**ENVIRONMENT ACT – 1986**	**9**
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001-No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution - fund - accounts and audit, penalties and procedures.		CO2
UNIT III	**MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**	**9**
Definitions - duties of authorities - responsibilities of occupier - notification of major accidents - information to be furnished - preparation of offsite and onsite plans - list of hazardous and toxic chemicals – safety reports – safety data sheets.		CO3
UNIT IV	**OTHER ACTS AND RULES**	**9**
Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983-Pesticides Act		CO4
UNIT V	**INTERNATIONAL ACTS AND STANDARDS**	**9**
Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) - Health and safety work act (HASAWA 1974, UK) - OSHAS 18000 - ISO 14000 - American National Standards Institute (ANSI).		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO2	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO3	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO4	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO5	2	2	-	-	1	2	2	2	2	2	2	2	1	1	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	2

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	**INTRODUCTION**	6
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		CO1
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	6
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		CO2
UNIT III	**ORGANS OF GOVERNANCE**	6
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		CO3
UNIT IV	**EMERGENCY PROVISIONS**	6
Emergency Provisions - National Emergency, President Rule, Financial Emergency		CO4
UNIT V	**LOCAL ADMINISTRATION**	6
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Panchayati raj- Introduction- PRI-Zila Panchayat-Elected officials and their roles- CEO ZilaPanchayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		CO5
		TOTAL : 30 PERIODS

TEXT BOOKS
1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015. 2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015. 3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014. 4. The Constitution of India (Bare Act), Government Publication,1950

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	2

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**6**
Values and self-development -Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		**CO1**
UNIT II	**IMPORTANCE OF VALUES**	**6**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		**CO2**
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**6**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence -Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		**CO4**
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**6**
Equality, Non-violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		**CO5**
		TOTAL : 30 PERIODS

REFERENCES

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self-destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	**INTRODUCTION AND METHODOLOGY**	**6**
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.		**CO1**
UNIT II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		**CO2**
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes		**CO4**
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		**CO5**
		TOTAL : 30 PERIODS

REFERENCES

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	2

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I	**INTRODUCTION TO YOGA**	**6**
Definitions of Eight parts of yog.(Ashtanga)		**CO1**
UNIT II	**YAM**	**6**
Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		**CO2**
UNIT III	**NIYAM**	**6**
Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		**CO3**
UNIT IV	**ASAN**	**6**
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes		**CO4**
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		**CO5**
		TOTAL : 30 PERIODS

REFERENCES

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (PublicationDepartment), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do's and Don't's in life through Yam
CO3	Learn Do's and Don't's in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	2

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**6**
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**6**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**6**
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 - Verses 37,38,63		**CO5**

TOTAL : 30 PERIODS

REFERENCE:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	2

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	6
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.		CO1
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	**6**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		CO2
UNIT III	**RURAL INSTITUTIONS**	**6**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		CO3

UNIT IV	RURAL DEVELOPMENT PROGRAMMES	6
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		CO4
UNIT V	**FIELD WORK**	**6**
Each student selects one programme for field visit Field based practical activities: • Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities • Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site • Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures • Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) • Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization • Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps • Participate in Gram Sabha meetings, and study community participation • Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries • Attend Parent Teacher Association meetings, and interview school drop outs • Visit local Anganwadi Centre and observe the services being provided • Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. • Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys • Raise understanding of people's impacts of climate change, building up community's disaster preparedness • Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants • Formation of committees for common property resource management, village pond maintenance and fishing.		CO5
		TOTAL : 30 PERIODS

TEXT BOOKS:
1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015 2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002 3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs
REFERENCE BOOKS:
1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers 2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	2

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	**INTRODUCTION TO CULTURE**	**6**
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		CO1
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**6**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2
UNIT III	**RELIGION AND PHILOSOPHY**	**6**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**6**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		CO4
UNIT V	**EDUCATION SYSTEM IN INDIA**	**6**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5
		TOTAL : 30 PERIODS

REFERENCE:
1. . Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005 2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007 3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200 4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993 5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989 6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Know the contribution of scientists of different eras.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	2

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

- 1. Introduction to Sanga Tamil Literature.
- 2.‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
- 3.‘Attruppadai’ in SangaTamil Literature.
- 4.‘Puranaanuru’ in SangaTamil Literature.
- 5.‘Pathitrupathuthu’ in SangaTamil Literature.

UNIT I	SANGA TAMIL LITERATURE – AN INTRODUCTION	6
Introduction to Tamil Sangam-History of Tamil Three Sangams-Introduction to Tamil Sangam Literature-Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s Grammar Tamil Sangam Literature’s parables.		CO1
UNIT II	**‘AGATHINAI’AND‘PURATHINAI’**	**6**
Tholkappiyar’s Meaningful Verses-Three literature materials-Agathinai’s message- History of Culture from Agathinai- Purathinai-Classification-Mesaage to Society from Purathinai.		CO2
UNIT III	**‘ATTRUPPADAI’.**	**6**
AttruppadaiLiterature-Attruppadaiin‘Puranaanuru’-Attruppadaiin‘Pathitrupaththu’-Attruppadaiin ‘Paththupaattu’.		CO3
UNIT IV	**‘PURANAANURU’**	**6**
Puranaanuru on Good Administration, Ruler and Subjects-Emotion & its Effect in Puranaanuru.		CO4
UNIT V	**‘PATHITRUPATHTHU’**	**6**
Pathitrupaththuin‘Ettuthogai’-Pathitrupaththu’sParables-Tamildynasty:Valor, Administration,Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu		CO5
		TOTAL : 30 PERIODS

REFERENCE:
1. . Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press,2018. 2. HankHeifetz and GeorgeL. Hart, The Purananuru, Penguin Books,2002. 3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997. 4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015. 5. XavierS.Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub.House, 1967.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’ in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

CT1701	ADVANCED DATA MANAGEMENT AND MACHINE INTELLIGENCE	L	T	P	C
		0	0	2	1

OBJECTIVES

- To recall data warehousing and business intelligence fundamentals with examples. State Data Lakehouse and its importance. Compare Data Lakehouse to the traditional SQL data warehouse.
- To write SQL queries to perform complex operations. Learn advanced SQL concept with examples and differentiate NO SQL with RDBMS (which uses SQL) by their advantages and disadvantages.
- To get clear understanding of AWS, Azure, GCP fundamentals. Cloud Computing- Benefits of it. Basic knowledge on few products and services provided by AWS, Azure, GCP.
- Be aware of advanced Python concepts programming with real-life examples.
- To gain insights of fundamental concepts of Artificial Intelligence (AI), Basics of Machine Learning and how to use concepts, Prompt Engineering.

UNIT I	MODERN DATA INTEGRATION	6
	Data Warehouse concepts: Need for BI, Data Warehouse, Key terminologies related to DWH Architecture -OLTP vs OLAP, ETL, Data Mart, Metadata, DWH Architecture. Data Lakehouse: Data Lake to Data Swamp, SQL Relational Databases, Transaction Processing, Relational Database Workload Types, Architectural Challenges, Databricks Evolution. ETL: Extract Data Dump from source, Data format consistency, Data Quality rules, Truncate & Load, Load strategies, Load Approach, Transform, Mapping, Enriching, Joins, filter, Remove Duplicates, Aggregation, Load, Dimension, Facts, EDW Tables, Data Marts. Variety of ETL Tools:Apache Airflow, Datastage,Oracle Data Integrator, SSIS, Talend, Hadoop, AWS Glue, Azure Data Factory, Google Cloud Dataflow, Stitch, SAP, Hevo, Qlik, Airbyte	CO1
UNIT II	**FOUNDATIONS OF DATA MANAGEMENT AND ANALYSIS**	**6**
	Informatica: Informatica Architecture, Informatica PowerCenter & Repository, Informatica PowerCenter Designer, Informatica Power Center workflow manager, Informatica PowerCenter workflow monitor, Run Mappings, Workflow creation & Deletion. SQL: DQL, DDL, DML, Filtering and sorting Data, Grouping and Aggregating Data, Joins and Subqueries, Window Functions, Optimizing SQL queries, Automation,Store Procedure, Trigger, Views, Functions. NoSQL: Fundamentals and Comparison with SQL,Connecting Data Sources and DataBases, Data Modeling, Creating Calculated Fields in Power BI.	CO2
UNIT III	**CLOUD COMPUTING PLATFORMS DEMYSTIFIED**	**6**
	Python: Variables, Operators, functions, Libraries, Methods, Refactoring, Enum, Tuples, Dictionaries, sets, Map, filter, reduce, Class & objects, Exceptions, Overloading ,Iterators, Modules, Packages, Generators, List, Comprehensions, Regular expressions, Serialization, Partial functions, closures, Decorators. AWS: Benefits of AWS, AWS Services - Computer, Storage, Database Service, NetworkingService, Security Service, Management tool Service, Developer tool Service. Azure: Cloud Computing, Services in Azure - Compute, Containers, Databases, Identity, Security, Networking, Storage. GCP: Cloud Computing, Benefits of GCP, GCP services, AWS vs Azure vs GCP	CO3

UNIT IV	PYTHON FOR DATA SCIENCE AND AI	6
	Python with Deep Learning: Python Data Science Libraries,Numpy, Scipy, Pandas, Matplotlib, Scikit-Learn, Statsmodels, Pandas, Sorting, Concatenate, Preprocessing - Time Series Data, Visualization Python with AI: Introduction, Demand of AI, What is AI, Types of AI, Why python for AI, Python Packages for AI Artificial Intelligence: Artificial intelligence and its types, AI Roadmap, Machine learning and its types, Linear regression Analysis, Classifications in Machine Learning.AI vs ML, Classification vs regression, Supervised learning, Unsupervised learning, Training Model, Preparing Data, K-Nearest Neighbors, Naive Bayes, Logistic Regression, Support Vector Machine, Neural Networks, Tensorflow, K-Means Clustering, Principal Component Analysis, KMeans and PCA Implementations .	CO4

UNIT V	EXPLORING AI FOUNDATIONS	6
	Prompt Engineering: Introduction to AI, Linguistics, Language Models, Prompt Engineering Mindset, Zero shot and few shot prompts, AI hallucinations, Vectors/text embeddings.Generative AI Fundamentals:Generative AI and its use cases, How do LLMS (Large Language Models) work, LLMs generates output for NLP task, LLM model decision criteria, Proprietary models, Fine tuned models, Mixing LLM flavors in workflow, Data privacy, Data security.	CO5

TOTAL: 30 PERIODS

REFERENCE BOOKS

1. Wes McKinney - "Python for Data Analysis" - O'Reilly Media; 2nd edition (October 20, 2017).
2. Foster Provost and Tom Fawcett - "Data Science for Business: What You Need to Know about DataMining and Data-Analytic Thinking" - O'Reilly Media; 1st edition (July 27, 2013).
3. Philip C. Jackson - "Introduction to Artificial Intelligence" - Pearson; 1st edition (January 14, 1998).
4. Paulraj Ponniah - "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" -Wiley; 2nd edition (August 3, 2010).
5. Anthony Molinaro - "SQL Cookbook" - O'Reilly Media; 2nd edition (June 18, 2009).
6. Thomas Erl et al. - "Cloud Computing: Concepts, Technology & Architecture" - Prentice Hall; 1st edition (June 25, 2013).
7. Stuart Russell and Peter Norvig - "Artificial Intelligence: A Modern Approach" - Pearson; 3rd edition (December 11, 2009).

REFERENCES

https://www.youtube.com/watch?v=J326LIUrZM8 https://www.youtube.com/watch?v=Muyq3qtHzzo
https://www.youtube.com/watch?v=Tw44ml26Mos
https://www.datacamp.com/blog/a-list-of-the-16-best-etl-tools-and-why-to-choose-them
https://www.youtube.com/watch?v=Q2tX2v7KXhk
https://www.youtube.com/watch?v=oreAsJTNcsA https://www.youtube.com/watch?v=M-55BmjOuXY https://www.youtube.com/watch?v=xQnIN9bW0og
https://www.youtube.com/watch?v=ootqUuVk_js
https://www.youtube.com/watch?v=eWRfhZUzrAc
https://www.youtube.com/watch?v=Yrtm7d3TJbs
https://www.youtube.com/watch?v=qu9rTSI_ZUU
https://www.youtube.com/watch?v=3h0ZXIZvra0
https://www.youtube.com/watch?v=vACTtmLWiQY
https://www.youtube.com/watch?v=Rgz9SRg3DGw
https://www.youtube.com/watch?v=RpuObKwE43k
https://www.youtube.com/watch?v=faBRsREN1Dg
https://www.youtube.com/watch?v=i_LwzRVP7bg
https://www.youtube.com/watch?v=_ZvnD73m40o
https://www.youtube.com/watch?v=1fQ1DDMmiqo

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Gain a solid understanding of AI fundamentals, including machine learning algorithms, natural language processing techniques, and data science libraries, enabling you to work on AI projects effectively.
CO2	Acquire skills in data warehousing, SQL and NoSQL databases, data modeling, and data integration, allowing you to efficiently manage and analyze large datasets.
CO3	Develop expertise in utilizing cloud computing platforms like AWS, Azure, and GCP, enabling you to deploy, scale, and manage applications and services in the cloud.
CO4	Learn advanced data analysis techniques, including sorting, preprocessing, visualization, and statistical modeling, empowering you to derive meaningful insights from complex datasets.
CO5	Understand the ethical implications of AI technologies, including data privacy, security, and bias mitigation, and learn how to implement responsible AI solutions in compliance with ethical standards and regulations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO2	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO3	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO4	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO5	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3

VAC001	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		1	0	2	2

OBJECTIVES

1.The main learning objective of this course is to make the students an appreciation for:

2. To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.

3. Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students

UNIT I	**INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS**	**9**
The Various Industrial Revolutions – Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry – Industry 4.0 revolutions – Support System for Industry 4.0 – Smart Factories.		**CO1**
UNIT II	**IMPLEMENTATION SYSTEMS FOR IIOT**	**9**
Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.		**CO2**
UNIT III	**IIOT DATA MONITORING & CONTROL**	**9**
IoT Gate way – IoT Edge Systems and It's Programming – Cloud computing – Real Time Dashboard for Data Monitoring – Data Analytics and Predictive Maintenance with IIoT technology		**CO3**
UNIT IV	**IIOT SENSORS & NETWORKS**	**9**
Next Generation Sensors – Collaborative Platform and Product Lifecycle Management – Industrial IoT- Layers – Software Defined Networks: IIoT Analytics – Security and Fog Computing – Fog Computing in IIoT – Emerging descriptive data standards for IIoT – Cloud data base.		**CO4**
UNIT V	**INDUSTRIAL IOT- APPLICATIONS**	**9**
Healthcare Power Plants – Inventory Management & Quality Control – Plant Safety and Security Oil – Chemical and Pharmaceutical industry – Applications of UAVs in Industries.		**CO5**

TOTAL : 45 PERIODS

REFERENCE:

1. Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Students can develop a comprehensive understanding of Internet of Things (IoT) technologies, including sensors, communication protocols, cloud computing, and data analytics.
CO2	The program can provide students with hands-on experience in designing, implementing, and managing IoT-based solutions for industrial applications.
CO3	The program can provide students with an understanding of IoT security and privacy issues, including data encryption, access control, and device authentication.
CO4	The program can help students develop effective communication and teamwork skills through group projects and case studies, which are essential for working in cross-functional teams in industrial IoT settings.
CO5	Graduates of the program can be better equipped to take on roles in IoT-based industrial applications and other areas of technology, due to their in-depth knowledge of IoT technologies and their practical experience in designing and implementing industrial IoT solutions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	-	-	-	2	2	2	2	2	3
CO2	1	1	1	1	2	2	-	-	1	2	2	2	1	2	2
CO3	3	2	2	2	2	2	-	-	1	1	1	1	2	2	2
CO4	1	1	2	1	2	2	-	-	3	2	2	1	1	2	2
CO5	1	1	1	2	1	2	1	1	2	2	2	2	2	2	2

VAC002	AUGMENTED REALITY & VIRTUAL REALITY	L	T	P	C
		1	0	2	2

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

1. To provide students with good depth of knowledge of Augmented Reality and Virtual Reality
2. Knowledge on Tools and Applications of Augmented Reality and Virtual Reality

UNIT I	INTRODUCTION TO AUGMENTED REALITY AND VIRTUAL REALITY (VR)	9
History of AR - Augmented reality characteristics- Difference between Augmented Reality and Virtual Reality- AR technological components- Technologies used in AR- Feature Extraction - Hardware components - AR devices - Importance of AR - Real world uses of AR - AR types - Software tools available for AR.		CO1
UNIT II	COMPUTER GRAPHICS AND GEOMETRIC MODELING	9
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference.		CO2
UNIT III	NEED OF TECHNOLOGIES FOR AUGMENTED REALITY & VIRTUAL REALITY	9
Hardware technology- virtual scenes - 3D objects- AR & VR components Display - HMD - Eyeglasses- Contact Lenses - significance of AR - AR powered devices - Motion tracking -Virtual environment - VR technology, AR & VR application development drawbacks - Compatibility Performance.		CO3
UNIT IV	TOOLS AND APPLICATIONS OF AUGMENTED REALITY & VIRTUAL REALITY	9
Tools available for Augmented Reality and Recognition - Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems - Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.		CO4
UNIT V	AUGMENTED REALITIES AND VIRTUAL REALITY FOR MICRO LEARNING	9
Micro learning techniques - Utilizing VR for learning - VR for Practical online assessment - VR info graphics - Virtual case considerations - Utilizing AR for learning - Accessible learning - sensible data - elevated learner engagement - Engineering, Entertainment, Science, Training, Game Development		CO5

TOTAL : 45 PERIODS

REFERENCE:

Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand the importance of augmented reality in Industry 4.0 with real-time examples
CO2	To describe the history and recent developments of AR
CO3	To provide the need on emerging technologies AR and VR
CO4	To discuss the revolution and impact of AR
CO5	To understand the applications of AR and VR

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC003	ETHICAL HACKING - CYBER SECURITY	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To learn the fundamentals of Cyber Security and Ethical Hacking
- To learn the Foot printing & Reconnaissance and Scanning Networks
- To understand Enumeration and Vulnerability Analysis
- To understand Exploitation on Network
- To learn the Web Attacks and Report Writing

UNIT I	FUNDAMENTALS OF CYBER SECURITY AND ETHICAL HACKING	9
Introduction to Cyber Security - Cyber Security & Ethical Hacking - Domains of Cyber Security - Principles of Cybersecurity (CIA Triad, Security Models, Principles of Privileges) - Offensive & Defensive Security - Cyber Kill Chain - Types of Security Teams (Red Team, Blue Team, Purple Team) - Cyber Security Frameworks (NIST, MITRE, ISO/IEC) Phases & Methodologies in Ethical Hacking - Introduction to Malware - Types of Malware		CO1

UNIT II	FOOTPRINTING RECONNAISSANCE AND SCANNING NETWORKS	9
Introduction to Foot printing Reconnaissance - Types of Reconnaissance (Passive & Active) - Active Reconnaissance (Ping, Traceroute, Telnet, Whatweb, Wappalyzer, Netcraft) - Passive Reconnaissance (nslookup, whois, dig, DNSDumpster, Shodan) - Introduction to OSINT (OSINT Framework, OSRFRAMEWORK, Social Searcher,) - Introduction to Scanning Networks - Types of Network Scanning (Port Scan, Service Scan, Vulnerability Scan) - Scanning Techniques - Port Scanning (TCP, UDP) - Host Discovery (ICMP, ARP) - Introduction to Wireshark - Capturing Data Packets - Packet Analysis.		CO2

UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.		CO3

UNIT IV	EXPLOITATION ON NETWORK	9
Introduction to Exploitation - What is Shell - Types of Linux Shells (Bash, Csh/Tcsh, Ksh, Zsh, Fish) - What is Gaining Access & Maintaining Access - Reverse Shell & Bind Shell - Introduction to Metasploit Framework - Metasploit Modules - Staged Payload & Non-Staged Payload - Using Metasploit Framework Gaining the User Shell Acess - Gaining Root Shell Acess in Metasploit Framework - Introduction to Manual Exploitation - Gaining User Shell in Manual Exploitation - What is Privilege Escalation - Linux & Windows Privilege Escalation - Using Linpeass Script Finding Non-Privilege Path on Linux System - Using Winpeass Script Finding Non-Privilege Path on Windows System - Hands-on Windows & Linux Privilege Escalation - Introduction to Post Exploitation.		CO4

UNIT V	WEB ATTACKS AND REPORT DOCUMENTATION	9
Introduction to OWAP TOP 10 and SANS TOP 25 - Web Server & Web Application Attack Methodology - Indirect Object Reference (IDOR) - SQL Injection - Cross Site Scripting - XML Injection or XML External Internal - Account Hijacking - Sensitive Data Exposure - Server Side Forgery - Race Condition - Generate Proper Vulnerability Assessment Penetration Testing Report Document.		CO5
		TOTAL : 45 PERIODS

REFERENCE:
1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010. 2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013. 3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand the importance of fundamentals of cyber security and ethical hacking
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods.
CO3	To demonstrate the enumeration and vulnerability analysis methods
CO4	To acquire knowledge on the options for network protection.
CO5	To gain knowledge on hacking options available in Web applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC004	BLOCKCHAIN AND CRYPTO CURRENCIES	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To understand Blockchain's fundamental components, and examine decentralization using blockchain.
2. To understand Cryptocurrency and its background concepts.
3. To learn smart contract programing language solidity.
4. To understand public blockchain application development platform and develop distributed applications.
5. To understand enterprise blockchain application development platform and develop distributed enterprise applications

UNIT I	**INTRODUCTION**	9
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash function, consensus, byzantine fault-tolerant, distributed computing, 51% attack, digital cash etc.		CO1
UNIT II	**CRYPTOCURRENCY BASICS**	9
Bitcoin blockchain, Challenges and solutions, Crypto mining, mining types, mining hardware, proof of work, Proof of stake, alternatives to Bitcoin consensus, other crypto currencies like Ethereum, Tether, BNB etc		CO2
UNIT III	**SOLIDITY WALKTHROUGH**	9
Introduction to Ethereum blockchain – Ethereum Virtual Machine – remix IDE - MetaMask wallet – running simple smart contract – voting application – Lottery application – File sharing application		CO3
UNIT IV	**PUBLIC BLOCKCHAIN APPLICATION DEVELOPMENT**	9
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		CO4
UNIT V	**ENTERPRISE BLOCKCHAIN APPLICATION DEVELOPMENT**	9
Introduction to Hyperledger – Hyperledger Fabric architecture- language supports for hyperledger fabric – setting up hyprledger fabric - Building application in hyperledger fabric.		CO5

TOTAL : 45 PERIODS

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. A Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.
4. https://hyperledger-fabric.readthedocs.io/en/latest/tutorials.html

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand Blockchain's fundamental components, and examine decentralization using blockchain.
CO2	Understand Cryptocurrency and its background concepts
CO3	Write smart contract using programing language solidity.
CO4	Develop distributed applications using public blockchain application development platform Ethereum.
CO5	Develop distributed applications using enterprise blockchain application development platform Hyperledger

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	-	2	1	-	-	1	-	-	1	2	2	3
CO2	3	3	2	-	2	2	-	-	1	-	-	1	2	2	3
CO3	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO4	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO5	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3

VAC005	INDUSTRIAL PRACTICES WITH DEVOPS	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To introduce DevOps terminology, definition & concepts
2. To understand the Maven, Profiles and Plugins
3. To understand the concepts of Continuous Integration/ Continuous Testing/ ContinuousDeployment using Jenkins
4. To understand to leverage Cloud-based DevOps tools using Azure DevOps
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

UNIT I	**INTRODUCTION TO DEVOPS**	**9**
Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github		**CO1**
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**9**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artifacts, Dependency management, Installation of Gradle, understand build using Gradle		**CO2**
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	**9**
Install & Configure Jenkins, Jenkins Architecture Overview, creating a Jenkins Job, configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace		**CO3**
UNIT IV	**BUILDING DEVOPS PIPELINES USING AZURE**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		**CO4**
UNIT V	**DEVOPS PRACTICALS**	**9**
Create Maven Build pipeline in Azure - Run regression tests using Maven Build pipeline in Azure - Install Jenkins in Cloud - Create CI pipeline using Jenkins - Create a CD pipeline in Jenkins and deploy in Cloud		**CO5**
		TOTAL : 45PERIODS

REFERENCES:

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Mitesh Soni, Hands-On Azure Devops: CICD Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for .DevOps and Microsoft Azure (English Edition) , 2020
3. Mariot Tsitoara, “ Beginning Git and GitHub: A Comprehensive Guide to Version Control Management, and Teamwork for the New Developer”, Second Edition, 2019.
4. https://www.jenkins.io/user-handbook.pdf
5. https://maven.apache.org/guides/getting-started

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand different actions performed through Version control tools like Git.
CO2	Compile and Build using Maven & Gradle applications
CO3	Ability to Perform Continuous Integration using Jenkins.
CO4	Understand to leverage Cloud-based DevOps tools using Azure DevOps
CO5	Develop various Devops applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

VAC006	APPLIED MACHINE LEARNING WITH PYTHON	L	T	P	C
		1	0	2	2

OBJECTIVES

- To provide a basic understanding of data manipulation.
- To understand scikit learn for model evaluation.
- To provide a comprehensive understanding of neural networks and computer vision.

UNIT I	**DATA MANIPULATION WITH PYTHON LIBRARIES**	9
Overview of Data Manipulation with Python-Introduction to Pandas and NumPy-Data Cleaning and Preprocessing-Handling Missing Data-Data Exploration and Analysis		CO1
UNIT II	**MACHINE LEARNING BASICS WITH SCIKIT-LEARN**	9
Introduction to Machine Learning-Types of Machine Learning Algorithms-Overview of Decision Trees and Random Forests-Hands-on Implementation with Scikit-Learn-Model Evaluation and Validation.		CO2
UNIT III	**LINEAR REGRESSION AND BEYOND**	9
Linear Regression Fundamentals-Implementing Linear Regression from Scratch-Logistic Regression for Classification-Introduction to Support Vector Machines (SVM)-Hands-on Exercises with Scikit-Learn.		CO3
UNIT IV	**ADVANCED MACHINE LEARNING TECHNIQUES**	9
Introduction to Gradient Boosting-Implementation of Gradient Boosting with XGBoost-Neural Networks Basics with PyTorch-Deep Learning Fundamentals-Applications of Neural Networks.		CO4
UNIT V	**COMPUTER VISION AND TRANSFER LEARNING**	9
Image Classification with Convolutional Neural Networks (CNN)-Transfer Learning Concepts and Applications-Hands-on Image Classification with PyTorch-Fine-tuning Pre-trained Models-Building Custom Models for Specific Tasks.		CO5
	TOTAL: 45 PERIODS	

REFERENCES:	
1. “Data Wrangling with Pandas" by Kevin Markham - A practical guide that delves into data cleaning, preprocessing, handling missing data, and exploratory data analysis using Pandas. 2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron - A comprehensive guide that covers a wide range of machine learning topics, including decision trees, random forests, and model evaluation with scikit-learn.	
COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	To understand a predictive model that can classify or regress on data by recursively partitioning.
CO2	To develop a foundational understanding of the underlying algorithms, optimizing model parameters
CO3	To build a robust and high-performance ensemble model for regression or classification tasks.
CO4	To understand the automatic learning of hierarchical representations from data for tasks such as classification, regression, and feature extraction.
CO5	To incorporating transfer learning are to leverage pre-trained models to efficiently learn and classify features in images, facilitating accurate predictions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO2	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO4	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO5	-	-	-	-	1	-	-	-	-	1	-	1	-	1	1

You Choose, We Do It

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(An Autonomous Institution)

St. JOSEPH'S GROUP OF INSTITUTIONS

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B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

Batch-(2021-2025)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates to exploit the knowledge of basic science, mathematics, statistics, and data science to build systems that require management and analysis of large volumes of real time data.

PEO2: To enrich the graduates with technical and professional skills to apply the concept of Artificial Intelligence to develop elegant solutions for the complex problems in various domains.

PEO3: To enable the graduates to think logically, pursue lifelong learning, and pioneering research in the field of Artificial Intelligence and Data Science to create disruptive and sustainable solutions for the real world issues.

PEO4: To inculcate ethical attitude, social responsibilities, and soft skills to work as a team to solve social, business and environmental problems.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Understand, Analyze, evolve and develop AI based efficient domain specific processes for effective decision making in several domains such as business, IT and governance.

PSO2: Able to arrive at actionable foresight, insight, hindsight from data for solving business and engineering problems by applying mathematical, statistical and computational principles

PSO3: Create, select and apply the theoretical knowledge of AI and Data Analytics along with practical industrial tools and techniques to manage and solve societal problems.

MAPPING OF PROGRAM OUTCOMES (POs) WITH PROGRAM EDUCATIONAL OBJECTIVES (PEOs) &PROGRAM SPECIFIC OUTCOMES (PSOs)

PROGRAM OUTCOMES (POs)	PROGRAM EDUCATIONAL OBJECTIVES (PEOs)				PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
PO1: Engineering knowledge	3	3	2	1	3	3	3
PO2: Problem analysis	2	2	2	1	3	3	3
PO3: Design/development of solutions	3	3	2	1	3	3	3
PO4: Conduct investigations of complex problems	3	3	3	1	3	3	3
PO5: Modern tool usage	2	3	2	1	2	3	3
PO6: The engineer and society	2	2	1	2	2	2	3
PO7: Environment and sustainability	2	2	2	3	2	2	3
PO8: Ethics	2	2	3	1	2	2	3
PO9: Individual and team work	2	3	3	3	2	2	2
PO10: Communication	2	2	3	2	2	2	2
PO11: Project management and finance	2	3	3	1	1	2	3
PO12: Life-long learning	3	3	3	2	2	2	2

MAPPING OF PSOs TO PEOs

PROGRAM SPECIFIC OUTCOMES (PSOs)	PROGRAM EDUCATIONAL OBJECTIVES (PEOs)			
	PEO1	PEO2	PEO3	PEO4
PSO1	2	2	3	2
PSO2	2	3	3	1
PSO3	3	3	3	2

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES (POs)

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Communicative English		✓	✓	✓	✓		✓		✓	✓			✓		✓
	Engineering Mathematics-1	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
	Engineering Physics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Engineering Chemistry	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Problem Solving and Python Programming	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Engineering Graphics	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
	Python Programming Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Physics and Chemistry Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
II	Professional English		✓	✓	✓	✓		✓		✓	✓			✓		✓
	Linear Algebra	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Physics for Information Science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Environmental Science and Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Basic Electrical, Electronics and Measurement Engineering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Programming in C	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Engineering Practice Laboratory	✓	✓	✓			✓						✓	✓	✓	✓
	Programming in C Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	Probability and Statistics	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
	Computer Organization and Architecture	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	Data Structures	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Object Oriented Programming (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Introduction to Artificial Intelligence	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
	Foundations of Data Science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Data Structures Laboratory using Python	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
	Artificial Intelligence Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IV	Discrete Mathematics	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Design and Analysis of Algorithms	✓	✓	✓	✓	✓				✓		✓	✓	✓	✓	✓
	Operating Systems	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Database Design and Management (Lab Integrated)	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Foundations of Machine Learning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Python Programming for Data Science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Data Science Laboratory using Python	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Machine Learning Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Professional Skills Laboratory		✓	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
V	Optimization in Data Analysis	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Advanced Artificial Intelligence	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
	Data Mining	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Exploratory Data Analysis	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Data Preparation and Analysis Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Advanced Artificial Intelligence Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VI	Modern Scripting Languages	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	Computational Linguistics	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓
	Data Visualization	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Data Analytics (Lab Integrated)	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Data Visualization Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Mini Project - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VII	Neuro-Fuzzy Computing	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Text Analytics	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Computer Vision	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
	Big Data Management	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Neuro-Fuzzy Computing Laboratory	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Project Work Phase - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Credit Course on Advanced Data Management and Machine Intelligence by Cognizant**(Common to AI-DS& AI-ML)**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Summer Internship*															
VIII	Project Work Phase - II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MAPPING OF PROFESSIONAL ELECTIVES

SEM	**COURSE TITLE**	**PROGRAM OUTCOMES (POs)**												**PSOs**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
V	XML and Web Services	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	R Programming for Data Science	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
	Prolog Programming for Artificial Intelligence	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	Knowledge Engineering	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Data Science Tools	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
VI	Image and Video Analytics	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Healthcare Analytics	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Cloud Computing for Data Analysis	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
	Computational Thinking	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
	Ethics in Data Science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
VII	Data and Information Security	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Evolutionary Computation	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓
	Pattern Recognition	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Web Analytics	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	Principles of Management	✓	✓	✓								✓		✓	✓	✓
	Stochastic Process	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	Software Testing using Automated Tools	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
	Multivariate Analysis	✓	✓	✓	✓	✓			✓			✓	✓	✓	✓	✓
	Social Network Analytics	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Entrepreneurship				✓		✓	✓	✓		✓	✓	✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
VIII	Data Mining and Information Security	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Speech Processing and Synthesis	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Cyber Security	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Predictive Analytics	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Statistical Computing	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Engineering Economics	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓
	Cognitive Systems	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
	Parallel Computing	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Bio-inspired Optimization Techniques	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓
	Information Storage Management	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	HS1101	Communicative English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	0	0	3
2	MA1102	Engineering Mathematics – I **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	1	0	4
3	PH1103	Engineering Physics **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	0	0	3
4	CY1104	Engineering Chemistry **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	0	0	3
5	GE1105	Problem Solving and Python Programming **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	3	0	0	3
6	GE1106	Engineering Graphics **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	2	0	4	4
PRACTICAL							
7	GE1107	Python Programming Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	0	0	4	2
Total				**17**	**1**	**12**	**24**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	HS1201	Professional English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	0	0	3
2	MA1251	Linear Algebra **(Common to AI-DS & AI-ML)**	BSC	3	1	0	4
3	PH1252	Physics for Information Science **(Common to CSE, IT, AI-DS,CC& AI-ML)**	BSC	3	0	0	3
4	GE1204	Environmental Science and Engineering **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	0	0	3
5	BE1251	Basic Electrical, Electronics and Measurement Engineering **(Common to CSE, IT, AI-DS,CC& AI-ML)**	ESC	3	0	0	3
6	CS1206	Programming **in C** **(Common to CSE, IT, AI-DS,CC& AI-ML)**	PCC	3	0	0	3
PRACTICAL							
7	GE1207	Engineering Practice Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	0	0	4	2
8	CS1208	Programming in C Laboratory **(Common to CSE, IT, AI-DS,CC& AI-ML)**	PCC	0	0	4	2
Total				**18**	**1**	**8**	**23**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MA1351	Probability and Statistics **(Common to CSE, IT,CC& AI-DS)**	BSC	3	1	0	4
2	DS1301	Computer Organization and Architecture	ESC	3	0	0	3
3	CS1302	Data Structures **(Common to CSE, IT,AI-DS, CC, AI-ML & ECE Semester IV)**	PCC	3	0	0	3
4	DS1302	Object Oriented Programming **(Lab Integrated)** **(Common to AI-DS,EEE & EIE)**	PCC	3	0	2	4
5	DS1303	Introduction to Artificial Intelligence	PCC	3	0	0	3
6	DS1304	Foundations of Data Science	PCC	3	0	0	3
PRACTICAL							
7	DS1307	Data Structures Laboratory using Python **(Common to AI-DS & AI-ML)**	PCC	0	0	4	2
8	DS1308	Artificial Intelligence Laboratory	PCC	0	0	4	2
Total				**18**	**1**	**10**	**24**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MA1453	Discrete Mathematics **(Common to CSE, IT & AI-DS)**	BSC	3	1	0	4
2	CS1401	Design and Analysis of Algorithms **(Common to CSE, IT, AI-DS,CC& AI-ML)**	PCC	3	0	0	3
3	CS1402	Operating Systems **(Common to CSE, IT, AI-DS, CC& AI-ML)**	PCC	3	0	0	3
4	CS1403	Database Design and Management (Lab Integrated) **(Common to CSE, IT, AI-DS, CC& AI-ML)**	PCC	3	0	2	4
5	DS1401	Python Programming for Data Science	PCC	3	0	0	3
6	ML1401	Foundations of Machine Learning	ESC	3	0	0	3
PRACTICAL							
7	DS1407	Data Science Laboratory using Python	PCC	0	0	4	2
8	ML1408	Machine Learning Laboratory **(Common to IT, AI-DS& AI-ML)**	PCC	0	0	4	2
9	HS1310	Professional Skills Laboratory **(Common to CSE & AI-DS)**	HSMC	0	0	2	1
Total				**18**	**1**	**12**	**25**

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	DS1501	Optimization in Data Analysis	PCC	4	0	0	4
2	DS1502	Advanced Artificial Intelligence **(Common to AI-DS& AI-ML)**	PCC	3	0	0	3
3	DS1503	Data Mining	PCC	3	0	0	3
4	DS1504	Exploratory Data Analysis	PCC	3	0	0	3
5		Open Elective - I	OEC	3	0	0	3
6		Professional Elective - I	PEC	3	0	0	3
PRACTICAL							
7	DS1507	Data Preparation and Analysis Laboratory	PCC	0	0	4	2
8	DS1508	Advanced Artificial Intelligence Laboratory **(Common to AI-DS& AI-ML)**	PCC	0	0	4	2
Total				**19**	**0**	**8**	**23**

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	DS1601	Modern Scripting Languages	PCC	3	0	0	3
2	DS1602	Computational Linguistics	PCC	3	0	0	3
3	DS1603	Data Visualization	PCC	3	0	0	3
4	DS1604	Data Analytics (Lab Integrated)	PCC	3	0	2	4
5		Open Elective - II	OEC	3	0	0	3
6		Professional Electives - II	PEC	3	0	0	3
PRACTICAL							
7	DS1607	Data Visualization Laboratory	PCC	0	0	4	2
8	DS1608	Mini Project - I	EEC	0	0	4	2
Total				**18**	**0**	**10**	**23**
9		Value Added Course	EEC	**TWO WEEKS**			2
10		Audit Course (Optional)	AC				

For Value Added Course, the grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	DS1701	Neuro - Fuzzy Computing	PCC	3	0	0	3
2	DS1702	Text Analytics	PCC	3	0	0	3
3	DS1703	Computer Vision	PCC	3	0	0	3
4	DS1704	Big Data Management	PCC	3	0	0	3
5		Professional Electives - III	PEC	3	0	0	3
6		Professional Electives - IV	PEC	3	0	0	3
PRACTICAL							
7	DS1707	Neuro - Fuzzy Computing Laboratory	PCC	0	0	4	2
8	DS1708	Project Work Phase - I	EEC	0	0	4	2
9	DS1716	Internship	EEC				1
10	CT1701	Credit Course on Advanced Data Management and Machine Intelligence by Cognizant**(Common to AI-DS& AI-ML)**	EEC	0	0	2	1
Total				**18**	**0**	**8**	**22**

#Two weeks Summer Internship carries one credit and it will be done during VI semester summer vacation and same will be evaluated in VII semester.

***Credit Course-Evaluation is Fully Internal**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1		Professional Elective - V	PEC	3	0	0	3
2		Professional Elective - VI	PEC	3	0	0	3
3	DS1807	Project Work Phase - II	EEC	0	0	20	10
Total				**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 180

HUMANITICS SCIENCE AND MANAGEMENT COURSES (HSMC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	HS1101	Communicative English	3	3	0	0	3
2	HS1201	Professional English	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	3	3	0	0	3
4	HS1310	Professional Skills Laboratory	2	0	0	2	1

BASIC SCIENCE COURSES (BSC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	MA1102	Engineering Mathematics - I	4	3	1	0	4
2	PH1103	Engineering Physics	3	3	0	0	3
3	CY1104	Engineering Chemistry	3	3	0	0	3
4	CY1104	Physics and Chemistry Laboratory	4	0	0	4	2
5	MA1251	Linear Algebra	4	3	1	0	4
6	PH1252	Physics for Information Science	3	3	0	0	3
7	MA1351	Probability and Statistics	4	3	1	0	4
8	MA1453	Discrete Mathematics	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	GE1105	Problem Solving and Python Programming	3	3	0	0	3
2	GE1106	Engineering Graphics	6	2	0	4	4
3	GE1107	Python Programming Laboratory	4	0	0	4	2
4	BE1251	Basic Electrical, Electronics and Measurement Engineering	3	3	0	0	3
5	GE1207	Engineering Practice Laboratory	4	0	0	4	2
6	DS1301	Computer Organization and Architecture	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1206	Programming in C	3	3	0	0	3
2	CS1208	Programming in C Laboratory	4	0	0	4	2
3	CS1302	Data Structures	3	3	0	0	3
4	DS1302	Object Oriented Programming (Lab Integrated)	5	3	0	2	4
5	DS1303	Introduction to Artificial Intelligence	3	3	0	0	3
6	DS1304	Foundations of Data Science	3	3	0	0	3
7	DS1307	Data Structure Laboratory using Python	4	0	0	4	2
8	DS1308	Artificial Intelligence Laboratory	4	0	0	4	2
9	CS1401	Design and Analysis of Algorithms	3	3	0	0	3
10	CS1402	Operating Systems	3	3	0	0	3
11	CS1403	Database Design and Management (Lab Integrated)	5	3	0	2	4
12	ML1401	Foundations of Machine Learning	3	3	0	0	3
13	DS1401	Python Programming for Data Science	3	3	0	0	3
14	DS1407	Data Science Laboratory using Python	4	0	0	4	2
15	ML1408	Machine Learning Laboratory	4	0	0	4	2
16	DS1501	Optimization in Data Analysis	4	4	0	0	4
17	DS1502	Advanced Artificial Intelligence	3	3	0	0	3
18	DS1503	Data Mining	3	3	0	0	3
19	DS1504	Exploratory Data Analysis	3	3	0	0	3
20	DS1507	Data Preparation and Analysis Laboratory	4	0	0	4	2
21	DS1508	Advanced Artificial Intelligence Laboratory	4	0	0	4	2
22	DS1601	Modern Scripting Languages	3	3	0	0	3
23	DS1602	Computational Linguistics	3	3	0	0	3

24	DS1603	Data Visualization	3	3	0	0	3
25	DS1604	Data Analytics	5	3	0	2	4
26	DS1607	Data Visualization Laboratory	4	0	0	4	2
27	DS1701	Neuro-Fuzzy Computing	3	3	0	0	3
28	DS1702	Text Analytics	3	3	0	0	3
29	DS1703	Computer Vision	3	3	0	0	3
30	DS1704	Big Data Management	3	3	0	0	3
31	DS1707	Neuro-Fuzzy Computing Laboratory	4	0	0	4	2
32	CT1701	Credit Course on Advanced Data Management and Machine Intelligence by Cognizant	2	0	0	2	1

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V
PROFESSIONAL ELECTIVE – I

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1511	XML and Web Services	3	3	0	0	3
2	DS1512	R Programming for Data Science	3	3	0	0	3
3	DS1513	Prolog Programming for Artificial Intelligence	3	3	0	0	3
4	DS1514	Data Science Tools	3	3	0	0	3
5	IT1514	Knowledge Engineering	3	3	0	0	3

SEMESTER VI
PROFESSIONAL ELECTIVE – II

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1611	Image and Video Analytics	3	3	0	0	3
2	DS1612	Healthcare Analytics	3	3	0	0	3
3	DS1613	Cloud Computing for Data Analysis	3	3	0	0	3
4	DS1614	Computational Thinking	3	3	0	0	3
5	DS1615	Ethics in Data Science	3	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE – III

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1711	Data and Information Security	3	3	0	0	3
2	DS1712	Evolutionary Computation	3	3	0	0	3
3	DS1713	Pattern Recognition	3	3	0	0	3
4	DS1714	Web Analytics	3	3	0	0	3
5	MG1001	Principles of Management	3	3	0	0	3

SEMESTER VII
PROFESSIONAL ELECTIVE – IV

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1721	Stochastic Process	3	3	0	0	3
2	DS1722	Software Testing using Automated Tools	3	3	0	0	3
3	DS1723	Social Network Analytics	3	3	0	0	3
4	DS1724	Multivariate Analysis	3	3	0	0	3
5	MG1725	Entrepreneurship	3	3	0	0	3

SEMESTER VIII
PROFESSIONAL ELECTIVE – V

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1811	Data Mining and Information Security	3	3	0	0	3
2	DS1812	Speech Processing and Synthesis	3	3	0	0	3
3	DS1813	Cyber Security	3	3	0	0	3
4	DS1814	Predictive Analytics	3	3	0	0	3
5	DS1815	Statistical Computing	3	3	0	0	3
6	DS1816	Data Exploration and Visualization	3	3	0	0	3

SEMESTER VIII
PROFESSIONAL ELECTIVE – VI

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1821	Cognitive Systems	3	3	0	0	3
2	DS1822	Parallel Computing	3	3	0	0	3
3	DS1823	Bio-inspired Optimization Techniques	3	3	0	0	3
4	DS1824	Information Storage Management	3	3	0	0	3
5	MG1825	Engineering Economics	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1608	Mini Project - I	4	0	0	4	2
2	CS1708	Project Work Phase - I	4	0	0	4	2
3	CS1807	Project Work Phase - II	20	0	0	20	10
4		Value Added Course					2
5	DS1716	Internship					1

OPEN ELECTIVE COURSES – I & II

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OBT101	Industrial Biotechnology	3	3	0	0	3
2	OBT104	Bio Sensors	3	3	0	0	3
3	OBT105	Introduction to Nano Science and Nano Technology	3	3	0	0	3
4	OCE102	Introduction to Geographic Information System	3	3	0	0	3
5	OCH101	Hospital Management	3	3	0	0	3
6	OEC103	Basics of Embedded Systems and IoT	3	3	0	0	3
7	OEE101	Basic Circuit Theory	3	3	0	0	3
8	OEE103	Introduction to Renewable Energy Systems	3	3	0	0	3
9	OEI102	Robotics	3	3	0	0	3
10	OMB101	Total Quality Management	3	3	0	0	3
11	OME104	Industrial Safety Engineering	3	3	0	0	3

OPEN ELECTIVE COURSES OFFERED BY CSE, IT, AI-DS & AI-ML

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OCS101	Introduction to C Programming	3	3	0	0	3
2	OCS102	Programming and Data Structures	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	3	3	0	0	3
4	OCS104	Fundamentals of Database Design	3	3	0	0	3
5	OCS105	Data Analytics with R Programming	3	3	0	0	3
6	OCS106	Data Communications and Networking	3	3	0	0	3

AUDIT COURSES (AC)

S. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	2	2	0	0	0
2	AD1002	Value Education	2	2	0	0	0
3	AD1003	Pedagogy Studies	2	2	0	0	0
4	AD1004	Stress Management by Yoga	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	2	2	0	0	0

* Registration for any of these courses is optional to students

CREDIT SUMMARY

S. No.	SUBJECT AREA	I	II	III	IV	V	VI	VII	VIII	TOTAL CREDIT	PERCENTAGE
1	**HSMC**	3	6		1					**10**	**5.56**
2	**BSC**	12	7	4	4					**27**	**15.00**
3	**ESC**	9	5	3	3					**20**	**11.11**
4	**PCC**		5	17	17	17	15	14		**85**	**47.22**
5	**PEC**					3	3	6	6	**18**	**10.00**
6	**OEC**					3	3			**6**	**3.33**
7	**EEC**						2	2	10	**14**	**7.78**
TOTAL CREDIT		**24**	**23**	**24**	**25**	**23**	**23**	**22**	**16**	**180**	**100**

Board Chairman	**Dr. A.Chandrasekar**	
Dean Academics	Dr. G. Sreekumar	
Principal	Dr. Vaddi Seshagiri Rao	

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	Common for all Branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	**SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS**	9
Reading–critical reading–finding key information in a given text – shifting facts from opinions - Writing -autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development–voices-Wh- Questions- asking and answering-yes or no questions–parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		CO1
UNIT II	**GENERAL READING AND FREE WRITING**	9
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening-long texts-TED talks-extensive speech on current affairs and discussions Speaking–describing a simple process–asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context –use of sequence words.		CO2
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	9
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing–types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		CO3
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	9
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking –Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		CO4
UNIT V	**EXTENDED WRITING**	9
Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening - popular speeches and presentations - Speaking- impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English, A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102	ENGINEERING MATHEMATICS–1	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	1	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	**MATRICES**	9+3
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		CO1
UNIT II	**CALCULUS OF ONE VARIABLE**	9+3
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		CO2
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	9+3
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		CO3
UNIT IV	**INTEGRAL CALCULUS**	9+3
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		CO4
UNIT V	**MULTIPLE INTEGRALS**	9+3
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6,

3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., —Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I	PROPERTIESOF MATTER	9
	Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.	CO1
UNIT II	LASER ANDFIBER OPTICS	9
	Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homo junction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system.	CO2
UNIT III	THERMAL PHYSICS	9
	Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.	CO3
UNIT IV	QUANTUMPHYSICS	9
	Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.	CO4
UNIT V	CRYSTAL PHYSICS	9
	Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).	CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press,2019.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers,2017.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India,2019.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley,2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman,2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and itsapplications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibreoptics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heatexchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes,and
CO5	Understand the basics of crystals, their structures and different crystal growthtechniques.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.		CO1
UNIT II	**SURFACE CHEMISTRY AND CATALYSIS**	9
Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.		CO2
UNIT III	**PHASE RULE AND ALLOYS**	9
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		CO3
UNIT IV	**FUELS AND COMBUSTION**	9
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		CO4
UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	9
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand &Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media., New Delhi., (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	**ALGORITHMIC PROBLEM SOLVING**	9
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		CO1
UNIT II	**INTRODUCTION TO PYTHON**	9
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		CO2
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		CO3
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	9
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		CO4
UNIT V	**FILES, MODULES, PACKAGES**	9
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors		CO5

and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.	

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

<table>
<tr><td rowspan="2">GE1106</td><td>ENGINEERING GRAPHICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Common for all branches of B.E. / B. Tech Programmes</td><td>2</td><td>0</td><td>4</td><td>4</td></tr>
</table>

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		1
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	7+12
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		CO1
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	6+12
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		CO2
UNIT III	**PROJECTION OF SOLIDS**	5+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		CO3
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	6+12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		CO4
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	6+12
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		CO5
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd

Edition, 2019.

2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	**0**	**0**	**4**	**2**

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.	CO1
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	CO2
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	CO3
11. Demonstrate Exceptions in Python.	
12. Applications: Implementing GUI using turtle, pygame.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.

4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. **http://www.edx.org**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	CO1
2. Determination of Young's modulus of the material of the given beam by uniform bending method.	
3. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	
4. Determination of wavelength of mercury spectra using Spectrometer and grating.	CO2
5. Determination of dispersive power of prism using Spectrometer.	
6. (a) Determination of wavelength and particle size using a laser. 7. (b) Determination of Numerical and acceptance angle of an optical fibre.	
8. Determination of energy band gap of the semiconductor.	
9. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method	CO1

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Determination of chloride content of water sample by argentometric method.	CO3
2. Estimation of copper content of the given solution by Iodometry.	
3. Determination of strength of given hydrochloric acid using pH meter.	
4. Determination of strength of acids in a mixture of acids using conductivity meter.	CO4
5. Estimation of iron content of the given solution using potentiometer.	

6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	
7. Conductometric titration of strong acid vs strong base.	
8. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	CO5
9. Determination of total, temporary & permanent hardness of water by EDTA method.	
10. Determination of DO content of water sample by Winkler's method.	

DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).	**CO3**
2. Estimation of sodium and potassium present in water using flame photometer.	**CO5**
TOTAL: 60 PERIODS	

REFERENCE BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press,2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers,2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India,2013.
4. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
5. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand &Co.Ltd., New Delhi (2020).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend Engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT	TITLE / CONTENT	PERIODS / CO
UNIT I	**INTRODUCTION TO PROFESSIONAL ENGLISH**	9
	Listening: Listening to technical talks with comprehension tasks - Speaking– conversationmethodsinreallifeoccurrencesusingexpressions of different emotions and imperative usages- Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists- recommendations-Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.	CO1
UNIT II	**READING AND STUDY SKILLS**	9
	Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs-easily confused words Language Development- impersonal passive voice, numerical adjectives.	CO2
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	9
	Listening–listening to conversation–effective use of words and their sound aspects, stress, intonation & pronunciation- Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.	CO3
UNIT IV	**REPORT WRITING**	9
	Listening – Model debates & documentaries and making notes. Speaking– expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.	CO4
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	9
	Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.	CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020. 2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006. 3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.
REFERENCE BOOKS
1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014. 2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015 3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014. 4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007 5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007. 6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021. 7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1251	LINEAR ALGEBRA	L	T	P	C
	Common for AI-DS and AI-ML	3	1	0	4

OBJECTIVES

- To test the consistency and solve the system of linear equations
- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To find orthonormal basis of inner product space and find least square approximation
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I	**MATRICES AND SYSTEM OF LINEAR EQUATIONS**	9+3
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordon method.		CO1
UNIT II	**VECTOR SPACES**	9+3
Vector spaces, Subspaces, Linear combinations, Linear independence and linear dependence, Bases and dimensions.		CO2
UNIT III	**LINEAR TRANSFORMATION**	9+3
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation.		CO3
UNIT IV	**INNER PRODUCT SPACES**	9+3
INNER product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation		CO4
UNIT V	**EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION**	9+3
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Friedberg S.H, Insel A.J. and Spence L, Linear Algebra, Fifth edition, Pearson, 2018
2. Burden R. and Faires J.D. Numerical Analysis, tenth edition, Brooks/Cole, 2015.
3. Strang G, Linear algebra for everyone, Wellesley Cambridge press, 2020.

REFERENCE BOOKS

1. Seymour Libschutz and Marc Lipson, Linear Algebra, Sixth edition, McGraw Hill Education India private limited, New Delhi, 2017.

2. Iyengar S.R.K. and Jain R.K., Numerical Methods, Third edition, New age international publications, 2012.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Bernard Kolman and David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, First Reprint, 2009.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Test the consistency and solve the system of linear equations
CO2	Find the basis and dimension of vector space
CO3	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors
CO4	Find orthonormal basis of inner product space and find least square approximation
CO5	Determine eigen values of a matrix using numerical techniques and perform matrix decomposition

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	-	-	1	1	3	3	3	3
CO2	3	3	2	3	2	2	1	-	-	-	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	3	3

PH1252	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
	Common for CSE, IT, AI-DS and AI-ML	3	0	0	3

OBJECTIVES

- To acquire knowledge on the electron transport properties
- To understand the essential principles of semiconductor device
- To have the necessary understanding in optical properties of materials.
- To grasp the principles of magnetic materials and its applications.
- To understand the basics of Nano-electronic devices.

UNIT I	**ELECTRICAL PROPERTIES OF MATERIALS**	9
Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - Electron effective mass - concept of hole - Applications of low resistive and high resistive materials.		CO1
UNIT II	**SEMICONDUCTOR PHYSICS**	9
Intrinsic semiconductors - Energy band diagram - direct and indirect band gap semiconductors - carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n-type & p-type semiconductors - variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - carrier transport in semiconductors - Hall effect and devices - Ohmic contacts – Schottky diode - Semiconducting polymers.		CO2
UNIT III	**MAGNETIC PROPERTIES OF MATERIALS**	9
Magnetism in materials - magnetic dipole moment - magnetic permeability and susceptibility - Microscopic classification of magnetic materials : diamagnetism - paramagnetism - ferromagnetism – antiferromagnetism - ferrimagnetism - Curie temperature - Domain Theory - M versus H behavior - Hard and soft magnetic materials - examples and uses - Magnetic principle in computer data storage - Magnetic hard disc - Spintronics - GMR Sensor (Giant Magnetoresistance) - TMR (Tunnel Magnetoresistance)		CO3
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	9
Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - p-i-n Photodiodes - Avalanche Photodiodes -Optical data storage techniques- Holography - applications.		CO4
UNIT V	**NANO DEVICES**	9

Electron density in bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Ballistic transport - Carbon nanotubes: properties and applications - Material Processing by chemical vapor deposition and Laser ablation method - Graphene: properties and applications.	CO5
TOTAL : 45 PERIODS	

TEXT BOOKS

1. Jasprit Singh, ―Semiconductor Devices: Basic Principles, Wiley 2012.
2. Donald Neaman, Dhrubes Biswas , Semiconductor Physics and Devices (SIE), 4th Edition, 2017
3. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.
4. Kasap, S.O. ―Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
5. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. ―Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. ―Fundamentals of Nanoelectronics. Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. ―Nanotechnology: Understanding small systems, CRC press, 2014.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Gain knowledge on classical and quantum electron theories, and energy band structures.
CO2	Acquire knowledge on basics of semiconductor physics and its applications in various Devices.
CO3	Get knowledge on magnetic properties of materials and their applications in data storage.
CO4	Have the necessary understanding on the functioning of optical materials for Opto electronics.
CO5	Understand the basics of quantum structures and their applications in carbon electronics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	2	2	3
CO3	3	3	1	1	2	2	1	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	Common for all Branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
	Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.	CO1
UNIT II	ENVIRONMENTAL POLLUTION	9
	Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.	CO2
UNIT III	NATURAL RESOURCES	9
	Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.	CO3

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		CO4
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	9
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	To understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

BE1251	BASIC ELECTRICAL,ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	**3**	**0**	**0**	**3**

OBJECTIVES

- To learn the fundamental laws, network theorems and analyse the electric circuits.
- To study the basic principles of electrical machines and their performance.
- To study the fundamentals of power systems.
- To learn the characteristics of various electron devices and Op Amp integrated circuit.
- To understand the principle and operation of measuring instruments and transducers.

UNIT I	**ELECTRIC CIRCUITS ANALYSIS**	9
Ohms Law, Kirchhoff's Law-Instantaneous power - Series and parallel circuit: analysis of resistive, capacitive and inductive network, star delta conversion, Nodal analysis and mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, superposition theorem and maximum power transfer theorem. Three phase ac supply –Instantaneous power, Reactive power and apparent power.		CO1
UNIT II	**ELECTRICAL MACHINES**	9
DC and AC ROTATING MACHINES: Types, Construction, principle, EMF and torque equation, application, Speed Control. Basics of Stepper Motor and Brushless DC motors. Transformers-Introduction, types and construction, working principle of Ideal transformer, EMF equation, All day efficiency calculation.		CO2
UNIT III	**FUNDAMENTALS OF POWER SYSTEM**	9
Structure of power system. Sources of electrical energy – Non-renewable, Renewable- Storage systems: Batteries-Ni-Cd, Pb -Acid and Li-ion, SOC (State of Charge), DOD (Depth of Discharge)Characteristics. Utilization of electrical power - DC and AC load applications. - Electric circuit Protection-need for earthing, fuses and circuit breakers.		CO3
UNIT IV	**ELECTRON DEVICES AND INTEGRATED CIRCUITS**	9
PN Junction-VI Characteristics of Diode, Zener diode, Rectifiers, Zener voltage regulator. Transistor configurations – CE amplifier - RC and LC oscillators. Op Amps – Basic characteristics and its applications.		CO4
UNIT V	**MEASURING INSTRUMENTS AND TRANSDUCERS**	9
Characteristic of measurement-errors in measurement – Principle and working of indicting instrument- Moving Coil meter, Moving Iron meter, Energy meter and watt meter, Cathode Ray Oscilloscope –- Transducers, thermo-electric, RTD, Strain gauge, LVDT, LDR, and piezoelectric transducer.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, fourth Edition, 2019
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCE BOOKS

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. S.Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, sixth edition,2017.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to learn the fundamental laws, theorems of electrical circuits and to analyze them
CO2	Ability to understand the basic construction and operating principle of dc and ac machines.
CO3	Ability to understand the electrical power generation, energy storage and utilization of electric power.
CO4	Ability to understand the characteristics of various electronic devices and Op Amp integrated circuit.
CO5	Ability to understand the principles and operation of measuring instruments and transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO2	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO3	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO4	3	3	3	3	1	1	1	3	3	3	1	3	3	1	3
CO5	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2

CS1206	PROGRAMMING IN C	L	T	P	C
	Common for CSE, IT, AI-DS, AI-ML	3	0	0	3

OBJECTIVES

- To develop C Programs using basic programming constructs
- To develop C programs using arrays, strings and functions
- To develop applications in C using pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT I	BASICS OF C PROGRAMMING	9
An overview of C: History of C; Compiler Vs. Interpreter, Structure of a C Program, Compiling a C Program; Basic data types: Modifiers, Variables: Type qualifiers, Storage class specifiers; Constants: Enumeration Constants; Keywords; Operators: Precedence and Associativity; Expressions: Order of evaluation, Type conversion in expression, Casts; Input/Output statements; Assignment statements, Selection statements; Iteration statements; Jump statements; Expression statements; Pre-processor directives: Compilation process.		CO1
UNIT II	**ARRAYS, STRINGS AND FUNCTIONS**	9
Introduction to Arrays: Declaration, Initialization, Single dimensional array, Two dimensional array, Array manipulations; String operations: length, compare, concatenate, copy; Functions: General form of a function, Function Arguments, Built-in functions, return statement, Recursion		CO2
UNIT III	**POINTERS**	9
Pointers: Declaring and defining pointers, Pointer operators, Pointer expression; Pointer assignment, Pointer conversions, Pointer arithmetic, Pointer comparisons; Pointers and Arrays: Array of pointers; Multiple indirection; Pointers to function; Problems with pointers; Parameter passing: Pass by value, Pass by reference.		CO3
UNIT IV	**STRUCTURES AND UNIONS**	9
Structure: Accessing structure members, structure assignments; Nested structures; Pointer and Structures; Array of structures; Passing structures to functions: Passing structure member to function, Passing entire structure to functions; Arrays in structures; Self-referential structures; Dynamic memory allocation; typedef statement, Union and Enumeration.		CO4
UNIT V	**FILE PROCESSING**	9
File system basics: File pointer, opening and closing a File; reading and writing character; working with String: fputs() and fgets(); rewind(); ferror(); fread() and fwrite(); Erasing files; Types of file		CO5

processing: Sequential access; Random access: fprintf() and fscanf(), fseek() and ftell(); Command line arguments.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, -The C Programming language‖, Second Edition, Pearson Education,2006.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel,-C HowtoProgram,Seventh edition,Pearson Publication
2. Juneja, B.L andAnitaSeth,-Programmingin C,CENGAGELearning India pvt.Ltd.,2011.
3. Pradip Dey,Manas Ghosh,-FundamentalsofComputingandProgramming in C,First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, -Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia,2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education,1996.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C usingstructures and union.
CO5	Design applications using sequential and random-access fileprocessing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

GE1207	ENGINEERING PRACTICES LABORATORY	L	P	T	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13 CO1

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.

b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18 CO2

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending.

b) Model making – Trays and funnels.

c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump

b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)	
III **ELECTRICAL ENGINEERING PRACTICE** 13 1. **Residential house wiring using switches, fuse, indicator, lamp and energy meter.** 2. **Fluorescent lamp wiring.** 3. **Stair case wiring** 4. **Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.**	**CO3**
5. **Measurement of energy using single phase energy meter.** 6. **Measurement of resistance to earth of an electrical equipment.**	**CO4**
IV **ELECTRONICS ENGINEERING PRACTICE** 16 1. **Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.** 2. **Study of logic gates AND, OR, EX-OR and NOT.** 3. **Generation of Clock Signal.** 4. **Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.**	**CO5**
TOTAL: 60 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	**Description of Equipment**	**Quantity required**
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 sets
2.	Carpentry vice (fitted to work bench)	15 Nos
3.	Standard woodworking tools 15 Sets.	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	5 Nos
2.	Welding booth with exhaust facility.	5 Nos

3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre lathe.	2 Nos
6.	Hearth furnace, anvil and smithy tools.	2 Sets
7.	Moulding table, foundry tools.	2 Sets
8.	Power Tool: Angle Grinder.	2 Nos
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	1 each
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	15 Sets
2.	Electrical measuring instruments.	10 Sets
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	1 each
4.	Megger (250V/500V).	1 No.
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	2 Nos
	ELECTRONICS	
1.	Soldering guns 10 Nos.	10 Nos.
2.	Assorted electronic components for making circuits 50 Nos.	50 Nos.
3.	Small PCBs.	10 Nos.
4.	Multimeters	10 Nos.
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	1 each

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO2	3	2	3	-	-	3	-	-	-	-	-	3	3	3	3
CO3	3	1	2	-	-	2	-	-	-	-	-	3	3	3	3
CO4	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO5	3	2	2	-	-	2	-	-	-	-	-	3	2	2	2

CS1208	PROGRAMMING IN C LABORATORY	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS

1. C programming using simple statements and expressions.	CO1
2. Scientific problem-solving using decision making and looping.	
3. Generating different patterns using multiple control statements.	
4. Problems solving using one dimensional array.	
5. Mathematical problem solving using two dimensional arrays.	
6. Solving problems using string functions.	CO2
7. Solving problems with user defined functions.	
8. Solving problems using recursive function.	
9. Solving problems with dynamic memory allocation.	
10. Realtime application using structures and unions.	CO3
11. Realtime problem solving using sequential and random-access file.	
12. Solving problems with command line argument.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press.
4. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
5. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
6. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
7. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving string, functions, recursion, pointers, andstructures.
CO3	Design applications using sequential and random-access fileprocessing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

MA1351	PROBABILITY AND STATISTICS	L	T	P	C
	Common for CSE, IT & AI-DS	3	1	0	4

OBJECTIVES

- To understand the basic concepts of probability, one- and two-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in engineering applications.
- To acquaint the knowledge of testing of hypothesis for small and large samples, which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I	**PROBABILITY AND RANDOM VARIABLES**	9+3
Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		CO1
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	9+3
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables).		CO2
UNIT III	**RANDOM PROCESSES**	9+3
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		CO3
UNIT IV	**TESTING OF HYPOTHESIS**	9+3
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit.		CO4
UNIT V	**DESIGN OF EXPERIMENTS**	9+3
One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Ibe, O.C., —Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Indian Reprint, 2014.

REFERENCE BOOKS
1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2017. 2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014. 3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017. 4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4th Edition,Elsevier, 2009. 5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Get ideas to handle situations involving more than one random variable.
CO3	Gain an understanding and characterizes phenomena which evolve with respect to time in a probabilistic manner and modelling the real-life phenomena.
CO4	Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO5	Do design of experiments, carry them out, and analyze the data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	3	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	3	2	3	3	2	1	-	-	-	2	2	3	2	1
CO5	3	3	2	3	2	2	1	-	-	-	1	2	2	1	1

DS1301	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understand the basic structure and operation of digital computer
- To familiarize with implementation of fixed point and floating-point arithmetic operations
- To study the design of data path unit and control unit for processor
- To understand the concept of various memories and interfacing
- To introduce the parallel processing technique

UNIT I	**COMPUTER ORGANIZATION & INSTRUCTIONS**	9
Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations		**CO1**
UNIT II	**ARITHMETIC UNIT**	9
Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism		CO2
UNIT III	**PROCESSOR AND CONTROL UNIT**	9
Introduction, Logic Design Conventions, Building a Datapath - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions		CO3
UNIT IV	**MEMORY AND I/O ORGANIZATION**	9
Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices		CO4
UNIT V	**ADVANCED COMPUTER ARCHITECTURE**	9
Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. David A. Patterson and John L. Hennessey, ―Computer Organization and Design, Fifth edition, Morgan Kauffman / Elsevier, 2014. (UNIT I-V)
2. Miles J. Murdocca and Vincent P. Heuring, ―Computer Architecture and Organization: An Integrated approach, Second edition, Wiley India Pvt Ltd, 2015 (UNIT IV,V)

REFERENCE BOOKS

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, —Computer Organization—, Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings —Computer Organization and Architecture‖, Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, —Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Describe data representation, instruction formats and the operation of a digital computer
CO2	Illustrate the fixed point and floating-point arithmetic for ALU operation
CO3	Discuss about implementation schemes of control unit and pipeline performance
CO4	Explain the concept of various memories, interfacing and organization of multiple processors
CO5	Discuss parallel processing technique and unconventional architectures

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	1	2	-	-	1	-	-	1	2	3	3	2
CO2	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2
CO3	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2
CO4	2	3	2	1	2	-	-	1	-	-	1	2	3	3	2
CO5	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML & ECE Semester IV	3	0	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I	**LINEAR DATA STRUCTURES – LIST**	9
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		CO1
UNIT II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	9
Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.		CO2
UNIT III	**NON-LINEAR DATA STRUCTURES – TREES**	9
Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.		CO3
UNIT IV	**NON-LINEAR DATA STRUCTURES – GRAPHS**	9
Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.		CO4
UNIT V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	9
Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education, 1997.
2. Reema Thareja, —Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3

DS1302	OBJECT ORIENTED PROGRAMMING (Lab Integrated)	L	T	P	C
	(Common to AI-DS,EEE & EIE)	3	0	2	4

OBJECTIVES

- Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- Design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I	JAVA FUNDAMENTALS	9 +6
	Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and StringBuffer **Lab Component:** 1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 +bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 -4ac$ is negative, display a message stating that there are no real solutions. 2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the n^{th} value in the Fibonacci sequence	CO1
UNIT II	OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE	9 + 6
	Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes. **Lab Component:** 1. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number of Sides ( ) that shows the number of sides in the given geometrical figures 2. Write a Java program that counts the number of objects created by using static variable	CO2
UNIT III	EXCEPTIONS, COLLECTIONS AND STREAMS	9 + 6
	Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. **Lab Component:** 1. Write a Java program to make frequency count of words in a given text 2. Write a Java program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).	CO3

UNIT IV	CONCURRENT PROGRAMMING AND GUI PROGRAMMING	9 + 6
	Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag. 1. Write a Java program that creates three threads. First thread displays “Good Morning” everyone second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds. 2. Write a java Program to create a window when we press i. M or m the window displays Good Morning ii. A or a the window displays Good After Noon iii. E or e the window displays Good Evening iv. N or n the window displays Good Night	**CO4**
UNIT V	**JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING**	**9 + 6**
	Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams. 1. Develop a program for executing the remote command using TCP Socket 2. Create a GUI program in java with the following components. i. A frame with Flow layout. ii. Add the following components on to the frame. a) Two Text Field b) A button with the label display iii. Allow the user to enter data into the JTextField iv. When the button is clicked paint the frame by displaying the data entered in the JTextField v. Allow the user to properly close the frame	**CO5**

PRACTICALS : 45 PERIODS	THEORY : 30 PERIODS	TOTAL:75 PERIODS

TEXT BOOKS

1. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
3. Paul Deitel, Harvey M. Deitel, “Java How to Program”, 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , “Introduction to Java programming”, 7th Edition, Pearson education, 2010.
3. C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamental ideas behind the object-oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification
CO3	A modern coverage of concurrent programming that focuses on high-level synchronization constructs
CO4	Know the concept of event handling used in GUI.
CO5	Develop Server Programming Applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	-	-	2	1	1	1	2	2	1
CO2	1	1	2	1	1	1	2	1	2	1	1	1	2	2	2
CO3	1	1	1	1	1	-	-	1	2	2	2	1	1	2	2
CO4	1	1	2	-	1	-	1	-	1	1	2	1	3	1	3
CO5	2	2	2	2	2	-	1	1	2	1	2	2	1	2	2

DS1303	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	C
	Common for AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To impart basic knowledge about Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To learn to represent knowledge in solving AI problems
- To understand the concept of Planning in various situations
- To understand the application of AI namely Expert Systems

UNIT I	INTRODUCTION	9
	Introduction–Definition – Foundation and History of AI - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Agents and Environments – Nature of Environments – Structure of Agents - Typical Intelligent Agents	CO1
UNIT II	**PROBLEM SOLVING METHODS**	9
	Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning	CO2
UNIT III	**KNOWLEDGE REPRESENTATION**	9
	First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for categories – Reasoning with Default Information	CO3
UNIT IV	**PLANNING**	9
	Planning – Introduction – Planning Problem – Planning with State Space Search - Partial Order planning – Construction and Use of Planning Graphs - Conditional Planning – Continuous Planning – Multi Agent Planning	CO4
UNIT V	**EXPERT SYSTEMS**	9
	Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Russell S and Norvig P, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

REFERENCE BOOKS

1. M. Tim Jones - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. I. Bratko - Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.

4. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement basic AI Algorithms
CO2	Use appropriate search algorithms to solve AI based problems
CO3	Represent a problem using first order and predicatelogic
CO4	Design a simple agent system with associated planning technique.
CO5	Apply AI techniques to real-world problems to develop expert system

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES(PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3

DS1304	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Science.
- To present and interpret data using visualization.

UNIT I	INTRODUCTION	9
Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model– presenting findings and building applications – Machine learning: The Modeling Process – Types of Machine Learning – Semi Supervised Learning		CO1
UNIT II	**ORGANIZING AND SUMMARIZING DATA**	9
Types of Data – Types of Variables - Describing Data with Tables and Graphs – Describing Data with Averages – Describing Variability – Handling large data on a single computer: The problems you face when handling large data - General techniques for handling large volumes of data - General programming tips for dealing with large datasets.		CO2
UNIT III	**DESCRIBING RELATIONSHIPS**	9
Correlation – Scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – Regression – regression line – least squares regression line – Standard error of estimate – interpretation of r2 – multiple regression equations – regression towards the mean		CO3
UNIT IV	**PYTHON LIBRARIES FOR DATA SCIENCE**	9
Algorithms for Massive Data Problems: Frequency Moments of Data Streams – Matrix Algorithms using Sampling, Sketches of Documents; Clustering: k-Means Clustering, k-Center Clustering - Spectral Clustering – Community Finding and Graph Partitioning.		CO4
UNIT V	**DATA VISUALIZATION**	9
Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap – Visualization using Tableau.		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCE BOOKS

1. Dr .Gypsy Nandi & Dr.Rupam Kumar Sharma, "Data Science Fundamentals and Practical Approaches: Understand Why Data Science is the Next", BPB Publisher, 2020
2. Hans Petter Langtangen, "A Primer on Scientific Programming with Python", 4th Edition, Springer, 2016.
3. Jonathan Dinu,"Foundations of Data Science : A Practical Introduction to Data Science with Python", Addison-Wesley Data& Analytics Series,2016.
4. EMC Education Services, "Data Science and Big Data Analytics : Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
5. Joel Grus,"Data Science from Scratch: First Principles with Python", O'Reilly, 2015
6. JureLeskovek, Anand Rajaraman, Jeffrey Ullman, "Mining of Massive Datasets", V2.1, Cambridge University Press, 2014.
7. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Define the data science process
CO2	Understand different types of data description for data science process
CO3	Gain knowledge on relationships between data
CO4	Use the Python Libraries for Data Science
CO5	Apply visualization Libraries in Python to interpret and explore data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	1	2	2	-	3	3	2	2
CO2	3	3	3	3	2	-	-	1	1	2	-	3	3	3	1
CO3	3	3	3	3	2	1	1	1	2	2	-	3	3	3	3
CO4	3	3	3	3	2	-	-	1	2	2	-	3	3	3	2
CO5	3	3	3	3	2	-	-	1	2	2	-	3	3	3	2

DS1307	DATA STRUCTURE LABORATORY USING PYTHON	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

LIST OF EXPERIMENTS

CO1

1. IMPLIMENTATION OF LIST

Write Python programs to

a. Array implementation of Stack ADTs.
b. Array implementation of Queue ADTs.

2. LIST ADT

Array implementation of List ADT.

3. IMPLEMENTATION OF STACK AND QUEUE

Write Python programs to

a. Design and implement Single Linked List.
b. Design and implement Stack and its operations using List.
c. Design and implement Queue and its operations using List.

CO2

4. APPLICATIONS OF LINEAR DATA STRUCTURE

Write Python programs for the following:

a. Design and implement polynomial ADT using list
b. Uses Stack operations to convert infix expression into postfix expression.
c. Uses Stack operations for evaluating the postfix expression.

5. APPLICATIONS OF TREE

a. Write a Python program to Design and implement binary tree.
b. Traverse the above binary tree recursively in pre-order, post-order & in-order.

6. IMPLEMENTATION OF TREE

Write a Python program to Design and implement binary search tree.

CO3

7. IMPLEMENTATION OF ADVANCED TREE

a. Design and Implement AVL tree using Templates.
b. Design and Implement heap tree using Templates.

8. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS

Write Python programs for the following:

a. Design and Implement Dijkstra's algorithm
b. Design and Implement Floyd Warshall algorithm.

9. IMPLEMENTATION OF MINIMUM SPANNING TREE

Write Python programs for the following:

a. Design and Implement Kruskal's algorithm.
b. Design and Implement Prim's algorithm.

10. GRAPH TRAVERSAL & APPLICATIONS

Write Python programs to implement the following algorithms:

a. Depth first search.

b. Breadth first search.
c. Toplogical Sorting.

11. SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION

a. Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
   i. Insertion sort
   ii. Selection sort
   iii. Quick sort
   iv. Merge sort
b. Write Python programs for implement linear search and binary search.
c. Write Python programs for implement Hashing – any two collision techniques

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Rance D. Necaise, Data Structures and Algorithms Using Python, Willy Student Edition, 2016.

WEB REFERENCES

1. https://cloudacademy.com/lab/python-lab-1/
2. https://www.python.org/downloads/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Write functions to implement linear and non-linear data structure operations
CO2	Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

MAPPING OF COs WITH POs AND PSOs

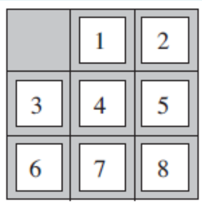
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

DS1308	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To get familiarized with the structure of agents
- To solve simple toy world problems
- To understand and develop solutions through search strategies.
- To develop solutions for constraint satisfaction problems.
- To increase the knowledge about real-world problems and how to plan and act in the real world and to get familiarized with expert systems

LIST OF EXPERIMENTS

1. Developed a simple reflex agent program in Python for the vacuum-cleaner world problem. This particular world has just two locations: squares A and B. The vacuum agent perceives which square it is in and whether there is dirt in the square. It can choose to move left, move right, suck up the dirt, or do nothing.	CO1
2. Solve the 8-puzzle problem, which consists of a 3×3 board with eight numbered tiles and a blank space. A tile adjacent to the blank space can slide into the space. The objective is to reach a specified goal state as given below. Find minimum number of steps required to reach the goal.  Goal State	
3. Write a Python program to solve N Queen Problem using backtracking. The N Queen is the problem of placing N chess queens on an N×N chessboard so that no two queens attack each other.	
4. Write a Python program for a path search problem to find a path from point A to point B using A* Search Algorithm.	CO2
5. Using Hill Climbing Search Algorithm, find the solution for a Travelling Salesman Problem, which has to find the shortest route from a starting location and back to the starting location after visiting all the other cities.	
6. Given an undirected graph and a number m, determine if the graph can be coloured with at most m colours such that no two adjacent vertices of the graph are colored with the same color. Here coloring of a graph means the assignment of colors to all vertices.	
7. Solve the cryptarithmetic puzzle SEND+MORE=MONEY using a Python program. Find digits that replace letters to make a mathematical statement true. Each letter in the	

problem represents one digit (0–9). No two letters can represent the same digit. When a letter repeats, it means a digit repeats in the solution.	
8. Write a Python program to solve Sudoko. Given an initial 9x9 grid of cells containig numbers between 1 and 9 or blanks, all blanks must be filled with numbers. You win Sudoko if you find all values such that every row, column, and 3x3 subsquare contains the numbers 1–9, each with a single occurrence.	
9. A job shop consists of a set of distinct machines that process jobs. Each job is a series of tasks that require use of particular machines for known durations, and which must be completed in specified order. Implement the job shop scheduling problem to schedule the jobs on the machines to minimize the time necessary to process all jobs.	CO3
10. Demonstrate the use of MYCIN: a medical expert system. Implement a small example of an expert system; which defines a few contexts, parameters, and rules, and presents a rudimentary user interface to collect data about an infection in order to determine the identity of the infecting organism.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Russell S and Norvig P, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

WEB REFERENCES

1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm
2. https://www.edureka.co/blog/artificial-intelligence-with-python/

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Familiarized with the structure of agents, implement simple agents and develop solutions for simple toy world problems.
CO2	Implement and develop solutions for problems through different search strategies. Identify constraints of problems and develop solutions for constraint satisfaction problems.
CO3	Approach a real-world problem, develop a plan and then solve those problems and use expert systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	3

MA1453	DISCRETE MATHEMATICS	L	T	P	C
	Common for CSE, IT & AI-DS	3	1	0	4

OBJECTIVES

- To introduce Mathematical Logic, Inference Theory and proof methods.
- To provide fundamental principles on combinatorial counting techniques.
- To introduce graph models, their representation, connectivity and traverse ability.
- To explain the fundamental algebraic structures, groups and their algebraic properties.
- To introduce partial ordering and some functions on a set.

UNIT I	LOGIC AND PROOFS	9+3
Propositional Logic – Propositional Equivalences – Normal Forms - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.		CO1
UNIT II	**COMBINATORICS**	9+3
Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations -Generating Functions - Solving Linear Recurrence Relations Using Generating Functions– Inclusion – Exclusion – Principle and Its Applications.		CO2
UNIT III	**SETS AND FUNCTIONS**	9+3
Set -Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.		CO3
UNIT IV	**GRAPHS**	9+3
Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.		CO4
UNIT V	**ALGEBRAIC STRUCTURES**	9+3
Groups – Subgroups – Homomorphisms – Isomorphism - Normal Subgroup and Coset – Lagrange's Theorem.		CO5

TOTAL : 60 PERIODS

TEXT BOOKS

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2012.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, Thirtieth Reprint, New Delhi, 2011.

REFERENCE BOOKS		

1. Ralph. P. Grimaldi, “Discrete and Combinatorial Mathematics: An Applied Introduction”, Pearson Education, Fifth Edition, New Delhi, 2014
2. Seymour Lipschutz and Mark Lipson,” Discrete Mathematics”, Schaum‘s Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
3. Thomas Koshy,” Discrete Mathematics with Applications”, Elsevier Publications, Boston, 2004.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Construct proofs by using direct proof, proof by contraposition, proof by contradiction. Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositions. Logic helps in arriving inferences for any problem.
CO2	Solve problems on permutation and combination. Prove mathematical theorems using mathematical induction. Demonstrate basic counting principles, compute and interpret the meaning in the context of the particular application which helps to apply the combinatorial techniques in Algorithms and Data structure for analysis and design.
CO3	Understand relations on a set and functions on a set
CO4	Apply the concepts of graph theory in data structures, data mining, image segmentation and in clustering.
CO5	Familiar with algebraic systems, groups, sub groups, Lagrange’s theorem and normal subgroups. In Coding algorithms and in theoretical computer science algebraic structures are applied.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO2	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO3	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO4	3	3	2	2	1	1	-	-	-	-	1	2	2	2	1
CO5	3	3	2	2	1	1	-	-	-	-	1	2	2	1	1

CS1401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To learn the general framework for analyzing algorithm efficiency
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

UNIT I	**INTRODUCTION**	9
Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – The Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Nonrecursive and Recursive Algorithms – Empirical Analysis of Algorithms.		CO1
UNIT II	**DECREASE AND CONQUER AND DIVIDE-AND-CONQUER**	9
Decrease-and-Conquer– Insertion Sort – Binary Search – Computing a Median and the Selection Problem – Divide-and-Conquer – Merge Sort – Quicksort – The Closest –Pair and Convex –Hull Problems by Divide-and-Conquer.		CO2
UNIT III	**DYMANIC PROGRAMMING AND GREEDY TECHNIQUE**	9
The Knapsack Problem and Memory Functions – Optimal Binary Search Trees – Warshall's Algorithm – Floyd's Algorithm – Greedy Technique – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman Trees and Codes.		CO3
UNIT IV	**ITERATIVE IMPROVEMENT**	9
Graphical Method – The Simplex Method – The maximum Flow Problem – Maximum Matching in Bipartite Graphs – The Stable Marriage Problem.		CO4
UNIT V	**BACKTRACKING, BRANCH-AND-BOUND AND APPROXIMATION ALGORITHMS**	9
P, NP, and NP- Complete Problems – Backtracking – n-Queens Problem – Hamiltonian Circuit Problem – Subset-Sum Problem – Branch-and-Bound – Assignment Problem – Knapsack Problem – Traveling Salesman Problem – Approximation Algorithms for the Traveling Salesman Problem and the Knapsack Problem.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008.
2. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education, 2011.
3. Donald E. Knuth, "Art of Computer Programming, Volume I - Fundamental Algorithms", Third Edition, Addison Wesley, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to investigate an algorithm's efficiency with respect to running time
CO2	Design and implement problems using algorithmic design techniques such as decrease and conquer and divide and conquer
CO3	Ability to understand the design techniques such as Dynamic programming and Greedy technique
CO4	Ability to understand the iterative design techniques
CO5	Understand the variations among tractable and intractable problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO2	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO3	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO4	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO5	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2

CS1402	OPERATING SYSTEMS	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I	OPERATING SYSTEM OVERVIEW	9
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.		CO1
UNIT II	**PROCESS MANAGEMENT**	9
Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		CO2
UNIT III	**STORAGE MANAGEMENT**	9
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Need for Page Replacement, Page Replacement Algorithm, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		CO3
UNIT IV	**FILE SYSTEMS AND I/O SYSTEMS**	9
Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.		CO4
UNIT V	**CASE STUDY**	9
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile		CO5

OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.	
TOTAL : 45 PERIODS	

TEXT BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, ―Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS

1. RamazElmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, ―Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education
6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.
7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.
8. http://nptel.ac.in/.
9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Analyze various scheduling algorithms.
CO2	Understand deadlock, prevention and avoidance algorithms.
CO3	Compare and contrast various memory management schemes.
CO4	Understand the functionality of file systems.
CO5	Perform administrative tasks on Linux Servers and Compare iOS and Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1403	DATABASE DESIGN AND MANAGEMENT (Lab Integrated)	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	3	0	2	4

OBJECTIVES

- To learn the fundamentals of data models, ER diagrams and to study SQL and relational database design.
- To familiarize relational model with Relational Database design and Normal Forms.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To understand the implementation techniques by learning file organization and Query Optimization.
- To understand the concepts of distributed databases, Object oriented databases and XML databases.

UNIT I	INTRODUCTION TO RELATIONAL DATABASES	9 + 6
Purpose of Database System – Views of data – Data Models – Database System Architecture Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping– Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features **Lab Component** • Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements .Database Querying – Simple queries, Nested queries, Sub queries and Joins • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views, Synonyms, Sequences. • Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)		CO1
UNIT II	**RELATIONAL DATABASE DESIGN**	9 + 6
Embedded SQL– Dynamic SQL - Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **Lab Component** • Simple Embedded SQL Program to demonstrate the concepts. • Database Design using normalization and Implementation for any application.		CO2
UNIT III	**TRANSACTIONS**	9 + 6
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery. **Lab Component** • Usage of Transaction control language commands like commit, rollback and save point. • Develop Programs using BEFORE and AFTER Triggers for INSERT, DELETE and UPDATE statements		CO3

UNIT IV	IMPLEMENTATION TECHNIQUES	9 + 6
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing. Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation. **Lab Component** • Implementation of B tree and B+ Tree. • Develop programs to demonstrate hashing techniques.		CO4
UNIT V	**ADVANCED TOPICS**	9 + 6
Distributed Databases: Architecture, Data Storage, Data Fragmentation - Replication and Allocation Techniques for Distributed Database Design. Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery. **Lab Component** • Database Connectivity with Front End Tools • Case Study using real life database applications.		CO5

PRACTICALS: 30 PERIODS	THEORY: 45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson, Seventh Edition, Global Edition,2016
2. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill,2012.
3. Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, An Introduction to Cloud Databases,O'Reilly Media, Inc.,2019.

REFERENCE BOOKS

1. C.J.Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education,2004.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Map ER model to Relational model to perform database design effectively
CO2	Able to understand the various normal forms and to minimize the redundancy in the relations
CO3	Able to know the logic behind the transaction processing, concurrency control and to recover system from failures.
CO4	Able to organize, index the files and to optimize the given queries
CO5	Able to know the concepts of distributed databases, Object Oriented databases and XML databases

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

ML1401	FOUNDATIONS OF MACHINE LEARNING	L	T	P	C
	Common for IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	INTRODUCTION	9
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – The Bias-Variance Trade-off, FIND–S Algorithm, Candidate Elimination Algorithm		CO1
UNIT II	**SUPERVISED LEARNING**	9
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		CO2
UNIT III	**UNSUPERVISED LEARNING**	9
Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA)		CO3
UNIT IV	**GRAPHICAL MODELS**	9
Bayesian Networks – Conditional Independence – Markov Random Fields – Learning – Naive Bayes Classifiers – Markov Model – Hidden Markov Model.		CO4
UNIT V	**ADVANCED LEARNING**	9
Reinforcement Learning – Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines – Deep Learning		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, CRC Press, 2014.
4. Tom Mitchell, “Machine Learning”, McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
6. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Gain knowledge about basic concepts of machine learning techniques
CO2	Develop predictive model based on both input and output data
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Ability to address the problem of learning control strategies for autonomous agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

DS1401	PYTHON PROGRAMMING FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the data scientists, work environment like IPython and Jupyter.
- To understand ndarray object for efficient storage and manipulation of dense data arrays in python using NumPy.
- To understand DataFrame object for efficient storage and manipulation of labelled / columnar data in python using Pandas.
- To perform data visualizations in python using Matplotlib.
- To practice machine learning algorithms in python using Scikit-Learn.

UNIT I	IPYTHON: BEYOND NORMAL PYTHON	9
Shell and Notebook- Help and Documentation in IPython- Keyboard Shortcuts in the IPython Shell- IPython Magic Commands- Input and Output History- IPython and Shell Commands- Errors and Debugging- Profiling and Timing Code.		CO1
UNIT II	**INTRODUCTION TO NUMPY**	9
Understanding Data Types in Python- The Basics of NumPy Arrays- Computation on NumPy Arrays: Universal Functions- Aggregations- Computation on Arrays- Comparisons, Masks, and Boolean Logic- Fancy Indexing- Sorting Arrays- Structured Data.		CO2
UNIT III	**DATA MANIPULATION WITH PANDAS**	9
Installing and Using Pandas- Introducing Pandas Objects- Data Indexing and Selection- Operating on Data in Pandas- Handling Missing Data- Hierarchical Indexing- Combining Datasets- Aggregation and Grouping- Pivot Tables- Vectorized String Operations- Working with Time Series- High-Performance Pandas.		CO3
UNIT IV	**VISUALIZATION WITH MATPLOTLIB**	9
General Matplotlib Tips- Simple Line Plots- Simple Scatter Plots- Visualizing Errors- Density and Contour Plots- Histograms, Binnings, and Density- Customizing Plot Legends- Customizing Colorbars- Multiple Subplots- Text and Annotation- Customizing Ticks- Customizing Matplotlib- Three-Dimensional Plotting in Matplotlib- Geographic Data with Basemap- Visualization with Seaborn.		CO4
UNIT V	**MACHINE LEARNING WITH SCIKIT-LEARN**	9
Machine Learning- Introducing Scikit-Learn- Hyperparameters and Model Validation- Feature Engineering- Naive Bayes Classification- Linear Regression- Support Vector Machines- Decision Trees and Random Forests- Principal Component Analysis- k-Means Clustering- Gaussian Mixture Models- Application: A Face Detection Pipeline.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017

REFERENCE BOOKS

1. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
2. Python for data science for dummies 2nd Edition, John Paul Mueller, Luca Massaron, Wiley

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Use data scientists work environment like IPython and Jupyter.
CO2	Use ndarray object for efficient storage and manipulation of dense data arrays in python using NumPy.
CO3	Use DataFrame object for efficient storage and manipulation of labeled/columnar data in python using Pandas.
CO4	Perform data visualizations in python using Matplotlib.
CO5	Use machine learning algorithms in python using Scikit-Learn.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO2	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO3	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO4	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3

DS1407	DATA SCIENCE LABORATORY USING PYTHON	L	T	P	C
		0	0	4	2

OBJECTIVES

- To provide knowledge of Data Exploration using Programming APIs and Freely Available Tools.
- To understand the concept of Data Formation.
- To visualize the data using various Python API.
- To use latest python libraries for Data Science in Real Time Applications.

LIST OF EXPERIMENTS

	Experiment	CO
1.	Python Environment Setup using Anaconda.	CO1
2.	Perform Mathematical Computing using NumPy - Array and Matrices.	
3.	Data Manipulation using Pandas – Importing Data, Understanding Data Frame, Indexing Data Frames, View and Select Data Demo	CO2
4.	Data Manipulation using Pandas – Data Operations, Missing Values, Renaming Columns, File Read and Write, Pandas SQL Operations.	
5.	Scientific Computing using SciPy - Special Function Package, Linear Algebra - Feature Engineering	
6.	Scientific Computing using SciPy - Linear Regression- Support Vector Machines	CO3
7.	Scientific Computing using SciPy – Naive Bayes Classification, Decision Trees and Random Forests, Principal Component Analysis, k-Means Clustering.	
8.	Data Visualization using Matplotlib – Types of plots such as HISTOGRAM, Scatter Plots, Line, Bar, Pie Chart.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Chirag Shah," A Hands-on Introduction to Data Science", Cambridge University Press, 2020.
2. Stephen Klosterman, "Data Science projects with Python: A case study approach to successful data science projects using Python, pandas and scikit-learn", Packt Publishing Ltd., 2019
3. Peter Morgan, "Data Analysis from scratch with python: Beginner guide using python, pandas, Numpy, SCIKIT-learn, IPython, TensorFlow and Matplotlib", AI Sciences, 2018.

WEB REFERENCES

1. https://socialresearchmethods.net/kb/statprep.php
2. https://www.nobledesktop.com/learn/python/data-visualization-matplotlib

3. https://www.dataquest.io/blog/python-api-tutorial/

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the concept of data formation with the help of crawling and usage of APIs
CO2	Apply various Data cleaning, data transformation, data exploration and data visualization techniques in Python programming language.
CO3	Explore and visualize data using various data science tools and python APIs.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2
CO2	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2
CO3	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2

		L	T	P	C
ML1408	**MACHINE LEARNING LABORATORY**	**L**	**T**	**P**	**C**
	Common for IT, AI-DS & AI-ML	**0**	**0**	**4**	**2**

OBJECTIVES

- To make use of Data sets in implementing the machine learning algorithms
- To implement the machine learning concepts and algorithms in any suitable language of choice
- To understand the practical aspects of probabilistic graphical models.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV File	CO1
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.	
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	CO2
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	CO3
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library lasses/API	
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library lasses/API in the program.	
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Aurelien Geron , "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts, Tools, and Techniques to Build Intelligent Systems", Second Edition, O'Reilly Media
2. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018

3. Practical Machine Learning with Python: A Problem-Solver's Guide to Building Real-World Intelligent Systems" Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress.

WEB REFERENCES

https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
Web Resources: https://www.anaconda.com/enterprise-machine-learning-getting-started/
https://www.tutorialspoint.com/machine_learning_with_python/index.htm

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Update the general and specific boundary for each new example in concept learning
CO2	Develop supervised learning predictive model for general data set
CO3	Ability to apply knowledge representation and machine learning techniques to real world problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
	Common for CSE & AI-DS	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I	6
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	CO1
UNIT II	6
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	CO2
UNIT III	6
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc	CO3
UNIT IV	6
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	CO4
UNIT V	6
Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management- developing a long- term career plan making career changes	CO5

TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	2	1	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	1	2	-	-	-	-	2
CO4	-	-	-	-	1	-	-	-	2	2	-	-	-	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	2	2

DS1501	OPTIMIZATION IN DATA ANALYSIS	L	T	P	C
		4	0	0	4

OBJECTIVES

- To use convex sets and convex functions
- To understand Regression analysis
- To learn clustering and classification
- To learn multivariate analysis

UNIT I	**CONVEX SETS**	9
Iteration principles- Fixed point algorithms- Convex sets and convex cones- Best approximation paradigms- Projection methods in convex feasibility problems- applications to data fusion and image recovery		CO1
UNIT II	**CONVEX FUNCTIONS**	9
Convex functions-Conjugation of convex functions-Duality in convex optimization-Sub differential calculus-Sub gradient algorithms for convex feasibility and best approximation-applications in inverse problems		CO2
UNIT III	**REGRESSION ANALYSIS**	9
Regression Analysis: Linear Regression-Logistic Regression- Polynomial Regression- Stepwise Regression- Ridge Regression- Lasso Regression- ElasticNet Regression		CO3
UNIT IV	**CLUSTER ANALYSIS AND CLASSIFICATIONS**	9
Cluster Analysis: Affinity Propagation- Agglomerative Clustering- BIRCH- DBSCAN- k-Means, Mini-Batch k-Means, Mean Shift, OPTICS, Spectral Clustering, Mixture of Gaissian, Classification Analysis: Naïve Bayes, Stochastic gradient dissent, k-Nearest Neighbors, Random Forest, Support Vector Machine		CO4
UNIT V	**MULTIVARIATE ANALYSIS**	9
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. H. H. Bauschke and P. L. Combettes, Convex Analysis and Monotone Operator Theory in Hilbert Spaces, 2nd ed. Springer, New York, 2017
2. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley-2017
3. Gareth James,Daniela Witten,Trevor Hastie,Rob Tibshirani , An Introduction to statistical Learning, Springer

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand and apply convex sets for data fusion
CO2	Understand and apply convex functions in inverse problems
CO3	Apply regression analysis for forecasting
CO4	Apply clustering and classification to classify the objects
CO5	Understand and apply multivariate analysis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO2	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2

DS1502	ADVANCED ARTIFICIAL INTELLIGENCE	L	T	P	C
	Common for AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To analyze Probabilistic Reasoning for knowledge
- To give understanding of main abstractions of decision making.
- To understand a wide variety of learning algorithms.
- To understand the different ways of designing software agents
- To understand the application of AI namely Robotics

UNIT I	UNCERTAINTY AND REASONING	9
	Uncertainty - Basic Probability Notation – Axioms of Probability – Bayes Rule - Probabilistic Reasoning – Bayesian Networks – Semantics – Inference – Other Approaches to Uncertain Reasoning – Dempster Shafer Theory – Fuzzy sets and Fuzzy Logic	CO1
UNIT II	**DECISION MAKING**	9
	Utility Theory - Utility Functions – Decision Networks – Value of Information – Decision Theoretic Expert Systems – Sequential Decision Problems – Value Iteration – Policy Iteration – Decision Theoretic Agents	CO2
UNIT III	**LEARNING METHODS**	9
	Learning from Observations - Forms of Learning – Inductive Learning – Learning Decision Trees – Ensemble Learning - Explanation Based Learning – Learning with Complete Data – Naïve Bayes Models – Learning with Hidden Variables – The EM Algorithm – Neural Networks	CO3
UNIT IV	**SOFTWARE AGENTS**	9
	Architecture for Intelligent Agents – Examples - Agent communication – KQML- KIF – FIPA ACL – Speech Acts - Argumentation among Agents – Trust and Reputation in Multi-agent systems	CO4
UNIT V	**ROBOTICS**	9
	Robot Hardware – Robotic Perception – Planning to Move, Planning Uncertain Movements – Moving – Robotic Software Architectures – Application Domains	CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Russell S and Norvig P, - Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Gerhard Weiss, - Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, Second Edition, The MIT Press, 2013.

REFERENCE BOOKS

1. Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011
2. David L. Poole and Alan K. Mackworth, - Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008.
4. Nils J. Nilsson,- The Quest for Artificial Intelligence, Cambridge University Press,2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire theoretical knowledge about principles for logic-based representation and reasoning
CO2	Develop a decision-making model that utilizes Artificial Intelligence.
CO3	Develop an understanding what is involved in learning models from data.
CO4	Select appropriately from a range of techniques when implementing intelligent systems
CO5	Gain knowledge on the functions of Robots

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3

DS1503	DATA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Learn data mining concepts understand association rules mining
- Discuss classification algorithms learn how data is grouped using clustering techniques
- To develop the abilities of critical analysis to data mining systems and applications
- To implement practical and theoretical understanding of the technologies for data mining
- To understand the strengths and limitations of various data mining models

UNIT	TITLE / CONTENT	PERIODS / CO
UNIT I	**INTRODUCTION**	9
	Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing, Data Cleaning, Missing data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binaryzation, Data Transformation; Measures of Similarity and Dissimilarity-Basics	CO1
UNIT II	**ASSOCIATION RULE**	9
	Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation; APRIOIRI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set- Maximal Frequent Item Set, Closed Frequent Item Set	CO2
UNIT III	**CLASSIFICATION**	9
	Problem Definition, General Approaches to solving a classification problem , Evaluation of Classifiers , Classification techniques, Decision Trees-Decision tree Construction , Methods for Expressing attribute test conditions, Measures for Selecting the Best Split, Algorithm for Decision tree Induction ; Naive-Bayes Classifier, Bayesian Belief Networks; K- Nearest neighbor classification-Algorithm and Characteristics	CO3
UNIT IV	**CLUSTERING**	9
	Problem Definition, Clustering Overview, Evaluation of Clustering Algorithms, Partitioning Clustering-K-Means Algorithm, K-Means Additional issues, PAM Algorithm; Hierarchical Clustering-Agglomerative Methods and divisive methods, Basic Agglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and Weakness; Outlier Detection	CO4
UNIT V	**WEB AND TEXT MINING**	9
	Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining –unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han, Micheline Kamber, Data Mining- Concepts and Techniques, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006
2. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Introduction to Data Mining, Pearson Education
3. Hongbo Du Cengage , Data mining Techniques and Applications, India Publishing

REFERENCE BOOKS

1. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press
2. T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Data Mining Principles & Applications, Elsevier
3. Vikaram Pudi, P Radha Krishna, Data Mining, Oxford University Press

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Apply suitable data pre-processing methods for the given dataset
CO2	Generate association rules using algorithms like Apriori, Frequent Pattern tree for the given problem
CO3	Analyze the performance of different classification algorithms
CO4	Use clustering techniques such as partitioning, hierarchical, density based for grouping data and processing massive data set
CO5	Classify web pages, extracting knowledge from the web

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	1	1	-	-	-	-	1	1	1	3	3	2
CO2	2	3	2	2	1	-	-	-	-	1	1	1	3	3	2
CO3	3	2	2	2	2	-	-	-	-	1	1	1	3	3	2
CO4	3	2	2	2	1	-	-	-	-	1	1	1	3	3	2
CO5	2	2	2	2	1	-	-	-	-	1	1	2	3	3	2

DS1504	EXPLORATORY DATA ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals Exploratory Data Analysis
- To understand the theoretical foundation of working with data.
- To learn essential statistical measures
- To understand time-series data and how to perform EDA on it.
- To get knowledge about quality on data analysis.

UNIT	TITLE	PERIODS / CO
UNIT I	**INTRODUCTION TO EXPLORATORY DATA ANALYSIS**	9
Exploratory Data Analysis Fundamentals - Understanding data science - The significance of EDA - Making sense of data - Comparing EDA with classical and Bayesian analysis - Software tools available for EDA - Visual aids for EDA – Types of Charts		CO1
UNIT II	**DATA TRANSFORMATION**	9
EDA with personal Email - Loading the dataset - Data transformation - Data Analysis - Merging database-style data frames - Transformation techniques - Benefits of Transformation		CO2
UNIT III	**DESCRIPTIVE STATISTICS, GROUPING DATASETS**	9
Understanding statistics - Measures of central tendency - Measures of dispersion - Grouping Datasets - Understanding groupby() - Data aggregation - Pivot tables and cross-tabulations - Correlation - Types of analysis - multivariate analysis using the Titanic dataset		CO3
UNIT IV	**TIME SERIES ANALYSIS, MODEL DEVELOPMENT AND EVALUATION**	9
Understanding the time series - Time Series Analysis with Open Power System - Hypothesis Testing and Regression - Hypothesis testing - p-hacking - Understanding regression - Model development and evaluation		CO4
UNIT V	**MACHINE LEARNING, EDA ON WINE QUALITY DATA ANALYSIS**	9
Types of machine learning - Supervised learning - Unsupervised learning - Reinforcement Learning - Unified machine learning workflow - Disclosing the wine quality dataset - Analyzing red wine - Analyzing white wine – Model Development and Evaluation		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data”, First Edition, Packt Publication, 2020.

REFERENCE BOOKS

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis”, Second Edition, Oreilly Publications, 2014.
2. Glenn J. Myatt and Wayne P. Johnson, “Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining”, Second Edition, Wiley Publications, 2014.
3. Glenn J. Myatt and Wayne P. Johnson, “Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods and Applications”, Wiley Publications, 2009.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamental concepts of exploratory data analysis using Python
CO2	Implement EDA with personal mail and to work with data transformation
CO3	Understand the variance and standard deviation of datasets
CO4	Describe the visualization and analysis of time series and survival calculations.
CO5	Understand different types of machine learning and to apply all the techniques learnt to perform EDA on a wine quality dataset.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

DS1507	DATA PREPARATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ Learn pre-processing method for multi-dimensional data
- ❖ Practice on data cleaning mechanisms
- ❖ Learn various data exploratory analysis
- ❖ Develop the visualizations for clusters or partitions

LIST OF EXPERIMENTS

Experiment	CO
1. DATA PRE-PROCESSING AND DATA CUBE Data pre-processing methods on student and labour datasets Implement data cube for data warehouse on 3-dimensional data	CO1
2. DATA CLEANING Implement various missing handling mechanisms, Implement various noisy handling mechanisms	
3. EXPLORATORY ANALYSIS Develop k-means and MST based clustering techniques, Develop the methodology for assessment of clusters for given dataset	CO2
4. ASSOCIATION ANALYSIS Design algorithms for association rule mining algorithms	
5. HYPTOTHYSIS GENERATION Derive the hypothesis for association rules to discovery of strong association rules; Use confidence and support thresholds	
6. TRANSFORMATION TECHNIQUES Construct Haar wavelet transformation for numerical data, Construct principal component analysis (PCA) for 5-dimensional data.	
7. DATA VISUALIZATION Implement binning visualizations for any real time dataset, Implement linear regression techniques	CO3
8. CLUSTERS ASSESSMENT Visualize the clusters for any synthetic dataset, Implement the program for converting the clusters into histograms	
9. HIERARCHICAL CLUSTERING Write a program to implement agglomerative clustering technique, write a program to implement divisive hierarchical clustering technique	
10. SCALABILITY ALGORITHMS Develop scalable clustering algorithms, Develop scalable a priori algorithm	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. SinanOzdemir, “Principles of Data Science”, Packt Publishers, 2016.

WEB REFERENCES

1. https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf
2. https://socialresearchmethods.net/kb/statprep.php
3. https://www.quest.com/solutions/data-preparation-and-analysis/

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Apply data pre-processing and data cleaning methods on multidimensional dataset
CO2	Apply various data exploratory analysis on the given dataset
CO3	Apply clustering algorithm to spilt the dataset and visualization technique to retrieve insights on the dataset

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2

DS1508	ADVANCED ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- ❖ To be able to reason under uncertainty of the real-world.
- ❖ To understand supervised learning techniques.
- ❖ To increase knowledge about learning with hidden variables.
- ❖ To understand how to use natural language processing.
- ❖ To get familiarized with basics of robotics.

LIST OF EXPERIMENTS

1. Implement a Python program of automatic Tic Tac Toe game using random number.	CO1
2. Apply Bayes' Rule to a scenario of drug screening, which is a mandatory testing for federal or many other jobs which promise a drug-free work environment.	
3. Demonstrate the application of Bayesian Network for the Monty Hall Problem. The Monty Hall problem is a brain teaser, in the form of a probability puzzle. Assume that you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?	
4. Write a Python program to create a fuzzy control system which models how you might choose to tip at a restaurant. When tipping, you consider the service and food quality, rated between 0 and 10. You use this to leave a tip of between 0 and 25%.	
5. Formulate a decision tree, which is applicable in the field of medical sciences that will help predict whether or not a patient has diabetes.	CO2
6. Implement Adaptive Boosting in Python for a simple fruit classification problem. Consider classification of the fruits into oranges or apples. The characteristics that are provided for the fruits to be classified are weight and size (diameter). Classify a new fruit as either apple or orange just based on the data on the size and weights.	
7. For a coin toss example with incomplete information, we have missing data and the problem of estimating θ, where θ is the probability of heads or tails is harder to solve. Apply Expectation Maximization (EM) Algorithm to start with a guess for θ, then calculate z, then update θ using this new value for z, and repeat till convergence. The label of the coin is indicated by z.	
8. Perform text classification for a real-world example. Consider a model capable of predicting whether a given movie review is positive or negative. Use people's sentiments which are classified into different categories and based upon the text classification give either a positive review or a negative review.	CO3
9. Given a robot which can only move in four directions, UP (U), DOWN (D), LEFT (L), and RIGHT®. Given a string consisting of instructions to move. Output the coordinates of a robot after executing the instructions. Initial position of robot is at origin (0, 0).	
10. A robot moves in a plane starting from the original point (0, 0). The robot can move toward UP, DOWN, LEFT and RIGHT with a given steps. Write a program to compute the distance from current position after a sequence of movement and original point. If the distance is a float, then just print the nearest integer.	
TOTAL : 60 PERIODS	

REFERENCE BOOKS
1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009. 2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.
WEB REFERENCES
1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm 2. https://machinelearningmastery.com/uncertainty-in-machine-learning/ 3. https://learn-robotics.com/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Approach a real-world problem, which is uncertain and provide appropriate reasoning.
CO2	Develop solutions using supervised learning techniques and know how to deal with problems with hidden variables.
CO3	Use natural language processing and program basics of robotics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

DS1601	MODERN SCRIPTING LANGUAGES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To become skilled at JavaScript and JQuery.
- To learn the concepts of Angular JS.
- To understand the basic framework of Node JS.
- To learn the various Features of PowerShell.
- To become familiar with the concepts of LINQ

UNIT I	**JAVASCRIPT AND JQUERY**	9
Introduction to JavaScript - Syntax - Variables and data types -JavaScript Control Statements - Functions -Objects - Fundamentals of JQuery –JQuery selectors - Traversing - Manipulators – Events		CO1
UNIT II	**ANGULAR JS**	9
Introduction to Angular JS –Directives –Expression –controllers –scope-events –services – Filters – Modules – Forms –Validation –Exception Handling		CO2
UNIT III	**NODE JS**	9
Introduction to Node JS – NPM – Callbacks –Events- Express Framework –Database Connectivity		CO3
UNIT IV	**POWER SHELL**	9
Introduction to Power shell –Variables –Operators –Arrays - Conditional Statements – Looping Statements Regular Expressions –File Operations		CO4
UNIT V	**LINQ**	9
Introduction to LINQ –Query Operators –SQL –XML – Objects –XML –Entities		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. "HTML 5 Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP & jQuery Black Book", Kogent Learning Solutions Inc., 2011
2. Pedro Teixeira, "Professional Node.js", John Wiley & sons, Inc., 2013

REFERENCE BOOKS

1. Valeri Karpov & Diego Netto, "Professional Angular JS", publication: John Wiley & sons, Inc., 2015
2. Bruce Payette, "Windows Powershell in Action", Manning Publication, 2011.
3. Fabrice Marguerie, Steve Eichert, Jim Wooley, "LINQ in Action", Manning Publication, 2008

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply JavaScript and JQuery to solve problems
CO2	Explore the Angular JS concepts
CO3	Understand and analyze the Node JS framework
CO4	Understand and analyze the Node JS framework
CO5	Understand LINQ Scripting language

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO2	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO3	2	2	3	1	1	-	-	1	-	-	1	2	2	2	2
CO4	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO5	2	2	3	1	1	-	-	1	-	-	1	2	2	2	2

DS1602	COMPUTATIONAL LINGUISTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Learn about expressing words
- Learn how to translate text to speech
- Learn the process of analysing a string of symbols
- Analyse the meaning of the word with and without considering the context
- Learn how to automatically extracting structured information

UNIT I	WORDS	9
Regular Expressions and Automata, Words and Transducers, N-grams, Part-of-Speech Tagging, Hidden Markov and Maximum Entropy Models		CO1
UNIT II	**SPEECH**	9
Phonetics, Speech Synthesis, Automatic Speech Recognition, Speech Recognition, Advanced Topics, Computational Phonology		CO2
UNIT III	**SYNTAX**	9
Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification Language and Complexity		CO3
UNIT IV	**SEMANTICS AND PRAGMATICS**	9
The Representation of Meaning, Computational Semantics, Lexical Semantics, Computational Lexical Semantics, Computational Discourse		CO4
UNIT V	**APPLICATIONS**	9
Information Extraction, Question Answering and Summarization, Dialog and Conversational Agents, Machine Translation		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, Second Edition

REFERENCE BOOKS

1. Ralph Grishman, Computational Linguistics: An Introduction, Studios in Natural Language Processing
2. Roland Hausser, Foundations of Computational Linguistics, Springer, Third Edition

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply regular expression to describe the word
CO2	Translate text to speech
CO3	Analyze the string of symbols
CO4	Analyze the meaning of the word with and without the context
CO5	Extract structured information automatically

MAPPING OF COs WITH POs AND PSOs													
COs	PROGRAM OUTCOMES (POs)										PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	1	-	-	1	1	3
CO2	3	2	2	1	1	-	-	1	-	-	1	1	3
CO3	3	2	2	1	1	-	-	1	-	-	1	1	3
CO4	3	2	2	1	1	-	-	1	-	-	1	1	3
CO5	3	2	2	1	1	-	-	1	-	-	1	1	3

DS1603	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand how accurately represent voluminous complex data set in web and from other data sources
- To understand the methodologies used to visualize large data sets
- To understand the process involved in data visualization and security aspects involved in data visualization

UNIT I	INTRODUCTION	9
Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.		CO1
UNIT II	**VISUALIZING DATA METHODS**	9
Mapping - Time series - Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics		CO2
UNIT III	**VISUALIZING DATA PROCESS**	9
Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.		CO3
UNIT IV	**INTERACTIVE DATA VISUALIZATION**	9
Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3, .js, tablo.		CO4
UNIT V	**SECURITY DATA VISUALIZATION**	9
Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems - Creating security visualization system.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Scott Murray, "Interactive data visualization for the web", O‟Reilly Media, Inc., 2013.

REFERENCE BOOKS

1. Ben Fry, "Visualizing Data", O‟Reilly Media, Inc., 2007.
2. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", No Starch Press Inc, 2007.
3. Alberto Cairo, "The Functional Art: An introduction to information graphics and visualization", New Riders, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design and create data visualizations.
CO2	Design and use various methodologies present in data visualization
CO3	Identify opportunities for application of data visualization in various domains.
CO4	Design and process the data for Virtualization.
CO5	Discuss the process involved and security issues present in data visualization

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2

DS1604	DATA ANALYTICS (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES

- To learn the fundamentals of data science and big data.
- To gain in-depth knowledge on descriptive data analytical techniques.
- Togainknowledgetoimplementsimpletocomplexanalytical.Algorithmsinbigdata frameworks.
- To develop programming skills using required libraries and packages to perform data analysis in Python.
- To under standand perform data visualization ,webscraping,machine learning and natural Language processing using various Data Science tools.

UNIT I	INTRODUCTION TO BIGDATA	9

Introduction to Big Data – Characteristics of Data – Evolution of Big Data – Big Data Analytics – Classification of Analytics – Top Challenges Facing Big Data – Importance of Big Data Analytics – Data Analytics Tools. Data Collections: Types of Data Sources - Sampling - Types of Data Elements - Visual Data Exploration and Exploratory - Statistical Analysis - Missing Values - Outlier Detection and Treatment - Standardizing Data - Categorization - Weights of Evidence Coding - Variable Selection – Segmentation. CO1

Lab Component:

1. Create and Analyze NYC Taxi Patterns: Develop a comprehensive framework to uncover, visualize, and analyze hidden patterns, correlations, and insights within the NYC Taxi and Limousine Commission (TLC) Trip Record Data. Utilize Apache Hadoop for optional data storage, Apache Spark for detailed data analysis, and Python libraries such as Pandas, Matplotlib, and Seaborn for advanced data manipulation and visualization techniques. Focus on exploring trip distances, fare amounts, trip durations, and other variables to extract meaningful insights into taxi and limousine usage patterns in NYC, including peak usage times and popular locations.
2. Develop a Predictive Model for Social Media Engagement: Construct a unified machine learning model framework using Apache Spark and the MLlib library, integrated with Python via the PySpark library, to predict user engagement metrics (likes, shares, comments) on a large social media platform dataset containing detailed user information. This task encompasses feature engineering to enhance predictive accuracy, model training, optimization through hyperparameter tuning and cross-validation, and a thorough evaluation of the model's performance in accurately forecasting user engagement levels.

UNIT II	DESCRIPTIVE DATA ANALYTICS	9

Types of Data Analysis – Descriptive, Diagnostic, Predictive and Prescriptive. Mean, Median and Mode – Standard Deviation and Variance – Probability – Probability Density Function – Types of Data Distribution – Percentiles and Moments – Correlation and Covariance – Conditional Probability – Bayes' Theorem – Introduction to Univariate, Bivariate and Multivariate Analysis – Dimensionality Reduction using Principal Component Analysis and LDA – Dimensionality CO2

<table>
<tr><td colspan="2">Reduction using Principal Component Analysis and Linear Discriminant Analysis (LDA) – Principal Component Analysis (PCA).
Lab Component:
3. Integrate Statistical Measures and Probability Analysis: Craft a comprehensive code base to perform statistical analysis and apply probability theories on a dataset, encompassing the calculation and summarization of mean, median, mode, standard deviation, and variance for dataset features. Develop visualizations to represent various data distributions and employ probability density function (PDF), percentiles, moments, correlation, and covariance to explore dataset characteristics further. Additionally, construct a practical application scenario for Bayes' Theorem, detailing the use of conditional probability to solve real-world problems demonstrated within the dataset context.
4. Implement and Compare Dimensionality Reduction Methods:Generate a succinct overview on the necessity of dimensionality reduction, highlighting the distinctions between feature selection and feature extraction methods. Execute Principal Component Analysis (PCA) to reduce dataset dimensions, creating visual aids to elucidate the variance captured by principal components and interpreting the implications of the reduced-dimensional space. Further, apply Linear Discriminant Analysis (LDA) to the same dataset with an aim to enhance class separability, and conduct a comparative analysis of PCA and LDA outcomes. Incorporate a simple multivariate analysis post-reduction to demonstrate the practical utility and insights gained from applying these dimensionality reduction techniques.</td><td></td></tr>
<tr><td>UNIT III</td><td>PREDICTIVE DATA ANALYTICS</td><td>9</td></tr>
<tr><td colspan="2">Linear Regression – Polynomial Regression – Multivariate Regression – Multi Level Models– Data Warehousing Overview – Bias/Variance Trade Off – K Fold Cross Validation – Data Cleaning and Normalization – Cleaning Web Log Data – Normalizing Numerical Data –Detecting Outliers – Introduction to Supervised and Unsupervised Learning – Reinforcement Learning – Dealing with Real World Data – Machine Learning Algorithms –Clustering –Python Based Application.
Lab Component:
5. Implement Regression Techniques and Data Pre-processing:Delve into regression analysis by writing code to apply linear regression, polynomial regression, and multivariate regression techniques on a selected dataset. Expand this analysis to include multi-level models, providing a robust framework for predicting outcomes based on various input variables. Complement this with a comprehensive data preprocessing phase, focusing on data cleaning, normalization, and outlier detection. This should include cleaning web log data, normalizing numerical data, and employing strategies to effectively manage and mitigate the bias/variance trade-off. Utilize Python for the implementation, ensuring a practical understanding of these concepts through application.
6. Explore Machine Learning Techniques with Real-World Data: Create a structured approach to understand and apply different machine learning paradigms, including supervised,</td><td>CO3</td></tr>
</table>

	unsupervised, and reinforcement learning, using Python-based applications. Focus on dealing with real-world data challenges by implementing K-fold cross-validation for model evaluation and exploring clustering techniques for data segmentation. Additionally, investigate a variety of machine learning algorithms to address specific problem types. The experiment should culminate in a project that applies these concepts to a real-world dataset, demonstrating the practical application of machine learning techniques to derive meaningful insights and predictions.	
UNIT IV	**DATA ANALYTICS FRAMEWORKS**	9
Introducing Hadoop –Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Processing Data with Hadoop – Introduction to MapReduce – NoSQL – MongoDB: RDBMS Vs MongoDB – Mongo DB Database Model – Data Types and Sharding – Introduction to Hive – Hive Architecture – Hive Query Language (HQL). PIG – Introduction to PIG. Lab Component: 7. Installation of Hadoop Framework, it's components and study the HADOOP ecosystem. 8. Write a program to implement word count program using MapReduce. 9. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication. 10. Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL Commands.		CO4
UNIT V	**DATA STREAMS AND VISUALIZATION**	9
Mining Data Streams – Stream Data Model – Sampling Data in stream- Filtering Stream – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window. Visual data analysis techniques-Interaction Techniques-Systems and applications - Analyzing big data with twitter- Big data for E-Commerce-Big data for blogs. Lab Component: 11. Develop a framework using Python and relevant libraries like Scikit-multiflow or MOA for real-time mining and analysis of data streams. Write code to model streaming data, effectively sample and filter stream content, implement algorithms for counting distinct elements, estimating moments, and managing time-sensitive data with decaying windows. The goal is to construct a practical application that demonstrates the handling and analysis of streaming data, emphasizing dynamic data processing techniques. 12. Craft a comprehensive codebase in Python, employing libraries such as Matplotlib, Seaborn for data visualization, Tweepy for Twitter data integration, and Beautiful Soup for blog data extraction. Develop visualizations to uncover trends, sentiments, and engagement patterns in social media data, specifically focusing on Twitter and blogs. Extend the analysis to explore the impact of big data on e-commerce strategies and blog content optimization, highlighting the use of predictive analytics in understanding consumer behavior and enhancing content engagement.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Frank Pane, “Hands On Data Science and Python Machine Learning”, Packt Publishers, 2017. 2. Baesens, Bart, “Analytics in a big data world : the essential guide to data science and its applications”. 3. Seema Acharya, Subhashini Chellapan, “Big Data and Analytics”, Wiley, 2015. 4. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets “, 2012.

REFERENCE BOOKS
1. Alberto Boschetti, Luca Massaron, “Python Data Science Essentials”, Packt Publications, 2nd Edition, 2016. 2. DT Editorial Services, Big Data, Black Book, Dream Tech Press, 2015. 3. Yuxi (Hayden) Liu, “Python Machine Learning”, Packt Publication, 2017. 3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunity in Huge Data Streams with advanced analytics, John Wiley & Sons, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the real-world business problems and model with analytical solutions.
CO2	Solve analytical problem with relevant mathematics background knowledge.
CO3	Convert any real-world decision-making problem to hypothesis and apply suitable Statistical testing.
CO4	Write and demonstrate simple applications involving analytics using Hadoop and MapReduce.
CO5	Use open-source frameworks for modeling and storing data and visualize using Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1607	DATA VISUALIZATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Understand how to apply ggplot for visualizing the data
- Understand how to visualize single variable
- Understand visualizing two or more variables
- Learn about customizing the plots with color and labels

LIST OF EXPERIMENTS

Experiment	CO
1. The built-in R data set quakes gives the locations of earthquakes off of Fiji in the 1960's. Create a plot of the locations of these earthquakes, showing depth with color and magnitude with size	CO1
2. Create a boxplot of highway mileage for each different cylinder in mtcars, and display on one plot with highway mileage on the y-axis and cylinder on the x-axis	
3. Create a barplot of the word lengths of the words in the data set, faceted by novel using austen data set from the fosdata package	
4. The pres_election data set gives voting results from the 2010-2016 U.S. presidential elections. Produce five bar charts, one for each election, that show the total number of votes received by each political party. Use facet_wrap to put all five charts into the same visualization.	
5. The pres_election data set gives voting results from the 2010-2016 U.S. presidential elections. Produce five bar charts, one for each election, that show the total number of votes received by each political party. Use facet_wrap to put all five charts into the same visualization.	
6. Create a scatterplot of highway mileage versus city mileage colored by the number of cylinders, using the mtcars data set. Experiment using categorical and sequential coloring.	CO2
7. In Emma, restrict to words that have non-zero sentiment score. Create a scatterplot of the percentage of words that have a positive sentiment score versus chapter. Add a line using geom_line or geom_smooth and explain your choice using austen data set from the fosdata package	
8. Make a scatterplot showing CO2 uptake as a function of concentration level for the built-in data set CO2. Include a smoothed fit line and color by Type. Facet your plot to one plot for each Plant	
9. Consider the ecars data set create a visualization showing scatterplots with the chargeTimeHrs variable on the x axis and the kwhTotal variable on the y axis. Facet your visualization with one plot per day of week and platform. Remove the web platform cars, so you have 14 facets in two rows and seven columns. Be sure your weekdays display in a reasonable order	
10. Consider the scotland_births data set in the fosdata package. This data set contains the number of births in Scotland by age of the mother for each year from 1945-2019. a. Create a line plot of births by year from 1945-2019 for each age group represented in the data. b. Highlight and color ages 20 and 30, and provide meaningful labels and titles	CO3

11. Consider the frogs data set in the fosdata package. This data was used to argue that a new species of frog had been found in a densely populated area of Bangladesh. Create a scatterplot of head length distance from tip of snout to back of mandible versus forearm length distance from corner of elbow to proximal end of outer palmar metacarpal tubercle, colored by species.

12. Use the babynames data set from the babynames package
    a. Make a line graph of the total number of babies of each sex versus year
    b. Make a line graph of the number of different names used for each sex versus year
    c. Make a line graph of the total number of babies with your name versus year. If your name doesn't appear in the data, use the name "Alexa"
    d. Make a line graph comparing the number of boys named Bryan and the number of boys named Brian from 1920 to the present

13. Use the Batting data set from the Lahman package, gives the batting statistics of every player who has played baseball from 1871 through the present day
    a. Create a scatterplot of the number of doubles hit in each year of baseball history.
    b. Create a scatterplot of the number of doubles hit in each year, in each league. Show only the leagues 'NL' and 'AL', and color the NL blue and the AL red
    c. Create boxplots for total runs scored per year in the AL and the NL from 1969 to the present
    d. Create a histogram of lifetime batting averages (H/AB) for all players who have at least 1000 career AB's.

FOR DATASET : Find Open Datasets and Machine Learning Projects | Kaggle

TOTAL : 60 PERIODS

WEB REFERENCES

1. Chapter 7 Data Visualization with ggplot | Foundations of Statistics with R (slu.edu)
2. **https://bookdown.org**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop plots such as histogram, bar plots, density plots, box plots and QQ plots by using single variable
CO2	Apply multivariable to develop plot such as scatter plot, line graphs, and faceting to visualize the data
CO3	Customize the plots with colors, labels and themes, text annotations, and highlighting

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2
CO2	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2
CO3	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2

DS1701	NEURO-FUZZY COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Get familiarized with different architectures and training algorithms of neural networks.
- ❖ Get exposed to the various neural modelling and control techniques with case study using simulation tool box.
- ❖ Gain Knowledge on fuzzy set theory and fuzzy rules.
- ❖ Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- ❖ Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box

UNIT	TITLE / CONTENT	
UNIT I	**ARTIFICIAL NEURAL NETWORK**	9
	Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perception – Limitation – Multilayer perception – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning	CO1
UNIT II	**NEURAL NETWORKS FOR MODELING AND CONTROL**	9
	Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture–Model validation – Control of non-linear systems using ANN – Direct and indirect Neuro control schemes – Adaptive Neuro controller – Familiarization with neural network toolbox	CO2
UNIT III	**FUZZY SET THEORY**	9
	Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions	CO3
UNIT IV	**FUZZY LOGIC FOR MODELING AND CONTROL**	9
	Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox	CO4
UNIT V	**HYBRID CONTROL SCHEMES**	9
	Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Case study – Familiarization with ANFIS toolbox	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000.

REFERENCE BOOKS

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989
2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992.
3. EthemAlpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.

4. Zhang Huaguang and Liu Derong, "Fuzzy Modeling and Fuzzy Control Series: Control Engineering", 2006

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the basics of artificial neural network architectures, algorithms and their limitations.
CO2	Get knowledge on modelling and control of neural network
CO3	Define the fuzzy sets, operations and relations to handle uncertainty
CO4	Get knowledge on modelling and control of fuzzy control schemes
CO5	Acquire knowledge on hybrid control schemes and particle swarm optimization

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1702	TEXT ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To get introduced to language processing technologies for processing the text data.
- To get introduced to Text analytics concepts and framework.
- To acquire knowledge on text data analytics and its classification using language models.
- To understand the need of Text similarity analysing and Clustering algorithms.
- To learn the theoretical techniques, tools and applications of text analytics.

UNIT I	INTRODUCTION TO NATURAL LANGUAGE PROCESSING	9
Natural Language Processing - Linguistic Background - Language syntax and structure - Grammar - Language Semantics - Mathematical Foundations - Morphological Analysis - Boundary Determination- Reading unstructured data - Representing text data - Text Analysis Framework.		CO1
UNIT II	**PROCESSING AND UNDERSTANDING TEXT**	9
Text Tokenization - Sentence Tokenization - Word Tokenization - Text Normalization - Cleaning Text -Tokenizing Text - Removing Special Characters - Expanding Contractions - Case Conversions - Removing Stop words - Correcting Words - Stemming - Lemmatization - Understanding Text Syntax and Structure - Installing Necessary Dependencies - Important Machine - Part of speech (POS) tagging - Shallow parsing - Dependency-based parsing - Constituency-based parsing.		CO2
UNIT III	**TEXT CLASSIFICATION**	9
Automated text classification - Text Normalization - Bag of words Model - TF-IDF Model - Classification Algorithms - Multinomial Naive Bayes - Support Vector Machines - Evaluating Classification Models - Building a Multi-Class Classification System - Application and uses.		CO3
UNIT IV	**TEXT SIMILARITY AND CLUSTERING**	9
Important concepts - Analysing Term Similarity - Analysing Document Similarity - Document Clustering - K Means - Affinity Propagation - Ward's Agglomerative Hierarchical Clustering - Semantic Analysis - Exploring WordNet - Word Sense Disambiguation - Named Entity Recognition - Analysing Semantic Representation - Proposition Logic - First Order Logic		CO4
UNIT V	**TEXT ANALYTICS APPLICATION**	9
Tools – Natural Language Tool kit, Apache OpenNLP. Applications of Text Analytics – Applications in Social media - Life science - Legal Text–Visualization -Case studies- Sentimental Analysis - Sentiment Analysis of IMDB Movie Reviews - Setting up Dependencies - Preparing Datasets - Supervised Machine Learning Technique - Unsupervised Lexicon - based Techniques - Comparing Model Performances.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2. Dipanjan Sarkar "Text Analytics with Python-A Practical Real-World Approach to Gaining Actionable Insights from Your Data", Apress ,2016

REFERENCE BOOKS	
1. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015. 2. Matthew A. Russell, “Mining the Social Web”, O'Reilly Media, 2013. 4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, 1 st Edition, O'Reilly Media, 2009. 3. James Allen, “Natural Language Understanding”, Second Edition, 2003, Pearson Education. 4. Daniel Jurafsky & James H.Martin, “ Speech and Language Processing”, Pearson Education (Singapore) Pte. Ltd., 2002. 5. Benjamin Bengfort, Rebecca Bilbro, Tony Ojeda ,” Applied Text Analysis with Python” ,1 st Edition, O'Reilly Media,2018	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Gain basic knowledge over language processing technologies for processing the text data.
CO2	Extract the key information from Text data and process it at semantic level.
CO3	Analyze the text content to provide predictions related to a specific domain using language models.
CO4	Interpret the results, gain insights, and recommend possible actions from analytics performed on text data
CO5	Perform a variety of NLP tasks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

DS1703	COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ To review image processing techniques for computer vision.
- ❖ To understand shape and region analysis.
- ❖ To understand Hough, Transform and its applications to detect lines, circles, ellipses.
- ❖ To understand three-dimensional image analysis techniques and motion analysis.
- ❖ To study some applications of computer vision algorithms.

UNIT I	**IMAGE PROCESSINGFOUNDATIONS**	9
Review of image processing techniques – classical filtering operations – thresholding techniques - edge detection techniques – corner and interest point detection – mathematical morphology – texture.		CO1
UNIT II	**SHAPESAND REGIONS**	9
Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.		CO2
UNIT III	**HOUGH TRANSFORM**	9
Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.		CO3
UNIT IV	**3D VISION AND MOTION**	9
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.		CO4
UNIT V	**APPLICATIONS**	9
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application- In-vehicle vision system- locating roadway – road markings – identifying road signs – locating pedestrians.		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Baggio D L et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

REFERENCE BOOKS

1. E. R. Davies, —Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
2. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
3. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
4. R. Szeliski, —Computer Vision: Algorithms and Applications‖, Springer 2011.
5. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement fundamental image processing techniques required for computer vision.
CO2	Implement boundary tracking techniques and perform shape analysis
CO3	Apply Hough Transform for line, circle, and ellipse detections.
CO4	Apply 3D vision techniques and implement motion relatedtechniques.
CO5	Develop applications using computer vision techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

DS1704	BIG DATA MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the differences and benefits of in-memory data management.
- To Understand the execution flow of a distributed query.
- To Identify the difficulties of scalability and parallelization.
- To Design a distributed database using NoSQL tools.
- To Produce a functional program to process Big Data in a Cloud environment.
- To Manage and process a Data Stream.
- To Design the architecture of a Big Data management system.

UNIT I	**INTRODUCTION**	9
Introduction to Big Data, Cloud Computing, Scalability - Big Data Design - Polyglot systems; Schema less databases; Key-value stores; Wide-column stores; Document-stores		CO1
UNIT II	**DATA MANAGEMENT**	9
Distributed Data Management: Transparency layers; Distributed file systems; File formats; Fragmentation; Replication and synchronization; Sharding; Consistent hash; LSM-Trees. In-memory Data Management: NUMA architectures; Columnar storage; Late reconstruction; Light-weight compression		CO2
UNIT III	**DATA PROCESSING**	9
Distributed Data Processing: Distributed Query Processing; Sequential access; Pipelining; Parallelism; Synchronization barriers; Multitenancy; Map Reduce; Resilient Distributed Datasets; Spark. Stream management and processing: One-pass algorithms; Sliding window; Stream to relation operations; Micro-batching; Sampling; Filtering; Sketching		CO3
UNIT IV	**DATA ANALYTICS FRAMEWORKS**	9
Big Data Architectures: Centralized and Distributed functional architectures of relational systems; Data Warehousing architectures; Service Oriented Architecture; Lambda architecture		CO4
UNIT V	**NOSQL DATA MANAGEMENT FOR BIG DATA**	9
Introduction to Big Data Storage Platforms for Large Scale Data Storage, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Introduction to Zookeeper and Paxos, Introduction to Cassandra, Cassandra Internals, Introduction to HBase, HBase Internals. NoSQL Databases: Schema-less Models: Increasing Flexibility for Data Manipulation-Key Value Stores-Document Stores - Tabular Stores - Object Data Stores - Graph Databases-Hive – Sharding. Bigtable: a distributed storage system for structured data.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mining of massive datasets - Leskovec, J.; Rajaraman, A.; Ullman, J.D, Cambridge University Press, 2020. ISBN: 9781108476348
2. In-memory data management - Plattner, H.; Zeier, A, Springer, 2012. ISBN: 9783642295744
3. Principles of distributed database systems - Özsu, M.T.; Valduriez, P, Springer, 2020. ISBN: 9783030262525.
4. NoSQL distilled: a brief guide to the emerging world of polygot persistence - Sadalage, P.J.; Fowler, M, Addison-Wesley, 2013. ISBN: 9780321826626

REFERENCE BOOKS
1. Zaharia, M ,An architecture for fast and general data processing on large clusters -, ACM Books, 2016.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Identify the real-world business problems and model with analytical solutions.
CO2	Understand the differences and benefits of in-memory data management.
CO3	Understand the execution flow of a distributed query.
CO4	Design the architecture of a Big Data management system.
CO5	Design a distributed database using NoSQL tools

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1707	NEURO-FUZZY COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Understand Fuzzy concepts
- Learn neural networks with back propagation and without preparation
- Learn the operators of genetic algorithms
- Practice on crisp partitions.

LIST OF EXPERIMENTS

Experiment	CO
1. Implementation of Perceptron.	CO1
2. Implementation of Perceptron Rule	
3. Implementation of Artificial Neural Networks	
4. Implementation of Fuzzy Sets	CO2
5. Implementation of Covariance	
6. Data Fitting by Regression	
7. Implementation of Crisp Model	
8. Implementation of Logic Gates	CO3
9. Implementation of Genetic Algorithms	
10. Implementation of Classification Algorithm	

TOTAL : 60 PERIODS

REFERENCE BOOK

1. D.K Prathikar, ―Soft Computing‖, Narosa Publishing House, New Delhi, 2008

WEB REFERENCES

1. http://mirlab.org/jang/book/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the implementation of Neural Network algorithms.
CO2	Design solutions for complex problems using Fuzzy set.
CO3	Design and apply Genetic and Classification Algorithms

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

SEMESTER V

PROFESSIONAL ELECTIVE – I

DS1511	XML AND WEB SERVICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of XML.
- To learn XML based technologies and SOAP
- To evaluate the technologies behind Web Services
- To learn to work with RESTful web services
- To implement and consume RESTful web services

UNIT I	**INTRODUCTION**	9
Role of XML - XML and the Web - XML Language Basics - SOAP - Web Services - Revolutions of XML - Service Oriented Architecture		CO1
UNIT II	**SOAP**	9
Overview Of SOAP - HTTP - XML-RPC - SOAP: Protocol - Message Structure - Intermediaries - Actors - Design Patterns And Faults - SOAP With Attachments		CO2
UNIT III	**WEB SERVICE TECHNOLOGIES**	9
Overview - Architecture - Key Technologies -UDDI - WSDL - ebXML - SOAP And Web Services In E-Com -Overview Of .NET And J2EE		CO3
UNIT IV	**INRTODUCTION TO RESFUL WEBSERVICES**	9
Kinds of Things on the Programmable Web - HTTP: Documents in Envelopes - Method Information - Scoping Information - The Competing Architectures - Technologies on the Programmable Web -Leftover Terminology - Web Services are Web Sites - del.icio.us: The Sample Application - Making the Request: HTTP Libraries - Processing the Response: XML Parsers -JSON Parsers: Handling Serialized Data - Clients Made Easy with WADL		CO4
UNIT V	**DEVELOPING AND CONSUMING RESTFUL WEB SERVICES**	9
9 Introducing the Simple Storage Service -Object-Oriented Design of S3 - Resources -HTTP Response Codes Resource URIs - Addressability - Statelessness - Representations - Links and Connectedness - The Uniform Interface –A Service Implementation.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Frank. P. Coyle, XML, Web Services And The Data Revolution, Pearson Education, 2002.
2. Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly Media, 2007.
3. Lindsay Bassett, Introduction to JavaScript Object Notation, O'Reilly Media, 2015.

REFERENCE BOOKS

1. Ramesh Nagappan, Robert Skoczylas and Rima Patel Sriganesh, "Developing Java Web Services", Wiley Publishing Inc., 2004.
2. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services", Pearson Education, 2004.
3. McGovern, et al., "Java Web Services Architecture", Morgan Kaufmann Publishers,2005

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand how to write XML documents
CO2	Apply XML based technologies and SOAP
CO3	Analyze the structure and implement Web Services
CO4	Understand and use RESTful web services
CO5	Create and Consume RESTful web service using JSON

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO2	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO3	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO4	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO5	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1

DS1512	R PROGRAMMING FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn basics and importance of R programming
- To define and manipulate R data structures, including vectors, factors, lists, and data frames.
- To read, write, and save data files and to tabulate the data using Factors
- To create artful graphs to visualize complex data sets and functions and to query the database
- To perform statistical analysis on variety of data

UNIT	TITLE / CONTENT	PERIODS / CO
UNIT I	**INTRODUCTION TO R PROGRAMMING**	9
	History and overview of R - Install and configuration of R programming environment - Starting and ending R, R as a scientific calculator, handling package, workspace, inspecting variables, operators and expressions in R- Conditions and Loops –Functions: built-in and user-defined functions.	CO1
UNIT II	**DATA STRUCTURES AND DATA MANIPULATION**	9
	Vectors - Combining multiple vectors - Arrays and Matrices, Lists – Creating lists - List operations – Applying functions to lists – Recursive lists, Data frames–Creating and Accessing Data frames - Merging Data Frames – Applying functions to Data frames, Data Transformation, Outlier Detection, String Operations - Regular Expressions - Date and Time Format	CO2
UNIT III	**WORKING WITH DATA**	9
	Reading CSV, Excel, and Built-in Datasets - Reading Text Files - Writing and Saving to Files - HTTP Request and REST API - Web Scraping: Working with Messy Data - Renaming Columns(Variable Names) - Attaching / Detaching - Tabulating Data: Constructing Simple Frequency Tables - Ordering Factor Variables	CO3
UNIT IV	**GRAPHICS AND VISUALIZATION**	9
	Visualize data using ggplot2package - Apply themes from ggthemes to refine and customize charts and graphs - Scatter Plots - Box Plots - Scatter Plots and Box and-Whisker Plots – Histograms - Building data graphics for dynamic reporting. Data Querying - Writing SQL statements - Using the Select, From, Where, Is, Like, Order By, Limit, Max, Min SQL functions.- Data wrangling with dplyr.	CO4
UNIT V	**STATISTICAL ANALYSIS**	9
	Importing data files, exporting data, outputting results, exporting - Performing data analysis tasks: R commands for descriptive statistics, data aggregation, representation of multivariate data, code factorization and optimization, statistical libraries in R.	CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Garrett Grolemund and Hadley Wickham, R for Data Science Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2016
2. Normal Maltoff, The Art of R programming O'Reilly Media, 2011

REFERENCE BOOKS

1. Purohit S. G., Gore S. D., Deshmukh S. K., “Statistics using R”, Narosa
2. Rizzo, M. L., “Statistical Computing with R”, Boca Raton, FL: Chapman & Hall/CRC Press
3. Learning resources:
   - R Project: http://www.r-project.org/
   - RStudio: http://www.rstudio.com
   - Quick-R: http://www.statmethods.net/

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand basics and importance of R programming
CO2	Understand data structures including vectors, factors, lists, and data frames.
CO3	Analyse the data files and to tabulate the data using Factors
CO4	Visualize complex data sets and functions and to query the database
CO5	Analyse and predict statistical data on variety of datasets

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2

DS1513	PROLOG PROGRAMMING FOR ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the background and basics of Prolog programming
- To learn the programming constructs to develop solution for specific problems
- To handle input and output operation through prolog and implementing data structure concepts
- To use prolog for artificial intelligence
- To apply prolog for machine learning, game playing and meta programming

UNIT I	AN OVERVIEW OF PROLOG	9
An Example program: defining family relations – extending the example program by rule – a recursive rule definition - how prolog answers questions – declarative and procedural meaning of programs; Syntax and meaning of Prolog Programs: Data objects – Matching – Declarative and Procedural meaning – Orders of clauses and goals; Relation between Prolog and Logic		CO1
UNIT II	PROGRAMMING CONSTRUTS	9
List – Operators – Arithmetic; Using Structures: Retrieving structured information from database – Data abstraction – simulating a non-deterministic automation – travel planning – Eight queen problem; Controlling Backtracking: Preventing backtracking – Examples using cut – Negation as failure – problems with cut and negation		CO2
UNIT III	I/O AND DATA STRUCTURES	9
Input and Output: Communication with files – Processing file of terms – Constructing and Decomposing atoms; Built-in Procedures – Programming Style and Techniques – Operations on Data Structures: Representing and sorting list – Representing sets by binary trees – Insertion and deletion in binary dictionary – Displaying trees – Graphs; Advanced Tree Representations: 2-3 dictionary – AVL-tree		CO3
UNIT IV	PROLOG IN ARTIFICIAL INTELLIGENCE	9
Basic problem solving strategies – Best Fit – Problem Reduction and AND/OR Graphs – Expert Systems and Knowledge Representation – An Expert System shell – Planning – Language Processing with Grammar Rule		CO4
UNIT V	MACHINE LEARNING, GAME PLAYING AND META-PROGRAMMING	9
Introduction: The problem of learning concepts – Learning concept by induction – A Program that learns relational descriptions – Learning simple attributional descriptions – Induction of decision trees – Success of learning; Game Playing: Two person – The minimax principle – The alpha-beta algorithm; Meta-Programming: Meta-programs and meta-interpreters – Prolog meta-interpreters – Explanation-based generalization – Object-oriented programming – Pattern directed programming		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison Wesley Publishing Company, Fourth Edition, 2012

REFERENCE BOOKS

2. Bramer M, Logic Programming with Prolog, Springer, 2013
3. Clocksin W, Mellish C S, Programming in Prolog, Springer, 2003

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the basics of prolog
CO2	Develop solutions using programming constructs
CO3	Implement data structure concepts using prolog
CO4	Apply prolog in artificial intelligence
CO5	Apply prolog to implement game programming and meta programming

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO2	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO3	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO4	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO5	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2

DS1514	DATA SCIENCE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of Data Science and import data on Tools
- To perform statistical tests using Data Science Tools.
- To perform specific statistical test using Data Science Tools
- To perform data storage, analysis and modeling using Data Science Tools.
- To learn visualization of data.

UNIT I	**INTRODUCTION**	9
Introduction to Data Tools – Why Data Science – Where to get data – Importing data into Excel, Apache Open Office, R and Rattle, Rstudio, KNIME.		CO1
UNIT II	**STATISTICAL TESTS USING TOOLS**	9
Descriptive Statistics using Excel, Open Office, RStudio / Rattle, KNIME - Cumulative Probability Charts using Excel, Open Office, RStudio / Rattle, KNIME – T – Test using Excel, Open Office, RStudio / Rattle, KNIME. - Correlation using using Excel, Open Office, RStudio / Rattle, KNIME – Regression using Excel, Open Office, RStudio / Rattle, KNIME – Confidence Interval using Excel, Open Office, RStudio / Rattle, KNIME – Random Sampling using using Excel, Open Office, RStudio / Rattle, KNIME.		CO2
UNIT III	**STATISTICAL METHODS FOR SPECIFIC TOOLS**	9
Power –R/ RStudio / Rattle. – F-Test – Excel, R/ Rstudio / Rattle. Benford – Rattle, Lift – KNIME, Wordcloud – R/Rstudio, KNIME. Filtering – All Tools.		CO3
UNIT IV	**DATASCIENCE TOOLS FOR DATA STORAGE**	9
Apache Hadoop – Microsoft HD insights – Data Science Tools for Exploratory Data Analysis – Informatica PowerCenter – RapidMiner. Data Science Tools for Data Modelling – H2o.ai – Data Robot.		CO4
UNIT V	**DATA VISUALIZATION TOOLS**	9
Data Science Tools for Visualization – Tableau – Qlikview. –DataScience Projects using R – Define Problem Statements – Data Cleaning – Data Exploration & Analysis – Data Modeling – Deployment & Optimzation.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Data Science Tools: R • Excel • KNIME • OpenOfficeby Christopher Greco , 2020.

REFERENCE BOOKS

1. Learning tableau 2019: Tools for business intelligence, data prep and visual analytics (3rd edition)
2. QlikView 11 for Developers, Barry Harsen

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concept of Data Science and import data on Tools
CO2	Perform statistical tests using Data Science Tools.
CO3	Perform specific statistical test using Data Science Tools
CO4	Perform data storage, analysis and modeling using Data Science Tools.
CO5	Learn visualization of data.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	2	2	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3

IT1514	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about first order logics
- To acquire knowledge about reasoning
- To apply object-oriented concepts for various expert systems
- To assess uncertainty using non monotonic logic
- To understand various action and planning strategies for problem solving

UNIT I	**INTRODUCTION**	9
Knowledge Representation and Reasoning – First order Logic – Syntax- Semantics Pragmatics – Expressing Knowledge – Levels of Representation – Knowledge Acquisition and Sharing – Sharing Ontologies – Language Ontologies –Language Patterns – Tools for Knowledge Acquisition		CO1
UNIT II	**RESOLUTION AND REASONING**	9
Proportional Case – Handling Variables and Quantifiers – Dealing with Intractability – Reasoning with Horn Clauses - Procedural Control of Reasoning – Rules in Production– Description Logic - Issues in Engineering		CO2
UNIT III	**REPRESENTATION**	9
Object Oriented Representations – Frame Formalism – Structured Descriptions – Meaning and Entailment - Taxonomies and Classification – Inheritance – Networks – Strategies for Defeasible Inheritance – Formal Account of Inheritance Networks		CO3
UNIT IV	**DEFAULTS, UNCERTAINTY AND EXPRESSIVENESS**	9
Defaults – Introduction – Closed World Reasoning – Circumscription – Default Logic imitations of Logic – Fuzzy Logic – Non monotonic Logic – Theories and World – Semiotics – Auto epistemic Logic - Vagueness – Uncertainty and Degrees of Belief – Non categorical Reasoning – Objective and Subjective Probability- linguistic fuzzy rule-based classification system - fuzzy cognitive maps- fuzzy for large data		CO4
UNIT V	**ACTIONS AND PLANNING**	9
Explanation and Diagnosis – Purpose – Syntax, Semantics of Context – First Order Reasoning Modal Reasoning in Context – Encapsulating Objects in Context – Agents – Actions – Situational Calculus – Frame Problem – Complex Actions – Planning –Strips– Planning as Reasoning – Hierarchical and Conditional Planning		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael K. Bergman “A Knowledge Representation Practionary: Guidance from Charles Sanders Peirce.” Springer -2018.
2. Ronald Brachman, Hector Levesque, “Knowledge Representation and Reasoning “, The Morgan Kaufmann Series, First Edition.

REFERENCE BOOKS

1. John F. Sowa, “Knowledge Representation: Logical, Philosophical, and Computational Foundations”, Brokes/Cole, First Edition, 2000.
2. Arthur B. Markman, “Knowledge Representation”, Lawrence Erlbaum Associates,1998.
3. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition,

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Formulate problem in first order logic and ontologies
CO2	Improve resolution and reasoning with horn clauses
CO3	Apply object-oriented abstractions for knowledge representation
CO4	Solve problems with uncertainty using fuzzy rules
CO5	Design and develop applications with action and planning

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

SEMESTER VI

PROFESSIONAL ELECTIVE – II

DS1611	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide a basic foundation towards digital image processing and video processing.
- To learn about image and video enhancement and restoration techniques.
- To provide Compression methods for image analytics applications.
- To Understand Compression methods for video analytics applications
- To learn about feature detection and description

UNIT I	INTRODUCTION TO DIGITAL IMAGE AND VIDEO PROCESSING	9
	Digital image representation, Sampling and Quantization, Types of Images, Basic Relations between Pixels - Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations, Introduction to Digital Video, Sampled Video, Video Transmission. Gray-Level Processing: Image Histogram, Linear and Non-linear point operations on Images, Arithmetic Operations between Images, Geometric Image Operations. Binary Image Processing: Image Thresholding, Region labeling, Binary Image Morphology	CO1
UNIT II	**IMAGE AND VIDEO ENHANCEMENT AND RESTORATION**	9
	Spatial domain - Linear and Non-linear Filtering, Morphological filtering, Frequency domain – Homomorphic Filtering, Blotch Detection and Removal - Blotch Detection, Motion Vector Repair and Interpolating Corrupted Intensities, Intensity Flicker Correction - Flicker Parameter Estimation, Brief introduction towards Wavelets, Wavelet based image denoising, Basic methods for image restoration using deconvolution filters	CO2
UNIT III	**IMAGE ANALYSIS**	9
	Image Compression: Huffman coding, Run length coding, LZW coding, Lossless Coding, Wavelets based image compression	CO3
UNIT IV	**VIDEO ANALYSIS**	9
	Video Compression: Basic Concepts and Techniques of Video Coding and the H.264 Standard, MPEG-1 and MPEG-2 Video Standards	CO4
UNIT V	**FEATURE DETECTION AND DESCRIPTION**	9
	Introduction to feature detectors, descriptors, matching and tracking, Basic edge detectors – canny, sobel, prewitt etc., Image Segmentation - Region Based Segmentation – Region Growing and Region Splitting and Merging, Thresholding – Basic global thresholding, optimum global thresholding using Otsu's Method	CO5
		TOTAL : 45 PERIODS

TEXT BOOK

1. Alan Bovik, Handbook of Image and Video Processing, Second Edition, Academic Press, 2005.
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Edition, Pearson Education, 2008.
3. Richard Szeliski, Computer Vision – Algorithms and Applications, Springer, 2011

REFERENCE BOOKS

1. Anil K Jain, Fundamentals of Digital Image Processing, PHI, 2011.
2. Oge Marques, Practical Image and Video Processing Using MatLab, Wiley, 2011.
3. John W. Woods, Multidimensional Signal, Image, Video Processing and Coding, Academic Press, 2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamental principles of image and video analysis
CO2	Apply different filters for enhancement of image and video
CO3	Investigate different coding techniques.
CO4	Comprehend different compression techniques for video.
CO5	Apply the image and video analysis approaches to solve real world problems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO2	2	3	2	3	3	-	-	-	-	2	2	2	3	3	3
CO3	1	2	2	3	3	-	-	-	-	2	2	2	3	3	3
CO4	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO5	1	2	3	3	3	-	-	-	-	2	2	2	3	3	3

DS1612	HEALTHCARE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To discuss the role of data analytics in Healthcare and Biomedical data.
- To understand advanced Healthcare data analytics.
- To Identify techniques for data processing
- To understand various optimization and generalization techniques
- To understand various data model

UNIT I	**INTRODUCTION**	9
Introduction to Healthcare Data Analytics- Healthcare Data Sources and Basic Analytics- Electronic Health Records - Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine- Natural Language Processing and Data Mining for Clinical Text - Mining the Biomedical Literature.		CO1
UNIT II	**ADVANCED HEALTHCARE DATA ANALYTICS**	9
Advanced Data Analytics: Advanced Data Analytics for Healthcare– Review of Clinical. Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.		CO2
UNIT III	**DEEP NETWORKS AND DIMENTIONALITY REDUCTION**	9
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning, Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.		CO3
UNIT IV	**OPTIMIZATION AND GENERALIZATION**	9
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.		CO4
UNIT V	**BIGDATA ANALTICS FRAMEWORKS**	9
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chandan K. Reddy and Charu C. Aggarwal,” Healthcare Data Analytics”, First Edition , Chapman & Hall /CRC Press 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCE BOOKS

1. Ross M. Mullner Edward M. Rafalski, “Healthcare Analytics – Foundations and Frontiers” First Edition, T&F/Routledge, 2020.
2. Hui Yang and Eva K. Lee, “Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.
3. El Morr, Christo, Ali-Hassan, Hossam ,“ Analytics in Healthcare”,springer 2019.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
6. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
7. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe the role of data analytics in healthcare institutions.
CO2	Describe advanced data analytics methods.
CO3	Apply data processing methods for processing healthcare data.
CO4	Apply Optimization and generalization Techniques.
CO5	Design Data Model that integrates healthcare data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO4	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2

DS1613	CLOUD COMPUTING FOR DATA ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of Cloud computing.
- To understand cloud storage
- To discuss serverless concept
- To provide basics of edge computing
- To develop projects pertaining to data science and cloud computing

UNIT I	**CLOUD COMPUTING FOUNDATIONS**	9
Overview of Cloud Computing – PaaS Continuous Delivery – IaC – Continuous Delivery for Hugo Static Site from Zero; Virtualization & Containerization: CPU – Memory – I/O – Elastic Resources – Kubernetes in the cloud		CO1
UNIT II	**CLOUD STORAGE**	9
Cloud Databases: HBase, MongoDB, Cassandra, DynamoDB, Google BigQuery;		CO2
UNIT III	**SERVERLESS**	9
FaaS (Function as a Service) - AWS Lambda - GCP Cloud Functions - Azure Functions - AWS Cloud-Native Primitives Overview - AWS Step Machines - AWS SQS - AWS SNS - AWS Cognito - AWS API Gateway		CO3
UNIT IV	**EDGE COMPUTING**	9
IoT Overview - AWS Greengrass - Raspberry Pi - Edge Machine Learning Solutions Overview - Google AutoML - Tensorflow lite - Intel Movidius - Apple X12		CO4
UNIT V	**DATA SCIENCE CASE STUDIES AND PROJECTS**	9
Case Study: Datascience meets intermittent fasting - Coronavirus Epidemic; Applied Computer Vision Overview; Project: AWS DeepLense Edge Computer Vision - Rasberry Pi - Intel Movidius Edge Computer Vision - Serverless Data Engineering Pipelines - Operationalizing Containerized Machine Learning Models - Continuous Delivery of GCP PaaS		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Noah Gift, Cloud Computing for Data Science, Pragmatic AI Labs, 2020

REFERENCE BOOKS

1. Francesco Diaz and Roberto Freato, Cloud Data Design, Orchestration, and Management Using Microsoft Azure, Apress

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the core concepts of the cloud computing paradigm.
CO2	Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems.
CO3	Apply AWS for problem solving
CO4	Comprehend edge computing
CO5	Develop data science models and apply them to solve problems on the cloud.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	2	2	-	2	2	2	2	3	2
CO2	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO3	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO4	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	2	2	-	2	2	2	2	3	2

DS1614	COMPUTATIONAL THINKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand different optimization problems.
- To learn about random and stochastic process
- To learn about simulation condition for optimization problems
- To provide students with an understanding of the role statistics.
- To use algorithms for classification and clustering problems.

UNIT I	**OPTIMIZATION PROBLEMS**	9
Knapsack problem: Greedy Algorithms – 0/1 Knapsack Problem; Graph Optimization Problem: Some classic Graph theoretical problems – Shortest Path: Depth first and Breadth first search; Dynamic Programming: Fibonacci sequences – 0/1 knapsack problem – divide and conquer		CO1
UNIT II	**RANDOM WALKS AND STOCHASTIC PROGRAMS**	9
Random walks – The Drunkard's walk – Biased Random walks – Treacherous Fields; Stochastic Programs – Calculating simple probabilities – Inferential Statistics – Distributions – Hashing and Collisions		CO2
UNIT III	**SIMULATION AND SAMPLING**	9
Monte Carlo Simulation: Pascal's Problem – Pass or Don't Pass? – Using Table Lookup to Improve Performance – Finding π; Sampling and Confidence intervals: Sampling the Boston Marathon – The Central Limit Theorem – Standard Error of the Mean; Understanding the experimental data: The behavior of springs – The behavior of Projectiles		CO3
UNIT IV	**RANDOMIZED TRIALS AND STATISTICS**	9
Checking significance – Beware of P-values – One tail and one sample tests – Multiple Hypothesis; Conditional Probability and Bayesian statistics: Conditional Probabilities – Bayes Theorem – Bayesian Updating; Lies, Demned Lies and statistics: Garbage In and Garbage Out – Sampling Bias – Context Matters		CO4
UNIT V	**CLUSTERING AND CLASSIFICATION**	9
A Quick Look at Machine Learning: Feature vectors – Distance Metrics; Clustering: Class cluster – k-means clustering – A Contrived Example – A Less Contrived Example; Classification Methods: Evaluating Classifiers – Predicting the Gender of Runner – k-nearest neighbors – Regression based classifiers – Surviving the Titanic		CO5
		TOTAL : 45 PERIODS

TEXT BOOK

1. John V Guttag, Introduction to Computation and Programming using python: with application to understanding data, MIT Press, Second Edition

REFERENCE BOOKS

1. Karl Beecher, Computational Thinking: A beginner's guide to problem solving and programming, BCS, The Charted Institute for IT

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand of the role computation in solving problems.
CO2	Apply stochastic models for problem solving
CO3	Apply probability theory for simulation
CO4	Apply statistical models for computation.
CO5	Develop projects pertaining to classification and clustering.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	-	-	1	-	-	1	1	3	3	2
CO2	3	3	2	1	1	-	-	1	-	-	1	1	3	3	2
CO3	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2
CO4	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2
CO5	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2

DS1615	ETHICS IN DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To apply ethical frameworks, guidelines, and codes to all phases of the analytics process.
- To describe the historical efforts in developing ethical practices in research.
- To identify how current standards provide a necessary but insufficient foundation for applying ethics in data science and analytics.
- To reflect on and acknowledge the centrality of the human in the analytics process.
- To distinguish between what an organization would like to do, what can be done technically, what can be done legally, and what should be done from an ethical perspective when performing and managing analytics projects.

UNIT I	**INTRODUCTION**	9
Ethics Review; Business Ethics; Elements of Big Data Ethics: Cambridge Analytica (example), Ethical Guidelines and Codes.		CO1
UNIT II	**ARTIFICIAL INTELLIGENCE**	9
Algorithmic Bias, Analyzing Behavioral Big Data: Methodological, Practical, Ethical, & Moral Issues, AI’s White Guy Problem Data Mining to Recruit Sick People License Plate Readers.		CO2
UNIT III	**RESEARCH ETHICS**	9
Necessary but Not Sufficient, Legal Frameworks; Regional (US, Europe, Asia) Differences, The 4R’s: Reuse, Repurposing, (Re)Combining, Reanalysis.		CO3
UNIT IV	**ETHICAL ISSUES**	9
Ethical Issues in Sports and Healthcare; Wearable Device Data; Ethical Issues in HR & Talent Analytics; Analytics for Social Good.		CO4
UNIT V	**CASE STUDY**	9
Facebook Mood Manipulation Facebook Faces New World Opioid Crisis; Disney / Staples Center Monitoring Is Alexa So Dangerous? Smart Toys; Reducing Costs of Employee Churn Boss Using Slack to Spy on You; Combatting Fake News Can AI Wipe Unconscious Bias? Child Abuse Prevention.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Davis, Kord, Ethics of Big Data, O’Reilly,

REFERENCE BOOKS

1. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O’Reilly Media.
2. Global Engineering Ethics (2017), by Heinz Luegenbiehl and Rockwell Clancy, Elsevier Press

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply ethical frameworks, guidelines, and codes to all phases of the analytics process.
CO2	Describe the historical efforts in developing ethical practices in research.
CO3	Identify how current standards provide a necessary but insufficient foundation for applying ethics in data science and analytics.
CO4	Reflect on and acknowledge the centrality of the human in the analytics process.

CO5	Distinguish between what an organization would like to do, what can be done technically, what can be done legally, and what should be done from an ethical perspective when performing and managing analytics projects.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO3	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO4	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO5	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2

SEMESTER VII

PROFESSIONAL ELECTIVE – III

DS1711	**DATA AND INFORMATION SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the data security fundamentals as well as Cryptography Theories, Algorithms and Systems.
- To apply the various Authentication Schemes to simulate different applications.
- To understand the various security standards, threats and vulnerabilities.
- To understand fundamentals of information security in various fields
- To understand various security services and their practices.

UNIT I	**DATA SECURITY FUNDAMENTALS**	9
Security trends – Security attacks, services and mechanisms – OSI security architecture -Types of Classical Encryption Techniques - Block Ciphers and stream ciphers - DES – AES -Public key cryptosystems - RSA-Diffie Hellman Key Exchange - Elliptic curve Cryptography.		CO1
UNIT II	**MESSAGE AUTHENTICATION AND INTEGRITY**	9
Authentication requirement – Authentication function – MAC – Hash function – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509-key distribution.		CO2
UNIT III	**SYSTEM SECURITY**	9
Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.		CO3
UNIT IV	**INFORMATION SECURITY**	9
Introduction-What is information security-Identification and Authentication-Authorization and Access Control-Auditing and Accountability-Operation Security.		CO4
UNIT V	**SECURITY PRACTICES**	9
Human Element Security -Physical Security-Mobile, Embedded and IoT Security-Application Security-Assessing security.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Cryptography and Network Security Principles and Practice, 6th Edition,Pearson Education,2014.
2. Jason Andress, Foundations of Information security (A Straightforward Introduction) no starch press,San Francisco,William Pollock,2019.

REFERENCE BOOKS

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and NetworkSecurity, Wiley India Pvt.Ltd, 2011.
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2, 2012.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the fundamentals of data security and apply the different cryptographic operations of symmetric and public cryptographic algorithms.
CO2	Apply the various Authentication schemes to simulate different applications.
CO3	Understand various System security standards, threats and vulnerabilities.
CO4	Understand fundamentals of information security in various fields.
CO5	Understand various security services and their security practices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	2	2

DS1712	EVOLUTIONARY COMPUTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the relations between the most important evolutionary algorithms presented in the course, new algorithms to be found in the literature now or in the future, and other search and optimisation techniques.
- Understand the implementation issues of evolutionary algorithms.
- Determine the appropriate parameter settings to make different evolutionary algorithms work well.
- Formulate a problem as an evolutionary computation search/optimization by specifying representations, selection and variation operators.
- Design new evolutionary operators, representations and fitness functions for specific practical and scientific applications.

UNIT I	INTRODUCTION	9
Optimization – Robust Adaptation – Machine Intelligence – Applications of Evolutionary Computation: Applications in Planning – Design – Simulation and Identification – Control – Classification; Principles of Evolutionary Processes - Principles of Genetics: Fundamental concepts in genetics – the gene – options for change – population thinking; Evolutionary Programming – Genetic Algorithms – Evolution strategies		CO1
UNIT II	**EVOLUTIONARY ALGORITUMS AND TUEIR STANDARDINSTANCES**	9
General outline of evolutionary algorithms – Genetic algorithms: basics and some variations – mutations and crossover – Representation – Parallel genetic algorithms; Evolution strategies: the archetype of evolution strategies – contemporary evolution strategies – nested evolution strategies; Evolutionary Programming - Derivative methods in genetic programming - Learning classifier systems - Hybrid methods		CO2
UNIT III	**REPRESENTATION**	9
Introduction to representations: Solutions and representations - Irnportant representations - Combined representations; Binary strings - Real-valued vectors; Permutations - Mapping integers to permutations - The mapping function - Matrix representations - Alternative representations - Ordering schemata and other metrics - Operator descriptions and local search; Finite-state representations - Parse trees - Other representations: Mixed-integer structures – Introns - Diploid representations		CO3
UNIT IV	**SELECTION**	9
Introduction to selection: Working mechanisms – Pseudocode - Theory of selective pressure; Proportional selection and sampling algorithms: Fitness functions - Selection probabilities – Sampling – Theory; Tournament selection - Rank-based selection - Boltzmann selection - Other selection methods - Generation gap methods - comparison of selection mechanisms - Interactive evolution		CO4
UNIT V	**SEARCH OPERATORS**	9
Mutation operators: Binary strings - Real-valued vectors - Permutations - Finite-state machines - Parse trees - Other representations; Recombination: Binary strings - Real-valued vectors - Permutations - Finite-state machines - Crossover: parse trees - Other representations - Multiparent recombination; Other operators: The Baldwin effect - Knowledge-augmented operators - Gene duplication and deletion		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas Bäck, David B Fogel and Zbigniew Michalewicz, Evolutionary Computation 1 - Basic Algorithms and Operators, Taylor & Francis

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Review the evolutionary computation techniques
CO2	Investigate evolutionary algorithms
CO3	Apply representation concept for evolutionary computation problems
CO4	Analyze selection operation concept for evolutionary computation problems
CO5	Formulate a problem as an evolutionary computation search/optimization by specifying representations, selection and variation operators.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	2	2	-	2	2	2	3	2	2
CO5	3	3	3	3	2	-	2	2	-	2	2	2	3	2	2

DS1713	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic pattern recognition concepts.
- Apply the mathematical foundations for recognition of patterns.
- Identify the pattern Recognition models.
- To study various pattern matching techniques.
- Apply the non-parametric techniques and clustering techniques in pattern Recognition in real time applications.

UNIT I	**INTRODUCTION**	9
Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis.		CO1
UNIT II	**STATISTICAL PATTERN RECOGNITION**	9
Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.		CO2
UNIT III	**MODELS**	9
Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models.		CO3
UNIT IV	**NON-PARAMETRIC TECHNIQUES**	9
Nonparametric Techniques: Density Estimation – Parzen Windows – K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification.		CO4
UNIT V	**CLUSTERING TECHNIQUES**	9
Unsupervised Learning and Clustering: Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation.		CO5

TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", Second Edition, John Wiley, 2006.
2. Bishop, Christopher M., "Pattern Recognition and Machine Learning", First Edition, Springer, 2009.
3. S. Theodoridis, K. Koutroumbas, "Pattern Recognition", Fourth Edition, Academic Press, 2009.
4. Keinosuke Fukunaga, "Introduction to Statistical Pattern Recognition", Second Edition, Academic Press, 2003.
5. Sergios Thedoridis, Konstantinos Koutroumbas, "Pattern Recognition", Fourth Edition, Academic Press, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basic pattern recognition concepts.
CO2	Apply the mathematical foundations for recognition of patterns.
CO3	Identify the pattern Recognition models.
CO4	To study various pattern matching techniques.
CO5	Apply various clustering algorithms

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

DS1714	WEB ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To be introduced to Web Analytics.
- Be aware of some Web-based Analytics and software products.
- Be aware of the different analytics tools.
- Learn Affiliate, Internet, and Referral Marketing.
- Understand advertising using analytics.

UNIT I	**INTRODUCTION**	9
Understanding web analytics – The foundations of Web analytics: Techniques and Technologies – Present and Future of Web analytics.		CO1
UNIT II	**DATA COLLECTION**	9
Importance and Options –Web server log files: Click stream data – User submitted information – Web server performance data – Page tags –First and third party tracking		CO2
UNIT III	**WEB ANALYTICS STRATEGY**	9
Key performance indicators – Web analytics process – Heuristics evaluations – Site visits – Surveys – Measuring reach – Measuring acquisition – Measuring conversion – Measuring retention – Security and privacy implications of Web analytics		CO3
UNIT IV	**WEB ANALYTICS TOOLS**	9
Content organization tools – Process measurement tools – Visitor segmentation tools – Campaign analysis tools – Commerce measurement tools – Google analytics – Omniture – Web trends – Yahoo! Web analytics		CO4
UNIT V	**GOOGLE ANALYTICS**	9
Key features and capabilities – Quantitative and qualitative data - Working of Google analytics – Privacy - Tracking visitor clicks, Outbound links and Non HTML files		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Bernard J. Jansen, Understanding User-Web Interactions via Web analytics, Morgan and Claypool, 2009.
2. Justin Cutroni, Google Analytics, O"Reilly, 2015.

REFERENCE BOOKS

1. Avinash Kaushik, Web Analytics2.0, John Wiley and Sons, 2010.
2. Brian Clifton, Advanced web metrics with Google analytics, John Wiley and Sons, 2012.
3. Jerri L. Ledford, Joe Teixeira and Mary E. Tyler, Google Analytics, John Wiley and Sons, 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the foundations of Web analytics
CO2	Compare and contrast the clickstream data collection techniques, their impact on metrics, and their inherent limitations
CO3	Apply web analytics techniques to effectively use the resulting insights to support website design decisions, campaign optimization, search analytics, etc
CO4	Understand the basics of software tools, techniques, and reports that are relevant to web analytics apply them to solve problems

CO5	Analyze and interpret web channel data and understand the difficulties and issues involved in it

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

MG1001	PRINCIPLE OF MANAGEMENT	L	T	P	C
	Common to CSE & AI-DS	3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9
	Definition of Management – Science or Art – Manager vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.	CO1
UNIT II	**PLANNING**	9
	Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.	CO2
UNIT III	**ORGANISING**	9
	Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority –77 centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management	CO3
UNIT IV	**DIRECTING**	9
	Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.	CO4
UNIT V	**CONTROLLING**	9
	System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

REFERENCE BOOKS

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Familiar with Management and Organizations task
CO2	Decision Making and Planning
CO3	Know about HRM, Performance Management, HR planning.
CO4	Communication and Motivational Theories
CO5	Familiar with controlling of process and reporting

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO2	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO4	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO5	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2

SEMESTER VII

PROFESSIONAL ELECTIVE – IV

DS1721	STOCHASTIC PROCESS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Study of the basic concepts of the theory of stochastic processes;
- Introduce of the most important types of stochastic processes;
- Study simplest and important classes of stochastic processes namely Poisson processes, Branching processes, Renewal Processes and Markov chains.
- Learn the applications of Stationary Processes

UNIT I	**INTRODUCTION TO STOCHASTIC PROCESSES**	9
Classification of Stochastic Processes, Markov Processes – Markov Chain - Countable State Markov Chain. Transition Probabilities, Transition Probability Matrix. Chapman - Kolmogorov's Equations, Calculation of n - step Transition Probability and its limit		CO1
UNIT II	**POISSON PROCESS**	9
Classification of States, Recurrent and Transient States - Transient Markov Chain, Random Walk and Gambler's Ruin Problem. Continuous Time Markov Process:, Poisson Processes, Birth and Death Processes, Kolmogorov's Differential Equations, Applications		CO2
UNIT III	**BRANCHING PROCESS**	9
Branching Processes – Galton – Watson Branching Process - Properties of Generating Functions – Extinction Probabilities – Distribution of Total Number of Progeny. Concept of Weiner Process		CO3
UNIT IV	**RENEWAL PROCESS**	9
Renewal Processes – Renewal Process in Discrete and Continuous Time – Renewal Interval – Renewal Function and Renewal Density – Renewal Equation – Renewal theorems: Elementary Renewal Theorem. Probability Generating Function of Renewal Processes		CO4
UNIT V	**STATIONARY PROCESS**	9
Stationary Processes: Discrete Parameter Stochastic Process – Application to Time Series. Auto-covariance and Auto-correlation functions and their properties. Moving Average, Autoregressive, Autoregressive Moving Average, Autoregressive Integrated Moving Average Processes. Basic ideas of residual analysis, diagnostic checking, forecasting		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.G Gallager, Stochastic Processes, Cambridge University Press, 2013.
2. S.M Ross, Stochastic Processes, Wiley India Pvt. Ltd, 2008

REFERENCE BOOKS

1. Stochastic Processes from Applications to Theory, P.D Moral and S. Penev, CRC Press, 2016
2. B..C. Liliana, A Viswanathan, S. Dharmaraja, Introduction to Probability and Stochastic Processes with Applications, Wiley Pvt. Ltd, 2012.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Classify a stochastic process, understand markov processes and handle discrete state markov chain properties with transition probability matrix.
CO2	Understand the classification of states of markov chain, continuous markov chain and Poisson processes
CO3	Explore the Branching processes
CO4	Explore the Renewal processes
CO5	Understand the Stationary Processes and apply the same for some real life applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO2	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO3	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO4	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO5	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2

DS1722	SOFTWARE TESTING USING AUTOMATED TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop and validate a test plan
- To select and prepare test cases
- To identify the need for testing
- To prepare testing policies and standards
- To use testing aids and tools

UNIT I	INTRODUCTION	9
Testing as an Engineering Activity – Testing as a Process – testing axioms - Basic Definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – cost of defects - Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support for Developing a Defect Repository – Defect Prevention Strategies – Software Testing Life cycle – V model		CO1
UNIT II	**TEST CASE DESIGN**	9
Test Case Design Strategies – Using Black Box Approach to Test Case Design - Random Testing – Requirements based testing –Boundary Value Analysis – Decision tables - Equivalence Cl ass Partitioning - State-based testing – Cause-effect graphing – Error guessing - Compatibility testing – User documentation testing –Domain testing Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing - Coverage and Control Flow Graphs – Covering Code Logic – Paths – Their Role in White–box Based Test Design –code complexity testing – Evaluating Test Adequacy Criteria		CO2
UNIT III	**LEVELS OF TESTING**	9
The Need for Levels of Testing – Unit Test – Unit Test Planning –Designing the Unit Tests - The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing - Regression Testing – Internationalization testing – Ad-hoc testing -Alpha , Beta Tests – testing OO systems – Usability and Accessibility testing – Configuration testing - Compatibility testing – Testing the documentation –Website testing –Static testing –reviews - walkthrough		CO3
UNIT IV	**TEST MANAGEMENT**	9
People and organizational issues in testing – organization structures for testing teams – testing services - Test Planning – Test Plan Components – Test Pl and Attachments – Locating Test Items – test. management – test process - Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group – Designing test cases using MS-Excel –Test Data management		CO4
UNIT V	**TEST AUTOMATION**	9
Software test automation – skills needed for automation – scope of automation – design and architecture for automation –requirements for a test tool – challenges in automation - Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing, understanding Testing framework with Selenium Web driver for automation testing		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson education, 2006. 2. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2012
REFERENCE BOOKS
1. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson,2007 2. Renu Rajani, Pradeep Oak, “Software Testing –Effective Methods, Tools and Techniques”,TMH 2004. 3. Rex Black (2001), Managing the Testing Process (2nd edition), John Wiley & Son 4. Dorothy Graham, Erik van Veenendaal, Isabel Evans, Foundations of software testing, Rex Black 5. Elfriede Dustin, Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the types of errors and fault models
CO2	Create test cases from requirements
CO3	Analyze use o various testing tools
CO4	Evaluate adequacy assessment using: control flow, data flow, and program mutations
CO5	Apply software testing techniques in commercial environments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO2	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO3	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO4	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO5	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1

DS1723	SOCIAL NETWORK ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To detect communities in social networks.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

UNIT I	**INTRODUCTION**	9
Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Statistical properties of social Networks-Definitions-Data Descriptions-Static properties- Dynamic properties-Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.		CO1
UNIT II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION**	9
Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.		CO2
UNIT III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS**	9
Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.		CO3
UNIT IV	**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES**	9
Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.		CO4
UNIT V	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS**	9
Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks-Random Walk based Proximity Measures -Clustering with random walk based measures-Algorithms for Computing Personalized PageRank and Sim Rank –Application-Computer Vision - Text Analysis - Collaborative Filtering - Combating Web Spam.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, 1st Edition, Springer, 2010.
3. Charu C. Aggarwal, “Social Network Data Analytics”, First Edition, Springer 2011.

REFERENCE BOOKS

1. David Camacho,Angel, Gema Bello and Antonio,”The Four Dimensions of Social Network Analysis: An Overview of Research Methods, Applications, and Software Tools” Feb 2020.
2. Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011.
3. John G. Breslin, Alexander Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop semantic web related applications.
CO2	Represent knowledge using ontology.
CO3	Detect communities in social networks.
CO4	Predict human behavior in social web and related communities.
CO5	Visualize social networks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	3	3	2	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2

DS1724	MULTIVARIATE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give mathematical and statistical background to handle the analysis involving multivariable.
- To explore the joint performance of the variables as well as to determine the effect of each variable in the presence of the others.
- To intelligently analyze data using appropriate multivariate methods
- Likelihood ratio tests, MANOVA models, Discriminate procedures and Factor analysis are included with the objective to handle and understand the concept of exploratory and confirmatory data analysis

UNIT	TITLE	HOURS / CO
UNIT I	**INTRODUCTION**	9
	Basic concepts on multivariate variable. Multivariate normal distribution, Marginal and conditional distribution, Concept of random vector: Its expectation and Variance-Covariance matrix. Marginal and joint distributions. Conditional distributions and Independence of random vectors. Multinomial distribution. Sample mean vector and its distribution	CO1
UNIT II	**DISTRIBUTION**	9
	Sample mean vector and its distribution. Likelihood ratio tests: Tests of hypotheses about the mean vectors and covariance matrices for multivariate normal populations. Independence of sub vectors and sphericity test	CO2
UNIT III	**MULTIVARIATE ANALYSIS**	9
	Multivariate analysis of variance (MANOVA) of one and two- way classified data. Multivariate analysis of covariance. Wishart distribution, Hotelling's T2 and Mahalanobis' D2 statistics, Null distribution of Hotelling's T2. Rao's U statistics and its distribution	CO3
UNIT IV	**CLASSIFICATION AND DISCRIMINANT PROCEDURES**	9
	Bayes, minimax, and Fisher's criteria for discrimination between two multivariate normal populations. Sample discriminant function. Tests associated with discriminant functions. Probabilities of misclassification and their estimation. Discrimination for several multivariate normal populations	CO4
UNIT V	**PRINCIPAL COMPONENT and FACTOR ANALYSIS**	9
	Principal components, sample principal components asymptotic properties. Canonical variables and canonical correlations: definition, estimation, computations. Test for significance of canonical correlations. Factor analysis: Orthogonal factor model, factor loadings, estimation of factor loadings, factor scores. Applications	CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Anderson, T.W. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Edition, John Wiley.
2. Everitt B, Hothorn T, 2011. An Introduction to Applied Multivariate Analysis with R, Springer.
3. Barry J. Babin, Hair, Rolph E Anderson, and William C. Blac, 2013, Multivariate Data Analysis, Pearson New International Edition

REFERENCE BOOKS

1. Giri, N.C. 1977. Multivariate Statistical Inference. Academic Press.
2. Chatfield, C. and Collins, A.J. 1982. Introduction to Multivariate analysis. Prentice Hall

3. Srivastava, M.S. and Khatri, C.G. 1979. An Introduction to Multivariate Statistics. North Holland

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Describe properties of multivariate distributions such as multivariate normal.
CO2	Do Likelihood ratio tests on mean vectors and covariance matrices , understand and interpret the computations of the critical values associated with these tests
CO3	Do Testing of various hypotheses for multivariate analysis of variance (MANOVA) models
CO4	Discriminate between groups and classify new observations using various discriminate procedures
CO5	Use principal component analysis effectively for data exploration and data dimension reduction. Use factor analysis effectively for exploratory and confirmatory data analysis.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO2	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO3	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO4	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO5	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2

MG1725	ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about how to establish a company
- To know how to find financial resources
- To learn the survival skills in accounting and financial management
- To know the fundamentals of finance and marketing
- To know about intellectual properties and prepare patents

UNIT I	**HOW TO ESTABLISH THE COMPANY**	9
The Founder and Team –Legal Procedure –Executive Summary –Management and Organization – Product/Service – Business Plan –Marketing Plan –Operating and Control Systems –Micro and Mac ro Environmental Fa ctors – Growth Plan –Financial Plan		CO1
UNIT II	**HOW TO FIND FINANCIAL RESOURCES**	9
Debt and Equity: Stock or Loan –Partnership –Venture Capital/Angel Money –Bank Loans – Research Funds: Small Business Innovation Research Programs –Successful Proposal Writing – Successful Proposal Presentation		CO2
UNIT III	**SURVIVAL SKILLS IN ACCOUNTING AND FINANCIAL MANAGEMENT**	9
Accounting Management –Sales and Payroll: Daily Accounting –Financial Statements –Demand, Supply, and Market Equilibrium –Break-even Analysis –Tax reduction considerations - Cash Flow Analysis		CO3
UNIT IV	**FUNDAMENTALS OF FINANCE AND MARKETING**	9
Key Financial Ratios –Financial forecasting –Time Value of Money –Short-term Financing – Investment Decisions – Marketing Research: The Five P's of Marketing Research – Target Marketing – Marketing Research Examples, Portfolio Model, Marketing Mix Four P's: Product, Price, Place, Promotion		CO4
UNIT V	**INTELLECTUAL PROPERTIES**	9
Intellectual Properties –Why is Intellectual Properties important –Patent preparation –Patent infringement (Law suits)		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kenji Uchino, "Entrepreneurship for Engineers", CRC Press, 2010 Second book

REFERENCE BOOKS

1. Paul Swamidass, "Engineering Entrepreneurship from Idea to Business Plan", Cambridge University Press, 2016.
2. Hisrich, "Entrepreneurship", Tata McGraw Hill, 9th Edition, 2014

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know how to establish a company
CO2	Understand how to find financial resources
CO3	Determine the survival skills in accounting and financial management
CO4	Understand the fundamentals of finance and marketing
CO5	Know about intellectual properties and patent preparation

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO2	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO3	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO4	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO5	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1

SEMESTER VIII

PROFESSIONAL ELECTIVE – V

DS1811	**DATA MINING AND INFORMATION SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand data pre-processing and data visualization techniques.
- To study algorithms in pattern mining.
- To understand and apply various classification and clustering techniques using tools.
- To study advanced concepts in Information security and Risk management.
- To understand and apply security technologies.

UNIT I	**DATA MINING – INTRODUCTION**	9
Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques– Issues – applications- Data Objects and attribute types, Statistical description of data, Data Visualization, Data similarity and dissimilarity measures, Data Preprocessing: Cleaning, Integration, Reduction, Transformation and discretization.		CO1
UNIT II	**PATTERN MINING**	9
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods-Frequent Itemset Mining Methods-Advanced Pattern Mining: Pattern Mining in Multilevel, Multidimensional Space-Constraint-Based Frequent Pattern Mining-Mining High-Dimensional Data and Colossal Patterns-Mining Compressed or Approximate Patterns-Pattern Exploration and Application		CO2
UNIT III	**CLASSIFICATION AND CLUSTERING**	9
Basic concepts-Decision Tree Induction - Bayes Classification Methods– Rule Based Classification – Model Evaluation and Selection-Techniques to Improve Classification Accuracy-Advanced methods: Bayesian Belief Networks-Classification by Back Propagation – Support Vector machines –– Lazy Learners - Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering Graph and Network Data-Clustering with constraints.		CO3
UNIT IV	**INFORMATION SECURITY: ADVANCED CONCEPTS**	9
The need for security-legal, Ethical and professional issues-Risk management: Risk Identification, Risk Assessment, Risk control strategies-selecting a risk control strategy.		CO4
UNIT V	**SECURITY TECHNOLOGY AND IMPLEMENTATION**	9
Intrusion detection and prevention systems-Honeypots and honeynets-Scanning and analysis tools-Biometric access control-Information security project management-Technical aspects of implementation-information security maintenance.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition,Elsevier, 2012.
2. Michael e Whitman, Herbert J Mattord,“Principles of Information security”,Fourth Edition,2011

REFERENCE BOOKS

1. Charu C. Aggarwal ,Jiawei Han , “Frequent Pattern Mining”, Springer,2014.
2. Malcolm W. Harkins, “Managing Risk and Information Security”, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Apply suitable pre-processing and visualization techniques for data analysis
CO2	Apply frequent pattern and association rule mining techniques for data analysis
CO3	Apply appropriate classification and clustering techniques for data analysis
CO4	Apply concepts in Information security and Risk management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO2	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO3	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO4	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO5	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2

DS1812	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I	FUNDAMENTALS OF SPEECH PROCESSING	9
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		CO1
UNIT II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	9
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.		CO2
UNIT III	**SPEECH RECOGNITION**	9
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		CO3
UNIT IV	**TEXT ANALYSIS**	9
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		CO4
UNIT V	**SPEECH SYNTHESIS**	9
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. James Whitaker, John Liu, and Uday Kamath, Deep learning for NLP and Speech Recognition,Springer,2019.
2. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
3. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
5. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
6. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
CO2	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
CO3	Justify the use of formant and concatenative approaches to speech synthesis
CO4	Identify the apt approach of speech synthesis depending on the language to be processed
CO5	Determine the various encoding techniques for representing speech.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

DS1813	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students should be able to understand.
- The difference between threat, risk, attack and vulnerability.
- How threats materialize into attacks.
- Where to find information about threats, vulnerabilities and attacks.
- Typical threats, attacks and exploits and the motivations behind them.

UNIT	TITLE / CONTENT	
UNIT I	**INTRODUCTION TO CYBER SECURITY**	9
	Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks	CO1
UNIT II	**SECURITY IN OPERATING SYSTEM & NETWORKS**	9
	Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.	CO2
UNIT III	**DEFENCES: SECURITY COUNTERMEASURES**	9
	Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.	CO3
UNIT IV	**PRIVACY IN CYBERSPACE**	9
	Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed.	CO4
UNIT V	**MANAGEMENT AND INCIDENTS**	9
	Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security.	CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
4. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe and understand the basics of the ethical hacking
CO2	Perform the foot printing and scanning - Demonstrate the techniques for system hacking
CO3	Characterize the malware and their attacks and detect and prevent them
CO4	Determine the signature of different attacks and prevent them
CO5	Detect and prevent the security attacks in different environments

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO2	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO3	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO4	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO5	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2

DS1814	PREDICTIVE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, logistic regression, support vector machines and , K-nearest –Neighbour classifiers.
- To know the use of the binary classifier and numeric predictor nodes to automate model selection.
- To advice on when and how to use each model.
- Also learn how to combine two or more models to improve prediction
- To learn about supervised and unsupervised learning

UNIT I	LINEAR METHODS FOR REGRESSION AND CLASSIFICATION	9
Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Perceptron learning algorithm.		CO1
UNIT II	**MODEL ASSESMENT AND SELECTION**	9
Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Esimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, conditional or expected test error.		CO2
UNIT III	**ADDITIVE MODELS, TREES AND BOOSTING**	9
Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples (Spam data, California housing, NewZealand fish, Demographic data)		CO3
UNIT IV	**NEURAL NETWORKS(NN) , SUPPORT VECTOR MACHINES(SVM), AND K-NEAREST NEIGHBOR**	9
Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest –Neighbour classifiers(Image Scene Classification)		CO4
UNIT V	**UNSUPERVISED LEARNING AND RANDOM FORESTS**	9
Association rules, Cluster analysis, Principal Components, Random forests and analysis.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. G.James,D.Witten,T.Hastie,R.Tibshirani-An introduction to statistical learning with applications in R,Springer,2013.
2. E.Alpaydin, Introduction to Machine Learning, Prentice Hall Of India,2010.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009.
4. C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications regression and classifications.
CO2	Design and implement model assessment and selection.
CO3	Develop and implement applications using additive models.
CO4	Develop applications using neural network and support vector machine.
CO5	Design applications using cluster and random forest analysis.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3

DS1815	STATISTICAL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand probability distributions, random number generation and density estimations to analysis the different kind of data
- To learn Monte Carlo experiments and sampling techniques
- To learn statistical analysis on data
- To understand statistical tests using tools
- To understand statistical analysis using graphical and numerical methods

UNIT I	DESCRIPTIVE STATISTICS	9
	Diagrammatic representation of data, measures of central tendency, measures of dispersion, measures of skewness and kurtosis, correlation, inference procedure for correlation coefficient, bivariate correlation, multiple correlations, linear regression and its inference procedure, multiple regression. Probability: Measures of probability, conditional probability, independent event, Bayes' theorem, random variable, discrete and continuous probability distributions, expectation and variance, markov inequality, chebyshev's inequality, central limit theorem.	CO1
UNIT II	**INFERENTIAL STATISTICS**	9
	Sampling & Confidence Interval, Inference & Significance. Estimation and Hypothesis Testing, Goodness of fit, Test of Independence, Permutations and Randomization Test, ttest/z-test (one sample, independent, paired), ANOVA, chi-square. Linear Methods for Regression Analysis: multiple regression analysis, orthogonalization by Householder transformations (QR); singular value decomposition (SVD); linear dimension reduction using principal component analysis (PCA)	CO2
UNIT III	**PSEUDO-RANDOM NUMBERS AND MANTE CARLO INTEGRATION**	9
	Pseudo-Random Numbers: Random number generation, Inverse-transform, acceptance-rejection, transformations, multivariate probability calculations. Monte Carlo Integration: Simulation and Monte Carlo integration, variance reduction, Monte Carlo hypothesis testing, antithetic variables/control variates, importance sampling, stratified sampling Markov chain Monte Carlo (McMC): Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence	CO3
UNIT IV	**RESAMPLING METHODS, DENSITY ESTIMATION, & NUMERICAL METHODS**	9
	Resampling Methods: Cross-validation, Bootstrapping, Jackknife resampling, percentile confidence intervals, permutation tests Density Estimation: Univariate density estimation, kernel smoothing, multivariate density estimation Numerical Methods: Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization; EM (Expectation Maximization) algorithm; simplex algorithm	CO4
UNIT V	**INTRODUCTION TO R PROGRAMMING**	9
	History of R programming, starting and ending R, R as a scientific calculator, handling package, workspace, inspecting variables, operators and expressions in R, data objects and types, vectors, matrices and arrays, lists and data frames, built-in and user-defined functions , strings and factors, flow control and loops, advanced looping, date and times. Using R for statistical analysis: Importing data files, exporting data, outputting results, exporting graphs, graphics in R, interactively adding information of plot, performing data analysis tasks. R commands for descriptive statistics, data aggregation, representation of multivariate data, code factorization and optimization, statistical libraries in R	CO5

TOTAL : 45 PERIODS
REFERENCE BOOKS
1. S.C. Gupta & V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons 2. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Press 3. Dudewicz, E.J., Mishra, S.N., “Modern Mathematical Statistics”, Willy 4. Purohit S. G., Gore S. D., Deshmukh S. K., “Statistics using R, Narosa 5. Rizzo, M. L., “Statistical Computing with R”, Boca Raton, FL: Chapman & Hall/CRC Press

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand and apply the probability distributions, random number generation and density estimations to perform analysis of various kinds of data
CO2	Understand and manipulate data, design and perform simple Monte Carlo experiments, and be able to use resampling methods
CO3	Perform statistical analysis on variety of data
CO4	Perform appropriate statistical tests using R and visualize the outcome
CO5	Discuss the results obtained from their analyses after creating customized graphical and numerical summaries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2

DS1816	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To outline an overview of exploratory data analysis and phases involved in data analytics
- To acquire an in-depth knowledge in EDA techniques
- To experiment the data visualization
- To describe the methods of time series analysis
- To explain the basics of tree and hierarchical representation of big data

UNIT I	EXPLORATORY DATA ANALYSIS	9
EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA		CO1
UNIT II	**EDA TECHNIQUES**	9
Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques -Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.		CO2
UNIT III	**VISUALIZING DATA**	9
The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping-Location, Data, two sided data ranges, smooth interpolation of values over time		CO3
UNIT IV	**TIME SERIES ANALYSIS**	9
Overview of time series analysis-showing data as an area, drawing tabs, handling mouse input, Connections And Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues		CO4
UNIT V	**TREES, HIERARCHIES, AND RECURSION**	9
Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Suresh Kumar Mukhiya and Usman Ahmed, "Hands-on Exploratory Data Analysis with Python", Packt publishing , March 2020.
2. Ben Fry, "Visualizing Data", O'reilly publications, 2007.

REFERENCE BOOKS

1. Danyel Fisher & Miriah Meyer, "Making Data Visual: A Practical Guide To Using Visualization For Insight", O'reilly publications, 2018.
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. EMC Education Services, "Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley Publishers, 2015.
4. Tamara Munzner, "Visualization Analysis and Design", A K Peters/CRC Press; 1st edition, 2014. 5. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Explain the overview of exploratory data analysis and phases involved in data analytics
CO2	Explore in-depth knowledge in EDA techniques
CO3	Apply the visualization techniques in data

CO4	Describe the methods of time series analysis
CO5	Represent the data in tree and hierarchical formats

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2
CO2	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	2	1	2	3	3	2

SEMESTER VIII

PROFESSIONAL ELECTIVE – VI

DS1821	COGNITIVE SYSTEMS	L	T	P	C
	Common for AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To provide an understanding of the central challenges in realizing aspects of human cognition.
- To provide a basic exposition to the goals and methods of human cognition.
- To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
- To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

UNIT I	INTRODUCTION TO COGNITIVE SCIENCE	9
Understanding Cognition, IBM's Watson, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition.		CO1
UNIT II	**MODELS**	9
Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics.		CO2
UNIT III	**COGNITIVE MODELING**	9
modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.		CO3
UNIT IV	**INDUCTIVE GENERALIZATION**	9
Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks.		CO4
UNIT V	**APPLICATION**	9
DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Formal Approaches in Categorization by Emmanuel M. Pothos, Andy J. Wills, Cambridge University Press,2012.
2. Cognition, Brain and Consciousness: Introduction to Cognitive Neuroscience by Bernard J. Bears, Nicole M. Gage, Academic Press,2013.
3. Cognitive Computing and Big Data Analytics by Hurwitz, Kaufman, and Bowles, Wiley,2012.
4. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press,2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand what cognitive computing and it's models
CO2	Understand how it differs from traditional approaches.
CO3	Plan and use the primary tools associated with cognitive computing.
CO4	Plan and execute a project that leverages cognitive computing.
CO5	Understand and develop the business implications of cognitive computing.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2

DS1822	PARALLEL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the development of parallel and massively parallel systems.
- To understand the challenges in heterogeneous processing systems.
- To Use shared programming models for parallel programs.
- To learn to program heterogeneous systems.
- To learn to provide effective parallel solutions for GPGPU architectures.

UNIT I	PARALLEL COMPUTING BASICS	9
Importance of Parallelism – Processes, Tasks and Threads – Modifications to von-Neumann model – ILP – TLP – Parallel Hardware – Flynns Classification – Shared Memory and Distributed Memory Architectures – Cache Coherence – Parallel Software – Performance – Speedup and Scalability – Massive Parallelism – GPUs – GPGPUs.		CO1
UNIT II	**SHARED MEMORY PROGRAMMING WITH OPENMP**	9
OpenMP Program Structure – OpenMP Clauses and Directives – Scheduling Primitives – Synchronization Primitives – Performance Issues with Caches – Case Study – Tree Search.		CO2
UNIT III	**PROGRAMMING GPUS**	9
GPU Architectures – Data Parallelism – CUDA Basics – CUDA Program Structure – Threads, Blocks, Grids – Memory Handling.		CO3
UNIT IV	**PROGRAMMING WITH CUDA**	9
Parallel Patterns – Convolution – Prefix Sum – Sparse matrix – Vector Multiplication – Imaging Case Study.		CO4
UNIT V	**OTHER GPU PROGRAMMING PLATFORMS**	9
Introduction to OpenCL – OpenACC – C++AMP – Thrust – Programming Heterogeneous Clusters – CUDA and MPI.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Peter Pacheco, "Introduction to Parallel Programming", Morgan Kauffman, 2011.
2. David B. Kirk, Wen–mei W. Hwu, "Programming Massively Parallel Processors", Third Edition, Morgan Kauffman, 2016.

REFERENCE BOOKS

1. Shane Cook, "CUDA Programming – A Developers Guide To Parallel Computing with GPUs", Morgan Kauffman, 2013.
2. B.R. Gaster, L. Howes, D.R. Kaeli, P. Mistry, D. Schaa, " Heterogeneous Computing with OpenCL 2.0", Morgan Kauffman, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify and Choose the right parallel processing paradigm for a given problem.
CO2	Write parallel programs using OpenMP
CO3	Devise solutions for an application on a heterogeneous multi-core platform.
CO4	Program GPUs using CUDA / OpenCL.
CO5	Compare characteristics of and evaluate different GPU programming platforms.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2

DS1823	BIO-INSPIRED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT	TITLE	
UNIT I	**INTRODUCTION**	9
Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.		CO1
UNIT II	**RANDOM WALK AND ANEALING**	9
Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.		CO2
UNIT III	**GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION**	9
Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.		CO3
UNIT IV	**SWARM OPTIMIZATION AND FIREFLY ALGORITHM**	9
Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients- Ant colony optimization toward feature selection.		CO4
UNIT V	**APPLICATION IN IMAGE PROCESSING**	9
Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016.

REFERENCE BOOKS

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014.
4. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement and apply bio-inspired algorithms
CO2	Explain random walk and simulated annealing
CO3	Implement and apply genetic algorithms
CO4	Explain swarm intelligence and ant colony for feature selection
CO5	Apply bio-inspired techniques in image processing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2

DS1824	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic components of Storage System Environment.
- To understand the Storage Area Network Characteristics and Components.
- To examine emerging technologies including IP-SAN.
- To consider the factors which optimize the information retrieval process;
- To examine current issues in information retrieval.

UNIT I	STORAGE SYSTEMS	9
Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.		CO1
UNIT II	**STORAGE NETWORKING TECHNOLOGIES**	9
Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.		CO2
UNIT III	**ADVANCED STORAGE NETWORKING AND VIRTUALIZATION**	9
IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.		CO3
UNIT IV	**BUSINESS CONTINUITY**	9
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.		CO4
UNIT V	**REPLICATION**	9
Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its technologies, Network Infrastructure.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, ―Storage Networks: The Complete Reference―, Tata McGraw Hill, Osborne, 2003.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Select from various storage technologies to suit for required application.
CO2	Apply theories to effectively solve information retrieval problems in real world situations.
CO3	Apply security measures to safeguard storage & farm.
CO4	Analyze QoS on Storage.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO2	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO3	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO4	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO5	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2

MG1825	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Acquire knowledge of economics to facilitate the process of economic decision making
- To analyze cost/revenue data and carry out make economic analyses in the decision-making process to justify or reject alternatives/projects on an economic basis.
- To obtain professional licensure
- To function in the business and management side of professional engineering practice.
- Prepare engineering and computer science students to write technical reports.

UNIT I	INTRODUCTION TO ECONOMICS	9
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.		CO1
UNIT II	**VALUE ENGINEERING**	9
Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.		CO2
UNIT III	**CASH FLOW**	9
Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.		CO3
UNIT IV	**REPLACEMENT AND MAINTENANCE ANALYSIS**	9
Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.		CO4
UNIT V	**DEPRECIATION**	9
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Pravin Kumar, “ Engineering Economy Management” Wiley Publication,2019.
2. R.Panneerselvam, “Engineering Economics”, PHI, 2013.

REFERENCE BOOKS

1. Zahid A. Khan , Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi , “Principles of Engineering Economics with Applications”, Cambridge,Second Edition, 2018.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Evaluate the economic theories, cost concepts and pricing policies
CO2	Understand the market structures and integration concepts
CO3	Understand the measures of national income, the functions of banks and concepts of globalization
CO4	Provide the students with a basic understanding of replacement analysis.
CO5	Understand ethical business practices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2

OPEN ELECTIVES – I & II

OBT101	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

UNIT I	**OVERVIEW OF THE CELL**	9
Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.		CO1
UNIT II	**MICROBIAL GROWTH: PURE CULTURE TECHNIQUES**	9
Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures. Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.		CO2
UNIT III	**MANAGEMENT OF WASTE**	9
Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting		CO3
UNIT IV	**BIOREMEDIATION**	9
Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex-situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.		CO4
UNIT V	**BIOENERGY AND BIOMINING**	9
Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,

REFERENCE BOOKS

1. Environmental Biotechnology - Allan Stagg.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	2	2	3	2	1	1	1	2	1	1
CO2	2	1	1	2	2	1	2	1	3	3	1	2	1	1	2
CO3	3	3	2	1	1	2	3	3	1	2	3	3	1	2	2
CO4	3	3	2	3	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	3	2	3	3	2	1	2	3	1	1	2	2

OBT104	BIOSENSORS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	**PROTEIN BASED BIOSENSORS**	9
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		CO1
UNIT II	**DNA BASED BIOSENSOR**	9
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		CO2
UNIT III	**ELECTRO CHEMICAL APPLICATION**	9
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		CO3
UNIT IV	**FABRICATION OF BIOSENSORS**	9
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		CO4
UNIT V	**BIOSENSORS IN RESEARCH**	9
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products

CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	2	1	2	2	3	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	3	1	2	1	1	2
CO3	1	2	3	3	1	2	3	3	1	2	3	3	1	2	2
CO4	1	2	2	3	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	3	3	2	1	2	3	1	1	2	2

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT I	**BASICS OF NANOTECHNOLOGY**	9
Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.		CO1
UNIT II	**DIFFERENT CLASSES OF NANOMATERIALS**	9
Classification based on dimensionality-Quantum Dots,Wells and Wires - Carbon based nano materials (buckyballs, nanotubes, grapheme) - Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		CO2
UNIT III	**SYNTHESIS OF NANOMATERIALS**	9
Chemical Methods: Metal Nanocrystals by Reduction -Sol - gel processing - Solvothermal Synthesis - Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		CO3
UNIT IV	**CHARACTERIZATION OF NANOSTRUCTURES**	9
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)- Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		CO4
UNIT V	**APPLICATIONS**	9
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices -Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)

2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	Develop an ability to critically evaluate the promise of a nanotechnology device.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	3	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	3	1	2	1	1	2
CO3	1	2	3	3	1	2	3	3	1	2	3	3	1	2	2
CO4	1	2	2	3	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	3	3	2	1	2	3	1	1	2	1

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data models.
- To know the details of data input and topology
- To know the knowledge on data management and output processes
- To know the data quality and standards

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open-source Software - Types of data – Spatial, Attribute data-types of attributes – scales/ levels of measurements.		CO1
UNIT II	**SPATIAL DATAMODELS**	9
Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector ModelsTIN and GRID data models - OGC standards - Data Quality.		CO2
UNIT III	**DATA INPUT AND TOPOLOGY**	9
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.		CO3
UNIT IV	**DATA ANALYSIS**	9
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.		CO4
UNIT V	**APPLICATIONS**	9
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition,2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver,Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2ndEdition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems,

Prentice-Hall India Publishers,2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO2	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2
CO3	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO4	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO5	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration and management.
- To know the market related research process and its HRM
- To understand the recruitment and training processes in hospitals
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I	**OVERVIEW OF HOSPITAL ADMINISTRATION**	9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		CO1
UNIT II	**HUMAN RESOURCE MANAGEMENT IN HOSPITAL**	9
Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.		CO2
UNIT III	**RECRUITMENT AND TRAINING**	9
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		CO3
UNIT IV	**SUPPORTIVE SERVICES**	9
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		CO4
UNIT V	**COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL**	9
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press, 1995.
4. William A. Reinke "Health Planning For Effective Management" - Oxford University Press.1988
5. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and issues in supporting departments of hospitals
CO5	Understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1

OEC103	BASICS OF EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IoT

UNIT	TITLE	
UNIT I	**INTRODUCTION TO EMBEDDED SYSTEM**	9
	Complex systems and microprocessors– Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques–Design example: Model train controller.	CO1
UNIT II	**BASICS OF ARM ARCHITECTURE AND PERIPHERAL INTERFACING**	9
	ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU	CO2
UNIT III	**EMBEDDED PROGRAMMING CONCEPTS**	9
	Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing	CO3
UNIT IV	**INTRODUCTION TO IoT**	9
	Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT - Passive and active sensors - Different applications of sensors - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.	CO4
UNIT V	**COMMUNICATION PROTOCOLS FOR EMBEDDED AND IoT**	9
	Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - Wi-Fi, Bluetooth, ZigBee.	CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Marilyn Wolf, —Computers as Components - Principles of Embedded Computing System Design‖, Third Edition —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons", Inc, USA, 2013

REFERENCE BOOKS

a. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons Ltd, UK, 2014

b. Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd, UK, 2015.

c. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi" , 1st Edition, Apress Publishers, USA, 2013.

d. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	2	1	2	-	1	2	2	3	3	2
CO2	3	3	2	3	-	3	1	2	-	1	2	2	3	3	2
CO3	3	3	2	3	3	3	1	2	1	1	2	2	3	3	2
CO4	3	3	3	3	-	2	1	2	-	1	2	2	3	3	2
CO5	3	3	3	3	2	3	1	2	1	1	2	2	3	3	2

OEE101	BASIC CIRCUIT THEORY		L	P	T	C
			3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I	**BASIC CIRCUITS ANALYSIS**	9
Resistive elements - Resistors in series and parallel circuits; Ohm's Law; Kirchoffs laws – methods of analysis-Mesh current and node voltage.		CO1
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS**	9
Network reduction- voltage and current division, source transformation, star delta conversion; Network theorems- Thevenins and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		CO2
UNIT III	**ANALYSIS OF AC CIRCUITS**	9
Introduction to AC circuits- Inductive reactance, Capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor; RL, RC , RLC networks; Network reductions- voltage and current division, source transformation; Mesh and node analysis; Network theorems- Thevenins and Norton Theorems, Superposition Theorem , Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		CO3
UNIT IV	**THREE PHASE CIRCUITS**	9
A.C. circuits – Average and RMS value, Phasor Diagram, Power, Power Factor and Energy; Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced; phasor diagram of voltages and currents; power measurement in three phase circuits.		CO4
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	9
Series and parallel resonance – frequency response, Quality factor and Bandwidth; Self and mutual inductance; Coefficient of coupling; Tuned circuits – Single tuned circuits.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.

2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”,Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd.,New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”,McGraw Hill, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to introduce electric circuits and its analysis
CO2	Ability to impart knowledge on solving circuit equations using network theorems
CO3	Ability to introduce the phenomenon of resonance in coupled circuits.
CO4	Ability to introduce Phasor diagrams and analysis of three phase circuits
CO5	Ability to impart knowledge on resonance and coupled circuits

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEE103	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	P	T	C
		3	0	0	3

OBJECTIVES

- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

UNIT I	**INTRODUCTION**	9
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.		CO1
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	9
Reference theory fundamentals-principle of operation and analysis: IG and PMSG		CO2
UNIT III	**POWER CONVERTERS**	9
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers		CO3
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	9
Standalone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system		CO4
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	9
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan, "Non-conventional Energy Sources", Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCE BOOKS

1. Muhammad H. Rashid, "Power Electronics Hand Book", Third Edition, Butterworth- Heinemann, 2015.
2. Ion Boldea, "Variability Speed Generators", Second Edition, CRC Press, 2015.
3. Rai. G.D, "Non- conventional Energy Sources", Khanna Publishers, 2004.
4. Gray, L. Johnson, "Wind Energy Systems", Prentice Hall, 2006.
5. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", Third Edition, Wiley India Pvt. Ltd, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to understand and analyze power system operation, stability, control and protection.
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization.
CO3	Ability to understand the stand alone and grid connected renewable energy systems.
CO4	Ability to design of power converters for renewable energy applications.
CO5	Ability to acquire knowledge on wind electrical generators and solar energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	**FUNDAMENTALSOF ROBOT**	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.		CO1
UNIT II	**ROBOT DRIVE SYSTEMS ANDEND EFFECTORS**	9
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		CO2
UNIT III	**SENSORS AND MACHINEVISION**	9
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		CO3
UNIT IV	**ROBOT KINEMATICS AND ROBOTPROGRAMMING**	9
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		CO4
UNIT V	**IMPLEMENTATION ANDROBOTECONOMICS**	9
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill,2001.

REFERENCE BOOKS

1. **Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education,2008.**
2. **Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co.,1994.**
3. **Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co.,1992.**
4. **Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.**
5. **Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill,1995.**
6. **Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company,2008.**
7. **Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd.,1991.**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functions of the basic components of a Robot.
CO2	Study the use of various types of End of Effectors and Sensors
CO3	Understand Sensors and Machine Vision of Robot
CO4	Understand Robot Kinematics and Robot Programming
CO5	Understand the Implementation of Robots in Industries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	2	3	2	1	2
CO2	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO3	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO4	3	2	1	2	2	-	-	-	-	2	2	3	3	2	2
CO5	2	2	1	2	2	-	-	-	-	2	2	3	2	2	2

OMB101	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3
OBJECTIVES ❖ To learn the quality philosophies and tools in the managerial perspective.		
UNIT I	**INTRODUCTION**	9
Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		CO1
UNIT II	**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**	9
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology		CO2
UNIT III	**STATISTICAL PROCESS CONTROL**	9
Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations.		CO3
UNIT IV	**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**	9
Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.		CO4
UNIT V	**QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**	9
Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011 2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
REFERENCE BOOKS
1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008. 2. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005. 3. Poornima M.Charantimath, Total Quality Management, Pearson Education, First Indian Reprint 2003. 4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able:

CO1	To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.
CO2	To understand the principles of business process improvement
CO3	To understand and apply the concepts of statistical process control
CO4	To apply the tools and techniques used for quality management
CO5	To understand the methods in organizing and implementation of quality systems

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948
- To familiarize students with powers of inspectorate of factories
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.
- To prepare onsite and offsite emergency plan.

UNIT I	**FACTORIES ACT – 1948**	9
Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948		CO1
UNIT II	**ENVIRONMENT ACT – 1986**	9
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.		CO2
UNIT III	**MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**	9
Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.		CO3
UNIT IV	**OTHER ACTS AND RULES**	9
Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act		CO4
UNIT V	**INTERNATIONAL ACTS AND STANDARDS**	9
Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO2	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO3	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO4	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO5	2	2	-	-	1	2	2	2	2	2	2	2	1	1	1

OTHER COURSES OFFERED BY CSE

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (LAB INTEGRATED)	L	T	P	C
	Common to EEE and EIE	3	0	2	4

OBJECTIVES

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table.

UNIT I	C PROGRAMMING BASICS	9 + 6
	Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays. **Lab Component** • Implementation of basic c programs a. Find greatest of three numbers b. Create a simple Calculator • Implementation of array a. Computing Mean, Median and Mode b. Matrix Addition	CO1
UNIT II	FUNCTIONS, POINTERS AND STRUCTURES	9 + 6
	Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation. **Lab Component** • Implementation of user defined data types a. Computation of Sine series. b. Swapping of two numbers and changing the value of a variable using pass by reference	CO2
UNIT III	LINEAR DATA STRUCTURES	9 + 6
	List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue. **Lab Component** • Implementation of linear data structure a. List implementation of List, Stack, Queue. b. Implement polynomial addition using list. c. Evaluate arithmetic expression.	CO3
UNIT IV	NON-LINEAR DATA STRUCTURES	9 + 6

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs. **Lab Component** • Implementation of tree a. Construct binary search tree. b. Traverse the binary tree recursively in pre-order, post-order and in-order. • Graph traversal a. Depth first search b. Breadth first search.	**CO4**

UNIT V	**SEARCHING, SORTING AND HASH TABLE**	**9 + 6**
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling. **Lab Component** • Sorting & Searching a. Insertion sort b. Merge sort c. Linear Search d. Binary Search		**CO5**

THEORY : 45 PERIODS	**PRACTICAL : 30 PERIODS**	**TOTAL : 75 PERIODS**

TEXT BOOKS

1. Reema Thareja, ―Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**											**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

CS1516	VISUAL PROGRAMMING	L	T	P	C
	Common to EEE and EIE	3	0	0	3

OBJECTIVES

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variability's, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB

UNIT I	FUNDAMENTALS OF WINDOWS AND MFC	9
Messages : Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.		CO1
UNIT II	**RESOURCES AND CONTROLS**	9
Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.		CO2
UNIT III	**DOCUMENT / VIEW ARCHITECTURE**	9
The in existence function revisited – Document object – View object – Frame window object Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in app wizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializability classes.		CO3
UNIT IV	**FUNDAMENTALS OF VISUAL BASIC**	9
Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming. Variabilitys: Declaration – Types – Converting variability types – User defined data types - Lifetime of a variability. Constants - Arrays – Types of arrays. Procedures: Subroutines –		CO4

Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.		
UNIT V	**DATABASE PROGRAMMING WITH VB**	9
Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Tability def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements–Cursortypes and locking mechanism–Manipulating the record set object – Simple record editing and updating.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted,2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications,2002.

REFERENCE BOOKS

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, McGraw Hill, reprinted,2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', McGraw Hill, Reprinted,2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Tech media Pub,1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand study about the concepts of windows programming models.
CO2	Understand the concepts of Menu basics, menu magic and classic controls.
CO3	Understand the concept of Document/View Architecture with single & multiple document interface.
CO4	Understand the integrated development programming event driven document interface.
CO5	Understand the database and the database management system programming.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2
CO5	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2

OPEN ELECTIVE COURSES OFFERED BY CSE, IT, AI-DS & AI-ML

OCS101	INTRODUCTION TO C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts in C Programming Language.
- To understand Input and Output Statements.
- To enhance analyzing and problem solving skills and use the same for writing programs in C.
- To familiarize the basic syntax in arrays and pointers
- To provide exposure to problem-solving through programming

UNIT I	INTRODUCTORY CONCEPTS & C FUNDAMENTALS	9
Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants.		CO1
UNIT II	**OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS**	9
Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement		CO2
UNIT III	**FUNCTIONS & PROGRAM STRUCTURE**	9
Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions		CO3
UNIT IV	**ARRAYS & POINTERS**	9
Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions		CO4
UNIT V	**STRUCTURES, UNIONS & DATA FILES**	9
Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.

REFERENCE BOOKS	
1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition. **2.** Let Us C Yashavant kanetkar, BPB	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify situations where computational methods and computers would be useful.
CO2	Demonstrate the use of operators, input and output statements and control statements
CO3	Identify solution to a problem and apply control structures and user defined functions for solving the problem
CO4	Demonstrate the use of numeric arrays and pointers
CO5	Demonstrate the ability to design creative solutions to real life problems faced by the industry.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS102	PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT I	**C PROGRAMMING BASICS**	9
Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays.		CO1
UNIT II	**FUNCTIONS, POINTERS AND STRUCTURES**	9
Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation.		CO2
UNIT III	**LINEAR DATA STRUCTURES**	9
List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue..		CO3
UNIT IV	**NON-LINEAR DATA STRUCTURES**	9
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs.		CO4
UNIT V	**SEARCHING, SORTING AND HASH TABLE**	9
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges
- To have knowledge on the various virtualization techniques that serve in computation and storage services on the cloud
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT	TITLE / CONTENT	
UNIT I	**INTRODUCTION**	9
Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing		CO1
UNIT II	**VIRTUALIZATION**	9
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization		CO2
UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	9
NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage.		CO3
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	9
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.		CO4
UNIT V	**CASE STUDIES**	9
Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons,2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press,2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill,2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill,2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly,2009.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	1	-	-	-	-	-	2	1	-	-	-	2	-	-	1
CO5	2	1	1	-	2	2	-	-	2	-	-	3	2	2	2

OCS104	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of Transaction Processing and concurrency
- To have an basic knowledge about the Storage implementation and query processing
- To understand database security concepts and database programming

UNIT I	INTRODUCTION	9
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL		CO1
UNIT II	**DATABASE DESIGN**	9
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form		CO2
UNIT III	**TRANSACTION CONCEPTS AND CONCURRENCY CONTROL**	9
Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery		CO3
UNIT IV	**IMPLEMENTATION TECHNIQUES**	9
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation		CO4
UNIT V	**ADVANCED TOPICS AND DATABASE PROGRAMMING**	9
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand relational data model, evolve conceptual model of a given problem and SQL
CO2	To understand Relational model and normalization to perform database design effectively
CO3	Apply and relate the concept of transaction, concurrency control and recovery in database
CO4	To understand the implementation technique and query processing
CO5	To understand the concepts of database security and database programming

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	2	1	2	-	1	1	-	1	-	1	1	-	1
CO2	2	-	1	1	1	-	1	1	-	-	-	1	1	-	1
CO3	1	-	1	1	1	1	-	1	-	-	-	1	1	-	1
CO4	2	-	2	1	1	1	-	1	-	-	-	1	1	-	1
CO5	1	-	2	1	2	1	-	1	1	-	-	1	1	-	1

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT I	**INTRODUCTION TO DATA ANALYSIS**	9
Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		CO1
UNIT II	**R PROGRAMMING BASICS**	9
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		CO2
UNIT III	**DATA VISUALIZATION USING R**	9
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		CO3
UNIT IV	**STATISTICS WITH R**	9
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		CO4
UNIT V	**PRESCRIPTIVE ANALYTICS**	9
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.

   URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
7. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
8. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2

OCS106	DATA COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols

UNIT I	**INTRODUCTION AND PHYSICAL LAYER**	9
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		CO1
UNIT II	**DATA-LINK LAYER & MEDIA ACCESS**	9
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		CO2
UNIT III	**NETWORK LAYER**	9
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		CO3
UNIT IV	**TRANSPORT LAYER**	9
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		CO4
UNIT V	**APPLICATION LAYER**	9
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	**INTRODUCTION**	9
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		CO1
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	9
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		CO2
UNIT III	**ORGANS OF GOVERNANCE**	9
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		CO3
UNIT IV	**EMERGENCY PROVISIONS**	9
Emergency Provisions - National Emergency, President Rule, Financial Emergency		CO4
UNIT V	**LOCAL ADMINISTRATION**	9
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI-Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS	
1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015. 2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015. 3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014. 4. The Constitution of India (Bare Act), Government	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I	INTRODUCTION TO VALUE EDUCATION	9
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		CO1
UNIT II	**IMPORTANCE OF VALUES**	9
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		CO2
UNIT III	**INFLUENCE OF VALUE EDUCATION**	9
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth.		CO3
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	9
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		CO4
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	9
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development

CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	**INTRODUCTION AND METHODOLOGY**	9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		CO1
UNIT II	**THEMATIC OVERVIEW**	9
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		CO2
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	9
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		CO3
UNIT IV	**PROFESSIONAL DEVELOPMENT**	9
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes		CO4
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	9
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I	**INTRODUCTION TO YOGA**	9
Definitions of Eight parts of yog.(Ashtanga)		CO1
UNIT II	**YAM**	9
Do`s and Don’t’s in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		CO2
UNIT III	**NIYAM**	9
Do`s and Don’t’s in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		CO3
UNIT IV	**ASAN**	9
Various yog poses and their benefits for mind & body		CO4
UNIT V	**PRANAYAM**	9
Regularization of breathing techniques and its effects-Types of pranayam		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do’s and Don’t’s in life through Yam
CO3	Learn Do’s and Don’t’s in life through Niyam

CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		CO1
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	9
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		CO2
UNIT III	**ORGANS OF GOVERNANCE**	9
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		CO3
UNIT IV	**EMERGENCY PROVISIONS**	9
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		CO4
UNIT V	**LOCAL ADMINISTRATION**	9
Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities

CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	**QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN**	9
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. Assignment: Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.		CO1
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	9
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		CO2
UNIT III	**RURAL INSTITUTIONS**	9
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		CO3
UNIT IV	**RURAL DEVELOPMENT PROGRAMMES**	9

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		CO4
UNIT V	**FIELD WORK**	9
Each student selects one programme for field visit Field based practical activities: ❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities ❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site ❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures ❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) ❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization ❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps ❖ Participate in Gram Sabha meetings, and study community participation ❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries ❖ Attend Parent Teacher Association meetings, and interview school drop outs ❖ Visit local Anganwadi Centre and observe the services being provided ❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. ❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys ❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness ❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants ❖ Formation of committees for common property resource management, village pond		CO5

maintenance and fishing.

TOTAL : 45 PERIODS

TEXT BOOKS

4. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
5. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
6. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS

2. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
3. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	**INTRODUCTION TO CULTURE**	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		CO1
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2
UNIT III	**RELIGION AND PHILOSOPHY**	9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	9
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		CO4
UNIT V	**EDUCATION SYSTEM IN INDIA**	9
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989

6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Understand education systems in India

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Introduction to Sanga Tamil Literature.
- ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
- ‘Attruppadai’ in SangaTamil Literature.
- ‘Puranaanuru’ in SangaTamil Literature.
- ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT I	SANGA TAMIL LITERATURE – AN INTRODUCTION	9
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s GrammarTamil Sangam Literature’s parables.		CO1
UNIT II	**‘AGATHINAI’AND‘PURATHINAI’**	9
Tholkappiyar’s Meaningful Verses–Three literature materials–Agathinai’s message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		CO2
UNIT III	**‘ATTRUPPADAI’**	9
Attruppadai Literature – Attruppadaiin ‘Puranaanuru’ – Attruppadaiin ‘Pathitrupaththu’- Attruppadaiin ‘Paththupaattu’.		CO3
UNIT IV	**‘PURANAANURU’**	9
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		CO4
UNIT V	**‘PATHITRUPATHTHU’**	9
Pathitrupaththuin ‘Ettuthogai’ – Pathitrupaththu’s Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.

5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

VAC001	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		1	0	2	2

OBJECTIVES

1.The main learning objective of this course is to make the students an appreciation for:

2. To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.

3. Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students

UNIT I	**INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS**	6
The Various Industrial Revolutions – Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry – Industry 4.0 revolutions – Support System for Industry 4.0 – Smart Factories.		CO1
UNIT II	**IMPLEMENTATION SYSTEMS FOR IIOT**	6
Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.		CO2
UNIT III	**IIOT DATA MONITORING & CONTROL**	6
IoT Gate way – IoT Edge Systems and It's Programming – Cloud computing – Real Time Dashboard for Data Monitoring – Data Analytics and Predictive Maintenance with IIoT technology		CO3
UNIT IV	**IIOT Sensors & Networks**	6
Next Generation Sensors – Collaborative Platform and Product Lifecycle Management – Industrial IoT- Layers – Software Defined Networks: IIoT Analytics – Security and Fog Computing – Fog Computing in IIoT – Emerging descriptive data standards for IIoT – Cloud data base.		CO4
UNIT V	**INDUSTRIAL IOT- APPLICATIONS**	6
Healthcare Power Plants – Inventory Management & Quality Control – Plant Safety and Security Oil – Chemical and Pharmaceutical industry – Applications of UAVs in Industries.		CO5
		TOTAL : 30 PERIODS

REFERENCE:

1. .Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. OvidiuVermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Students can develop a comprehensive understanding of Internet of Things (IoT) technologies, including sensors, communication protocols, cloud computing, and data analytics.
CO2	The program can provide students with hands-on experience in designing, implementing, and managing IoT-based solutions for industrial applications.
CO3	The program can provide students with an understanding of IoT security and privacy issues, including data encryption, access control, and device authentication.
CO4	The program can help students develop effective communication and teamwork skills through group projects and case studies, which are essential for working in cross-functional teams in industrial IoT settings.
CO5	Graduates of the program can be better equipped to take on roles in IoT-based industrial applications and other areas of technology, due to their in-depth knowledge of IoT technologies and their practical experience in designing and implementing industrial IoT solutions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	-	-	-	2	2	2	2	2	3
CO2	1	1	1	1	2	2	-	-	1	2	2	2	1	2	2
CO3	3	2	2	2	2	2	-	-	1	1	1	1	2	2	2
CO4	1	1	2	1	2	2	-	-	3	2	2	1	1	2	2
CO5	1	1	1	2	1	2	1	1	2	2	2	2	2	2	2

VAC002	AUGMENTED REALITY & VIRTUAL REALITY	L	T	P	C
		1	0	2	2

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

1. To provide students with good depth of knowledge of Augmented Reality and Virtual Reality
2. Knowledge on Tools and Applications of Augmented Reality and Virtual Reality

UNIT I	**Introduction to Augmented Reality and Virtual Reality (VR)**	6
History of AR - Augmented reality characteristics– Difference between Augmented Reality and Virtual Reality– AR technological components– Technologies used in AR– Feature Extraction– Hardware components – AR devices – Importance of AR - Real world uses of AR – AR types – Software tools available for AR.		CO1
UNIT II	**Computer Graphics and Geometric Modeling**	6
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference.		CO2
UNIT III	**Need of technologies for Augmented Reality & Virtual Reality**	6
Hardware technology– virtual scenes – 3D objects– AR & VR components Display – HMD – Eyeglasses– Contact Lenses– significance of AR – AR powered devices – Motion tracking –Virtual environment - VR technology, AR & VR application development drawbacks– Compatibility Performance.		CO3
UNIT IV	**Tools and Applications of Augmented Reality & Virtual Reality**	6
Tools available for Augmented Reality and Recognition - Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems - Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.		CO4
UNIT V	**Augmented Realities and Virtual Reality for Micro Learning**	6
Micro learning techniques – Utilizing VR for learning – VR for Practical online assessment – VR info graphics – Virtual case considerations - Utilizing AR for learning– Accessible learning – sensible data– elevated learner engagement- Engineering, Entertainment, Science, Training, Game Development		CO5

TOTAL : 30 PERIODS

REFERENCE:

1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2. Dieter Schmalstieg, Tobias Hollerer, “Augmented Reality: Principles & Practice”, Addison Wesley, 2016

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the importance of augmented reality in Industry 4.0 with real-time examples
CO2	To describe the history and recent developments of AR
CO3	To provide the need on emerging technologies AR and VR
CO4	To discuss the revolution and impact of AR
CO5	To understand the applications of AR and VR

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC003	ETHICAL HACKING - CYBER SECURITY	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To learn the fundamentals of Cyber Security and Ethical Hacking
- To learn the Foot printing & Reconnaissance and Scanning Networks
- To understand Enumeration and Vulnerability Analysis
- To understand Exploitation on Network
- To learn the Web Attacks and Report Writing

UNITI	**FUNDAMENTALS OF CYBER SECURITY AND ETHICAL HACKING**	6
Introduction to Cyber Security - Cyber Security & Ethical Hacking - Domains of Cyber Security - Principles of Cybersecurity (CIA Triad, Security Models, Principles of Privileges) - Offensive & Defensive Security - Cyber Kill Chain - Types of Security Teams (Red Team, Blue Team, Purple Team) - Cyber Security Frameworks (NIST, MITRE, ISO/IEC) Phases & Methodologies in Ethical Hacking - Introduction to Malware - Types of Malware		CO1
UNITII	**FOOTPRINTING RECONNAISSANCE AND SCANNING NETWORKS**	6
Introduction to Foot printing Reconnaissance - Types of Reconnaissance (Passive & Active) - Active Reconnaissance (Ping, Traceroute, Telnet, Whatweb, Wappalyzer, Netcraft) - Passive Reconnaissance (nslookup, whois, dig, DNSDumpster, Shodan) - Introduction to OSINT (OSINT Framework, OSRFRAMEWORK, Social Searcher,) - Introduction to Scanning Networks - Types of Network Scanning (Port Scan, Service Scan, Vulnerability Scan) - Scanning Techniques - Port Scanning (TCP, UDP) - Host Discovery (ICMP, ARP) - Introduction to Wireshark - Capturing Data Packets - Packet Analysis.		CO2
UNITIII	**ENUMERATION AND VULNERABILITY ANALYSIS**	6
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.		CO3
UNITIV	**EXPLOITATION ON NETWORK**	6
Introduction to Exploitation - What is Shell - Types of Linux Shells (Bash, Csh/Tcsh, Ksh, Zsh, Fish) - What is Gaining Access & Maintaining Access - Reverse Shell & Bind Shell - Introduction to Metasploit Framework - Metasploit Modules - Staged Payload & Non-Staged Payload - Using Metasploit Framework Gaining the User Shell Acess - Gaining Root Shell Acess in Metasploit Framework - Introduction to Manual Exploitation - Gaining User Shell in Manual Exploitation - What is Privilege Escalation - Linux & Windows Privilege Escalation - Using Linpeass Script Finding Non-Privilege Path on Linux System - Using Winpeass Script Finding Non-Privilege Path on Windows System - Hands-on Windows & Linux Privilege Escalation - Introduction to Post Exploitation.		CO4
UNITV	**WEB ATTACKS AND REPORT DOCUMENTATION**	6
Introduction to OWAP TOP 10 and SANS TOP 25 - Web Server & Web Application Attack Methodology - Indirect Object Reference (IDOR) - SQL Injection - Cross Site Scripting - XML Injection or XML External Internal - Account Hijacking - Sensitive Data Exposure - Server Side Forgery - Race Condition - Generate Proper Vulnerability Assessment Penetration Testing Report Document.		CO5
		TOTAL:30 PERIODS

REFERENCE:

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.

2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013. 3. The Web Application Hacker’s Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the importance of fundamentals of cyber security and ethical hacking
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods.
CO3	To demonstrate the enumeration and vulnerability analysis methods
CO4	To acquire knowledge on the options for network protection.
CO5	To gain knowledge on hacking options available in Web applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

VAC004	BLOCKCHAIN AND CRYPTO CURRENCIES	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To understand Blockchain's fundamental components, and examine decentralization using blockchain.
2. To understand Cryptocurrency and its background concepts.
3. To learn smart contract programing language solidity.
4. To understand public blockchain application development platform and develop distributed applications.
5. To understand enterprise blockchain application development platform and develop distributed enterprise applications

UNIT I	**Introduction**	6
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash function, consensus, byzantine fault-tolerant, distributed computing, 51% attack, digital cash etc.		CO1
UNIT II	**Cryptocurrency Basics**	6
Bitcoin blockchain, Challenges and solutions, Crypto mining, mining types, mining hardware, proof of work, Proof of stake, alternatives to Bitcoin consensus, other crypto currencies like Ethereum, Tether, BNB etc		CO2
UNIT III	**Solidity Walkthrough**	6
Introduction to Ethereum blockchain – Ethereum Virtual Machine – remix IDE - MetaMask wallet – running simple smart contract – voting application – Lottery application – File sharing application		CO3
UNIT IV	**Public Blockchain Application Development**	6
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		CO4
UNIT V	**Enterprise Blockchain Application Development**	6
Introduction to Hyperledger – Hyperledger Fabric architecture– language supports for hyperledger fabric – setting up hyprledger fabric - Building application in hyperledger fabric.		CO5

TOTAL : 30 PERIODS

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.
4. https://hyperledger-fabric.readthedocs.io/en/latest/tutorials.html

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand Blockchain's fundamental components, and examine decentralization using blockchain.
CO2	Understand Cryptocurrency and its background concepts
CO3	Write smart contract using programing language solidity.
CO4	Develop distributed applications using public blockchain application development platform Ethereum.
CO5	Develop distributed applications using enterprise blockchain application development platform Hyperledger

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	-	2	1	-	-	1	-	-	1	2	2	3
CO2	3	3	2	-	2	2	-	-	1	-	-	1	2	2	3
CO3	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO4	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO5	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3

VAC005	INDUSTRIAL PRACTICES WITH DEVOPS	L	T	P	C
		1	0	2	2

OBJECTIVES

1. TointroduceDevOpsterminology,definition&concepts
2. TounderstandtheMaven, Profiles and Plugins
3. To understand the concepts of Continuous Integration/ Continuous Testing/ ContinuousDeployment using Jenkins
4. To understandtoleverageCloud-basedDevOpstoolsusingAzureDevOps
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

UNIT I	**INTRODUCTION TO DEVOPS**	6
Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github		CO1
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	6
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artifacts, Dependency management, Installation of Gradle, understand build using Gradle		CO2
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	6
Install & Configure Jenkins, Jenkins Architecture Overview, creating a Jenkins Job, configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace		CO3
UNIT IV	**BUILDING DEVOPS PIPELINES USING AZURE**	6
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		CO4
UNIT V	**DEVOPS PRACTICALS**	6
Create Maven Build pipeline in Azure - Run regression tests using Maven Build pipeline in Azure - Install Jenkins in Cloud - Create CI pipeline using Jenkins - Create a CD pipeline in Jenkins and deploy in Cloud		CO5

TOTAL : 30 PERIODS

REFERENCES:

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Mitesh Soni, Hands-On Azure Devops: CICD Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for .DevOps and Microsoft Azure (English Edition) , 2020

3. Mariot Tsitoara, " Beginning Git and GitHub: A Comprehensive Guide to Version Control Management, and Teamwork for the New Developer", Second Edition, 2019.
4. https://www.jenkins.io/user-handbook.pdf
5. https://maven.apache.org/guides/getting-started

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand different actions performed through Version control tools like Git.
CO2	Compile and Build using Maven & Gradle applications
CO3	Ability to Perform Continuous Integration using Jenkins.
CO4	Understand to leverage Cloud-based DevOps tools using Azure DevOps
CO5	Develop various Devops applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

VAC006	APPLIED MACHINE LEARNING WITH PYTHON	L	T	P	C
		1	0	2	2

OBJECTIVES

- To provide a basic understanding of data manipulation.
- To understand scikit learn for model evaluation.
- To provide a comprehensive understanding of neural networks and computer vision.

UNIT I	**DATA MANIPULATION WITH PYTHON LIBRARIES**	6
Overview of Data Manipulation with Python-Introduction to Pandas and NumPy-Data Cleaning and Preprocessing-Handling Missing Data-Data Exploration and Analysis		CO1
UNIT II	**MACHINE LEARNING BASICS WITH SCIKIT-LEARN**	6
Introduction to Machine Learning-Types of Machine Learning Algorithms-Overview of Decision Trees and Random Forests-Hands-on Implementation with Scikit-Learn-Model Evaluation and Validation.		CO2
UNIT III	**LINEAR REGRESSION AND BEYOND**	6
Linear Regression Fundamentals-Implementing Linear Regression from Scratch-Logistic Regression for Classification-Introduction to Support Vector Machines (SVM)-Hands-on Exercises with Scikit-Learn.		CO3
UNIT IV	**ADVANCED MACHINE LEARNING TECHNIQUES**	6
Introduction to Gradient Boosting-Implementation of Gradient Boosting with XGBoost-Neural Networks Basics with PyTorch-Deep Learning Fundamentals-Applications of Neural Networks.		CO4
UNIT V	**COMPUTER VISION AND TRANSFER LEARNING**	6
Image Classification with Convolutional Neural Networks (CNN)-Transfer Learning Concepts and Applications-Hands-on Image Classification with PyTorch-Fine-tuning Pre-trained Models-Building Custom Models for Specific Tasks.		CO5

TOTAL : 30 PERIODS

REFERENCE:

1. " Data Wrangling with Pandas" by Kevin Markham - A practical guide that delves into data cleaning, preprocessing, handling missing data, and exploratory data analysis using Pandas.

2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron - A comprehensive guide that covers a wide range of machine learning topics, including decision trees, random forests, and model evaluation with scikit-learn.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand a predictive models that can classify or regress on data by recursively partitioning.
CO2	To develop a foundational understanding of the underlying algorithms, optimizing model parameters
CO3	To build a robust and high-performance ensemble model for regression or classification tasks.
CO4	To understand the automatic learning of hierarchical representations from data for tasks such as classification, regression, and feature extraction.
CO5	To incorporating transfer learning are to leverage pre-trained models to efficiently learn and classify features in images, facilitating accurate predictions.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO2	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO4	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO5	-	-	-	-	1	-	-	-	-	1	-	1	-	1	1

CT1701	ADVANCED DATA MANAGEMENT AND MACHINE INTELLIGENCE	L	T	P	C
		0	0	2	1

OBJECTIVES

- ❖To recall data warehousing and business intelligence fundamentals with examples. State Data Lakehouse and its importance. Compare Data Lakehouse to the traditional SQL data warehouse.
- ❖To write SQL queries to perform complex operations. Learn advanced SQL concept with examples and differentiate NO SQL with RDBMS (which uses SQL) by their advantages and disadvantages.
- ❖To get clear understanding of AWS, Azure, GCP fundamentals. Cloud Computing- Benefits of it. Basic knowledge on few products and services provided by AWS, Azure, GCP.
- ❖Be aware of advanced Python concepts programming with real-life examples.
- ❖To gain insights of fundamental concepts of Artificial Intelligence (AI), Basics of Machine Learning and how to use concepts, Prompt Engineering.

UNIT I	MODERN DATA INTEGRATION	6
	Data Warehouse concepts :Need for BI, Data Warehouse, Key terminologies related to DWH Architecture -OLTP vs OLAP, ETL, Data Mart, Metadata, DWH Architecture. Data Lakehouse : Data Lake to Data Swamp, SQL Relational Databases, Transaction Processing, Relational Database Workload Types, Architectural Challenges, Databricks Evolution. ETL :Extract Data Dump from source, Data format consistency, Data Quality rules, Truncate & Load, Load strategies, Load Approach, Transform, Mapping, Enriching, Joins, filter, Remove Duplicates, Aggregation, Load, Dimension, Facts, EDW Tables, Data Marts. Variety of ETL Tools:Apache Airflow, Datastage,Oracle Data Integrator, SSIS, Talend, Hadoop, AWS Glue, Azure Data Factory, Google Cloud Dataflow, Stitch, SAP, Hevo, Qlik, Airbyte	CO1
UNIT II	**FOUNDATIONS OF DATA MANAGEMENT AND ANALYSIS**	6
	Informatica:Informatica Architecture, Informatica PowerCenter & Repository, Informatica PowerCenter Designer, Informatica Power Center workflow manager, Informatica PowerCenter workflow monitor, Run Mappings, Workflow creation & Deletion. SQL:DQL, DDL, DML, Filtering and sorting Data, Grouping and Aggregating Data, Joins and Subqueries, Window Functions, Optimizing SQL queries, Automation,Store Procedure, Trigger, Views, Functions. NoSQL:Fundamentals and Comparison with SQL,Connecting Data Sources and DataBases, Data Modeling, Creating Calculated Fields in Power BI.	CO2
UNIT III	**CLOUD COMPUTING PLATFORMS DEMYSTIFIED**	6
	Python :Variables, Operators, functions, Libraries, Methods, Refactoring, Enum, Tuples, Dictionaries, sets, Map, filter, reduce, Class & objects, Exceptions, Overloading ,Iterators, Modules, Packages, Generators, List, Comprehensions, Regular expressions, Serialization, Partial functions, closures, Decorators. AWS :Benefits of AWS, AWS Services - Computer, Storage, Database Service, Networking Service, Security Service, Management tool Service, Developer tool Service. Azure :Cloud Computing, Services in Azure - Compute, Containers, Databases, Identity, Security, Networking, Storage. GCP:Cloud Computing, Benefits of GCP, GCP services, AWS vs Azure vs GCP	CO3
UNIT IV	**PYTHON FOR DATA SCIENCE AND AI**	6
	Python with Deep Learning : Python Data Science Libraries,Numpy, Scipy, Pandas, Matplotlib, Scikit-Learn, Statsmodels, Pandas, Sorting, Concatenate, Preprocessing - Time Series Data, Visualization	CO4

Python with AI : Introduction, Demand of AI, What is AI, Types of AI, Why python for AI, Python Packages for AI Artificial Intelligence : Artificial intelligence and its types, AI Roadmap, Machine learning and its types, Linear regression Analysis, Classifications in Machine Learning.AI vs ML, Classification vs regression, Supervised learning, Unsupervised learning, Training Model, Preparing Data, K-Nearest Neighbors, Naive Bayes, Logistic Regression, Support Vector Machine, Neural Networks, Tensorflow, K-Means Clustering, Principal Component Analysis, KMeans and PCA Implementations .		
UNIT V	**EXPLORING AI FOUNDATIONS**	6
Prompt Engineering : Introduction to AI, Linguistics, Language Models, Prompt Engineering Mindset, Zero shot and few shot prompts, AI hallucinations, Vectors/text embeddings.Generative AI Fundamentals:Generative AI and its use cases, How do LLMS (Large Language Models) work, LLMs generates output for NLP task, LLM model decision criteria, Proprietary models, Fine tuned models, Mixing LLM flavors in workflow, Data privacy, Data security.		CO5
		TOTAL PERIOD: 30

REFERENCE BOOKS

1. Wes McKinney - "Python for Data Analysis" - O'Reilly Media; 2nd edition (October 20, 2017).
2. Foster Provost and Tom Fawcett - "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" - O'Reilly Media; 1st edition (July 27, 2013).
3. Philip C. Jackson - "Introduction to Artificial Intelligence" - Pearson; 1st edition (January 14, 1998).
4. Paulraj Ponniah - "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" - Wiley; 2nd edition (August 3, 2010).
5. Anthony Molinaro - "SQL Cookbook" - O'Reilly Media; 2nd edition (June 18, 2009).
6. Thomas Erl et al. - "Cloud Computing: Concepts, Technology & Architecture" - Prentice Hall; 1st edition (June 25, 2013).
7. Stuart Russell and Peter Norvig - "Artificial Intelligence: A Modern Approach" - Pearson; 3rd edition (December 11, 2009).

REFERENCE

https://www.youtube.com/watch?v=J326LIUrZM8
https://www.youtube.com/watch?v=Muyq3qtHzzo
https://www.youtube.com/watch?v=Tw44ml26Mos
https://www.datacamp.com/blog/a-list-of-the-16-best-etl-tools-and-why-to-choose-them
https://www.youtube.com/watch?v=Q2tX2v7KXhk
https://www.youtube.com/watch?v=oreAsJTNcsA
https://www.youtube.com/watch?v=M-55BmjOuXY
https://www.youtube.com/watch?v=xQnIN9bW0og
https://www.youtube.com/watch?v=ootqUuVk_js
https://www.youtube.com/watch?v=eWRfhZUzrAc
https://www.youtube.com/watch?v=Yrtm7d3TJbs
https://www.youtube.com/watch?v=qu9rTSl_ZUU
https://www.youtube.com/watch?v=3h0ZXlZvra0
https://www.youtube.com/watch?v=vACTtmLWiQY
https://www.youtube.com/watch?v=Rgz9SRg3DGw
https://www.youtube.com/watch?v=RpuObKwE43k
https://www.youtube.com/watch?v=faBRsREN1Dg
https://www.youtube.com/watch?v=i_LwzRVP7bg
https://www.youtube.com/watch?v=_ZvnD73m40o

https://www.youtube.com/watch?v=1fQ1DDMmiqo	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Gain a solid understanding of AI fundamentals, including machine learning algorithms, natural language processing techniques, and data science libraries, enabling you to work on AI projects effectively.
CO2	Acquire skills in data warehousing, SQL and NoSQL databases, data modeling, and data integration, allowing you to efficiently manage and analyze large datasets.
CO3	Develop expertise in utilizing cloud computing platforms like AWS, Azure, and GCP, enabling you to deploy, scale, and manage applications and services in the cloud.
CO4	Learn advanced data analysis techniques, including sorting, preprocessing, visualization, and statistical modeling, empowering you to derive meaningful insights from complex datasets.
CO5	Understand the ethical implications of AI technologies, including data privacy, security, and bias mitigation, and learn how to implement responsible AI solutions in compliance with ethical standards and regulations

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO2	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO3	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO4	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3
CO5	3	3	3	2	-	-	-	-	2	2	2	3	3	3	3

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

FACULTY OF ELECTRICAL ENGINEERING

REGULATIONS – 2021

M.E. POWER ELECTRONICS AND DRIVES
(Choice Based Credit System–CBCS)

I–IV Semesters CURRICULUM AND SYLLABUS

Vision of the department

- To promote the Department of Electrical and Electronics Engineering as a pioneer in education and research by imparting quality education, creating and upgrading the academic facilities and inculcating professional values to the students to face the challenges in the dynamic global society.

Mission of the department

- To attain utmost qualities of teaching–learning process and provide a vibrant environment for the students to exhibit their fullest potential in the field of Electrical and Electronics Engineering.
- To improve research and development skills among students towards providing technical solutions with ethical values to meet social challenges.
- To develop the students to face the technological requirements of the industry with professional values and make them employable and to impart the spirit of entrepreneurship for their successful career.

Program Education Objectives (PEOs)

PEO1: Graduates of this program will have technical knowledge with the ability to design, develop and test power electronic converters and incorporate them in the control of electric drives in real time applications.

PEO2: Graduates of this program will be equipped skillfully to carry out academic and industrial research with cutting edge technologies thereby providing appropriate solutions with insightful innovations.

PEO3: Graduates of this program will show strong aptitude towards continuous learning and exhibit exemplary determination towards being a part of academia and exhibit higher order of ethical responsibility.

PEO4: Graduates of this program will show involvement and willingness in assuming responsibility in societal and environmental causes to promote sustainable growth in satisfying energy needs.

Program Specific Outcomes (PSOs)

PSO1: Understand and analyze the need for different modern power electronic converters and implement them for the operation of real time adjustable speed drives for flexible control.

PSO2: Contribute towards effective utilization of renewable energy sources by enabling the harness of maximum power with the help of power electronic conversion topologies.

PSO3: Design robust controllers for efficient energy storage and consumption by real time control of energy storage devices.

PSO4: Enhance knowledge by formulating and carrying out experiments to promote active research in the field of power electronics and drives, in order to improve the performance of electrical power systems.

Program Outcomes (POs)

PO1 – Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 – Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 – Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 – Conduct investigations of complex problems: Use research–based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 – Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 – The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 – Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 – Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 – Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 – Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 – Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 – Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the broadest context of technological change

PEO / PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO–1	*	*	*	*	*	*	*	*				*
PEO–2	*	*	*	*	*	*	*	*	*		*	*
PEO–3	*	*	*		*	*	*	*				*
PEO–4	*	*			*	*	*	*				

PO / POST GRADUATE SUBJECTS MAPPING
MAPPING – PG – M.E. POWER ELECTRONICS AND DRIVES

SEMESTER	NAME OF THE SUBJECT	a	b	c	d	e	f	g	h	i	j	k	l
SEM I	**THEORY**												
	Applied Mathematics for Electrical Engineers	*	*	*	*								
	Power semiconductor devices	*	*			*	*						
	Analysis of Electrical Machines	*	*	*	*	*	*						
	Analysis and Design of Power Converters	*	*	*		*	*						
	System Theory	*	*		*	*	*						
	Research methodology and IPR				*	*	*		*	*	*	*	*
	Audit course												
	PRACTICALS												
	Power electronic circuit Simulation laboratory	*	*			*				*			
	Power converters laboratory	*	*			*				*			
SEM II	**THEORY**												
	Analysis and Design of Inverters	*	*	*	*	*	*						
	Analysis of Electrical drives	*	*			*	*						
	E–Vehicles and power management	*	*	*		*	*						
	Embedded Controllers	*	*	*	*	*	*						
	Professional Elective I												
	Professional Elective II												
	PRACTICALS												
	Embedded Controller laborotory	*			*	*				*			
	Mini Project	*					*		*	*	*	*	*
SEM III	**THEORY**												
	Professional Elective III												
	Professional Elective IV												
	Open Elective												
	PRACTICALS												
	Project Work Phase I	*	*	*	*	*	*	*	*	*	*	*	*
	Electrical Drives Laboratory	*	*			*				*			
SEM IV	Project Work Phase II	*	*	*	*	*	*	*	*	*	*	*	*

M.E. POWER ELECTRONICS AND DRIVES
REGULATIONS – 2020
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA & SYLLABI

SEMESTER – I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1153	Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4
2.	PE1101	Power Semiconductor Devices	PCC	3	3	0	0	3
3.	PE1102	Analysis of Electrical Machines	PCC	3	3	0	0	3
4.	PE1103	Analysis and Design of Power Converters	PCC	3	3	0	0	3
5.	PE1104	System Theory	PCC	4	3	1	0	4
6.	RM1106	Research methodology and IPR	RMC	2	2	0	0	2
Audit course (One from the list of Audit Course)			AC					
PRACTICALS								
7.	PE1111	Power Electronic Circuit Simulation Laboratory	PCC	4	0	0	4	2
8.	PE1112	Power Converters Laboratory	PCC	4	0	0	4	2
			TOTAL	**29**	**20**	**1**	**8**	**23**

SEMESTER – II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	PE1201	Analysis and Design of Inverters	PCC	3	3	0	0	3
2.	PE1202	Analysis of Electrical drives	PCC	4	3	1	0	4
3.	PE1203	E–Vehicle and Power Management	PCC	3	3	0	0	3
4.	PE1204	Embedded Controllers	PCC	3	3	0	0	3
5.		Professional Elective I	PEC	3	3	0	0	3
6.		Professional Elective II	PEC	3	3	0	0	3
PRACTICALS								
7.	PE1211	Embedded Controller Laboratory	PCC	4	0	0	4	2
8.	PE1212	Mini Project	EEC	4	0	0	4	2
			TOTAL	**27**	**18**	**1**	**8**	**23**

SEMESTER – III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective III	PEC	3	3	0	0	3
2.		Professional Elective IV	PEC	3	3	0	0	3
3.		Open Elective (One from list of 6 courses)	OEC	3	3	0	0	3
PRACTICALS								
4	PE1311	Electrical Drives Laboratory	PCC	4	0	0	4	2
5.	PE1312	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**25**	**9**	**0**	**16**	**17**
		Career Competency Development I – BEC Training		**1 WEEK**				

SEMESTER – IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	PE1411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 75

FOUNDATION COURSES (FC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1153	Applied Mathematics for Electrical Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE COURSE (PCC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PE1101	Power Semiconductor Devices	PCC	3	3	0	0	3
2.	PE1102	Analysis of Electrical Machines	PCC	3	3	0	0	3
3.	PE1103	Analysis and Design of Power Converters	PCC	3	3	0	0	3
4.	PE1104	System Theory	PCC	4	3	1	0	4
5.	PE1111	Power Electronic Circuit Simulation Laboratory	PCC	4	0	0	4	2
6.	PE1112	Power Converters Laboratory	PCC	4	0	0	4	2
7.	PE1201	Analysis and Design of Inverters	PCC	3	3	0	0	3
8.	PE1202	Analysis of Electrical Drives	PCC	4	3	1	0	4
9.	PE1203	E–Vehicle and Power Management	PCC	3	3	0	0	3
10.	PE1204	Embedded Controllers	PCC	3	3	0	0	3
11.	PE1211	Embedded Controllers Laboratory	PCC	4	0	0	4	2
12.	PE1311	Electrical Drives Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSE (PEC)

Semester II **Elective I and II**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PE1251	Artificial Intelligence and Machine Learning	PEC	3	3	0	0	3
2.	PE1252	Electromagnetic Field Computation and Modelling	PEC	3	3	0	0	3
3.	PE1253	Control System Design for Power Electronics	PEC	3	3	0	0	3
4.	PE1254	Analog and Digital Controllers	PEC	3	3	0	0	3
5.	PE1255	Flexible AC Transmission Systems	PEC	3	3	0	0	3

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
6.	PE1256	Modern Rectifiers and Resonant Converters	PEC	3	3	0	0	3
7.	PE1257	Electromagnetic Interference and Compatibility	PEC	3	3	0	0	3
8.	PE1258	MEMS Technology	PEC	3	3	0	0	3
9.	PE1259	Distributed Generation and Microgrid	PEC	3	3	0	0	3

Semester III **Elective III and IV**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PE1351	High Voltage Direct Current Transmission	PEC	3	3	0	0	3
2.	PE1352	Solar and Energy Storage Systems	PEC	3	3	0	0	3
3.	PE1353	Wind Energy Conversion Systems	PEC	3	3	0	0	3
4.	PE1354	Energy Management and Auditing	PEC	3	3	0	0	3
5.	PE1355	Non – Linear Dynamics for Power Electronics Circuits	PEC	3	3	0	0	3
6.	PE1356	Smart Grid	PEC	3	3	0	0	3
7.	PE1357	Power Electronics for Renewable Energy Systems	PEC	3	3	0	0	3
8.	PE1358	Robotics and Control	PEC	3	3	0	0	3
9.	PE1359	Non – Linear Control	PEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	PE1212	Mini Project	EEC	4	0	0	4	2
2.	PE1312	Project Work – Phase I	EEC	12	0	0	12	6
3.	PE1411	Project Work – Phase II	EEC	24	0	0	24	12

OPEN ELECTIVE COURSES [OEC]
(Out of 6 Courses one Course must be selected)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE1001	Business Data Analytics	2	0	0	0	3
2.	OE1002	Industrial Safety	2	0	0	0	
3.	OE1003	Operations Research	2	0	0	0	
4.	OE1004	Cost Management of Engineering Projects	2	0	0	0	
5.	OE1005	Composite Materials	2	0	0	0	
6.	OE1006	Waste to Energy	2	0	0	0	

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	AX1001	English for Research Paper Writing	2	0	0	0	1/2
2.	AX1002	Disaster Management	2	0	0	0	
3.	AX1003	Value Education	2	0	0	0	
4.	AX1004	Constitution of India	2	0	0	0	
5.	AX1005	Pedagogy Studies	2	0	0	0	
6.	AX1006	Stress Management by Yoga	2	0	0	0	
7.	AX1007	Personality Development Through Life Enlightenment Skills	2	0	0	0	
8.	AX1008	Unnat Bharat Abhiyan	2	0	0	0	
Total Credits						**0**	

SUMMARY

M.E POWER ELECTRONICS AND DRIVES							
S. NO.	**SUBJECT AREA**	**CREDITS PER SEMESTER**				**TOTAL CREDITS**	**%**
		I	**II**	**III**	**IV**		
1.	FC	4	0	0	0	**04**	**4**
2.	PCC	17	15	2	0	**34**	**52**
3.	PEC	0	6	6	0	**12**	**14**
4.	RMC	2	0	0	0	**2**	**2**
5.	OEC	0	0	3	0	**3**	**3**
6.	EEC	0	2	6	12	**20**	**25**
7.	Non–Credit / Audit Course	0	0	0	0	**0**	**0**
	Total Credits	**23**	**23**	**17**	**12**	**75**	**100**

MA1153	APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS	L	T	P	C
		4	0	0	4

Objectives

- The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students of electrical engineering.
- To formulate and construct a mathematical model for a linear programming problem in real life situation.
- This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including matrix theory, calculus of variations, probability, and Fourier series.

UNIT – I	MATRIX THEORY	12

Cholesky decomposition – Generalized Eigenvectors – Canonical basis – QR Factorization – Least squares method – Singular value decomposition.

UNIT – II	CALCULUS OF VARIATIONS	12

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods: Ritz and Kantorovich methods.

UNIT – III	PROBABILITY AND RANDOM VARIABLES	12

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT – IV	LINEAR PROGRAMMING	12

Formulation – Graphical solution – Simplex method – Big M method – Two phase method – Transportation and Assignment models.

UNIT – V	FOURIER SERIES	12

Fourier trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: Cosine and sine series – Non periodic function: Extension to other intervals – Power signals: Exponential Fourier series – Parseval's theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm – Liouville systems – Generalized Fourier series.

Total Periods:	**60**

Reference Books:

1. L. C. Andrews and R. L. Phillips, 'Mathematical Techniques for Engineers and Scientists',

Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. R. Bronson, 'Matrix Operation', Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
3. Isarel M. Gelfand and S.V. Fomin, 'Calculus of Variations', Dover Publication Inc,2012.
4. R. A. Johnson, I. Miller, and J. Freund, 'Miller and Freund's Probability and Statistics for Engineers', Pearson Education, Asia, 8th Edition, 2015.
5. P. V. O'Neil, 'Advanced Engineering Mathematics', Thomson Asia Pvt. Ltd., 8th Edition, Singapore, 2017.
6. Hamdy A Taha, 'Introduction to Operations Research', Prentice Hall India, Tenth Edition, Third Indian Reprint 2019.

Course Outcomes (CO)

CO1	Apply various methods in matrix theory to solve system of linear equations.
CO2	Maximizing and minimizing the functional that occurs in electrical engineering disciplines.
CO3	Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
CO4	Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
CO5	Fourier series analysis and its uses in representing the power signals. Able to expand the periodic and non–periodic as a power signals and Regular Sturm – Liouville systems, Generalized form of Fourier series.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	2	2	1	1	1	2	2	2	3	3	3	2
CO2	3	2	2	2	1	2	1	1	1	1	1	2	3	3	3	1
CO3	2	3	2	3	2	1	1	1	1	2	1	2	3	3	3	2
CO4	3	2	2	3	3	2	2	1	1	2	2	3	3	3	3	2
C05	3	2	3	3	2	2	2	1	2	2	2	2	3	3	3	1

PE1101	POWER SEMICONDUCTOR DEVICES	L	T	P	C
		3	0	0	3

Objectives

- To improve power semiconductor device structures for adjustable speed motor control applications.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices
- To understand the static and dynamic characteristics of voltage–controlled power semiconductor devices
- To enable the students for the selection of devices for different power electronics applications
- To understand the control and firing circuit for different devices.

UNIT – I	INTRODUCTION	9

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On–state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – rating.

UNIT – II	CURRENTCONTROLLED DEVICES	9

BJT's – Construction, static characteristics, switching characteristics; negative temperature coefficient and second breakdown; – Thyristors – Physical and electrical principle underlying operating mode, two transistor analogy – Concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – Steady state and dynamic models of BJT & Thyristor – Basics of GTO, MCT, FCT, RCT

UNIT – III	VOLTAGE CONTROLLED DEVICES	9

Power MOSFETs and IGBTs – Principle of voltage – Controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs – and IGCT. New semiconductor materials for devices – Intelligent power modules – Integrated gate commutated thyristor (IGCT) – Comparison of all power devices.

UNIT – IV	FIRING AND PROTECTING CIRCUITS	9

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT – Over voltage, over current and gate protections; Design of snubbers.

UNIT – V	THERMAL PROTECTION	9

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour –

phase cooling; Guidance for hear sink selection – Thermal resistance and impedance – Electrical analogy of thermal components, heat sink types and design – Mounting types – Switching loss calculation for power device.

Total Periods: 45

Text Books:

1. B. W. Williams, 'Power Electronics Circuit Devices and Applications'. McGraw Hill Higher Education; 2nd edition, 1992.
2. M. H. Rashid, 'Power Electronics Circuits, Devices and Applications', Prentice Hall India, Third Edition, New Delhi, 2004.

Reference Books:

1. MD Singh and K.B Khanchandani, 'Power Electronics', Tata McGraw Hill,2001.
2. Mohan, Undeland and Robins, 'Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore,2000.
3. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw–Hill, 2010.

Course Outcomes (CO)

CO1	Able to understand and analyse different types of power semiconductor devices and their switching characteristics.
CO2	Able to understand and analyse different current controlled semiconductor devices and their switching characteristics.
CO3	Able to understand and analyse different voltage–controlled semiconductor devices and their switching characteristics.
CO4	Design and analyse the Firing and Protecting Circuits For various semiconductor devices
CO5	Design and analyse the cooling and thermal control of semiconductor devices

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	2	1	2	1	1	1	2	3	3	3	3	2
CO2	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	1
CO3	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	2
CO4	3	3	3	3	2	1	2	1	1	1	2	3	3	3	3	2
C05	3	3	3	3	2	1	2	1	1	1	2	3	3	3	3	1

PE1102	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Objectives

- To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi–excited systems.
- To analyze the steady state and dynamic state operation of DC machine through mathematical modelling and simulation in digital computer.
- To provide the knowledge of theory of transformation of three phase variables to two phase variables.
- To analyze the steady state and dynamic state operation of three–phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
- To analyze the steady state and dynamic state operation of three– phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

UNIT – I	PRINCIPLES OF ELECTROMAGNETICENERGY CONVERSION	9

Magnetic circuits, Permanent magnet, Stored magnetic energy, Co–energy – Force and torque in singly and doubly excited systems – Machine windings and air gap MMF – Winding inductances and voltage equations

UNIT – II	DC MACHINES	9

Elementary DC machine and analysis of steady state operation – Voltage and torque equations dynamic characteristics of permanent magnet and shunt D.C. motors – Time domain block diagrams – Solution of dynamic characteristic by Laplace transformation – Digital computer simulation of permanent magnet and shunt D.C. Machines

UNIT – III	REFERENCE FRAME THEORY	9

Historical background – Phase transformation and Commutator transformation – Transformation of variables from stationary to arbitrary reference frame – Variables observed from several frames of reference.

UNIT – IV	INDUCTION MACHINES	9

Three phase induction machine, equivalent circuit and analysis of steady state operation – Free acceleration characteristics – Voltage and torque equations in machine variables and arbitrary reference frame variables – Analysis of dynamic performance for load torque variations – Digital computer simulation.

UNIT – V	**SYNCHRONOUS MACHINES**	**9**
Three phase synchronous machine and analysis of steady state operation – Voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – Analysis of dynamic performance for load torque variations – Generalized theory of rotating electrical machine and Kron's primitive machine.		
	Total Periods:	**45**

Text Books:

1. Paul C. Krause, Oleg Wasyzczuk, Scott S, Sudhoff, 'Analysis of Electric Machinery and Drive Systems', John Wiley, Second Edition, 2010.

Reference Books:

1. P S Bimbhra, 'Generalized Theory of Electrical Machines', Khanna Publishers, 2008.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, 'Electric Machinery', Tata McGraw Hill, 5th Edition, 1992.
3. R. Krishnan, 'Electric Motor & Drives: Modelling, Analysis and Control', New Delhi, Prentice Hall of India, 2001.

Course Outcomes (CO)

CO1	Ability to understand the various electrical parameters in mathematical form.
CO2	Ability to find the electrical machine equivalent circuit parameters and modelling of DC machine.
CO3	Ability to understand the different types of reference frame theories and transformation relationships.
CO4	Ability to find the electrical machine equivalent circuit parameters and modeling of Induction machine.
CO5	Ability to find the electrical machine equivalent circuit parameters and modeling of Synchronous machine.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	1	1	1	1	1	2	1	2	3	2	3	1
CO2	3	3	2	3	3	1	1	1	1	2	1	2	3	3	3	1
CO3	3	3	3	2	3	2	1	2	2	2	1	2	3	3	3	1
CO4	3	3	3	3	2	2	1	2	2	2	2	2	3	2	3	2
C05	3	3	3	2	3	2	1	1	2	2	2	2	3	3	3	2

PE1103	ANALYSIS AND DESIGN OF POWER CONVERTERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand and analyse the operation, characteristics of controlled rectifiers.
- To apply switching techniques and basic topologies of DC–DC switching regulators.
- To introduce power converter components and to design the power converters.
- To provide an in–depth knowledge about resonant converters.
- To comprehend the concepts of AC–AC power converters and their applications.

UNIT – I	SINGLE PHASE & THREE PHASE CONVERTERS	9

Principle of phase–controlled converter operation – Single–phase full converter and semi–converter (RL, RLE load single phase dual converter – Three phase operation full converter and semi–converter (R, RL, RLE load) – Reactive power – Power factor improvement techniques – PWM rectifiers.

UNIT – II	DC–DC CONVERTERS	9

Limitations of linear power supplies, switched mode power conversion, Non–isolated DC–DC converters: operation and analysis of Buck, Boost, Buck–Boost, Cuk & SEPIC – under continuous and discontinuous operation – Isolated converters: basic operation of Flyback, Forward and Push–pull topologies

UNIT – III	DESIGN OF POWER CONVERTER COMPONENTS	9

Introduction to magnetic materials – hard and soft magnetic materials – Types of cores, copper windings – Design of transformer – Inductor design equations – Inductor design for buck/ boost/ fly–back converter – Selection of output filter capacitors – Selection of ratings for devices – Input filter design.

UNIT – IV	RESONANT DC–DC CONVERTERS	9

Switching loss, hard switching, and basic principles of soft switching – Classification of resonant converters – Load resonant converters – Series and parallel – Resonant switch converters – Operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS, ZVT/ZCT PWM converters.

UNIT – V	AC–AC CONVERTERS	9

Principle of on–off and phase angle control – Single phase ac voltage controller – Analysis with R & RL load – Three phase ac voltage controller – Principle of operation of cyclo converter – Single phase and three phase cyclo converters – Single phase matrix converters and three phase matrix converters

Total Periods:	**45**

Text Books:

1. M. H. Rashid, 'Power Electronics Circuits, Devices and Applications', Prentice Hall India, Third Edition, New Delhi, 2004.
2. P. C. Sen, 'Modern Power Electronics', Wheeler Publishing Co, First Edition, New Delhi, 1998.
3. P. S. Bimbra, 'Power Electronics', Khanna Publishers, Eleventh Edition, 2003.

Reference Books:

1. Ned Mohan, T. M. Undeland and W.P Robbin, 'Power Electronics: converters, Application and design' John Wiley and sons. Wiley India edition, 2006.
2. P. Simon Ang, Alejandro Oliva, 'Power–Switching Converters, Second Edition, CRC Press, Taylor & Francis Group, 2010.
3. V. Ramanarayanan, 'Course material on Switched mode power conversion', 2007.
4. Alex Van den Bossche and Vencislav Cekov Valchev, 'Inductors and Transformers for Power Electronics', CRC Press, Taylor & Francis Group, 2005.
5. W. G. Hurley and W. H. Wolfle, 'Transformers and Inductors for Power Electronics Theory, Design and Applications', 2013 John Wiley & Sons Ltd.
6. Marian. K. Kazimierczuk and Dariusz Czarkowski, 'Resonant Power Converters', John Wiley & Sons limited, 2011.

Course Outcomes (CO)

CO1	Ability to understand and analyse the operation, characteristics of controlled rectifiers.
CO2	Ability to apply switching techniques and basic topologies of DC–DC switching regulators.
CO3	Ability to introduce the design of power converter components and to design the converters.
CO4	Ability to provide an in–depth knowledge about resonant converters.
CO5	Ability to comprehend the concepts of AC–AC power converters and their applications

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3
CO2	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3
CO3	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3
C05	3	3	3	3	3	3	2	2	3	2	1	3	3	3	3	3

PE1104	SYSTEM THEORY	L	T	P	C
		3	2	0	4

Objectives

- To understand the fundamentals of physical systems in terms of its linear and nonlinear models.
- To educate on representing systems in state variable form
- To educate on solving linear and non–linear state equations
- To exploit the properties of linear systems such as controllability and observability
- To educate on stability analysis of systems using Lyapunov's theory
- To educate on modal concepts and design of state and output feedback controllers and estimators

UNIT – I	STATE VARIABLE REPRESENTATION	9

Introduction – Concept of State – State equations for Dynamic Systems – Time invariance and linearity – Non uniqueness of state model – Physical Systems and State Assignment – Free and forced responses – State Diagrams.

UNIT – II	SOLUTION OF STATE EQUATIONS	9

Existence and uniqueness of solutions to Continuous – Time state equations – Solution of Nonlinear and Linear Time Varying State equations – State transition matrix and its properties – Evaluation of matrix exponential – System modes – Role of Eigen values and Eigen vectors.

UNIT – III	STABILITY ANALYSIS OF LINEAR SYSTEMS	9

Controllability and Observability definitions and Kalman's rank conditions – Stabilizability and Detectability – Test for Continuous time Systems – Time varying and Time invariant case – Output Controllability – Reducibility – System Realizations.

UNIT – IV	STATE FEEDBACK CONTROL AND STATE ESTIMATOR	9

Introduction – Controllable and Observable Companion Forms – SISO and MIMO Systems – The Effect of State Feedback on Controllability and Observability – Pole Placement by State Feedback for both SISO and MIMO Systems – Full Order and Reduced Order Observers.

UNIT – V	LYAPUNOV STABILTY ANALYSIS	9

Introduction – Equilibrium Points – BIBO Stability – Stability of LTI Systems – Stability in the sense of Lyapunov – Equilibrium Stability of Nonlinear Continuous – Time Autonomous Systems – The Direct Method of Lyapunov and the Linear Continuous – Time Autonomous Systems – Finding Lyapunov Functions for Nonlinear Continuous – Time Autonomous Systems – Krasovskil's and Variable – Gradient Method.

Total Periods:	45+30 = 75 PERIODS

Text Books:

1. M. Gopal, 'Modern Control System Theory', New Age International, 2005.
2. K. Ogatta, 'Modern Control Engineering', PHI, 2002.
3. John S. Bay, 'Fundamentals of Linear State Space Systems', McGraw–Hill, 1999.

Reference Books:

1. D. Roy Choudhury, 'Modern Control Systems', New Age International,2 005.
2. John J. D'Azzo, C. H. Houpis and S. N. Sheldon, 'Linear Control System Analysis and Design with MATLAB', Taylor Francis, 2003.
3. Z. Bubnicki, 'Modern Control Theory', Springer, 2005.
4. C.T. Chen, 'Linear Systems Theory and Design', Oxford University Press, 3rd Edition, 1999.
5. M. Vidyasagar, 'Nonlinear Systems Analysis', 2nd edition, Prentice Hall, Englewood Cliffs, NewJersey.

Course Outcomes (CO)

CO1	Ability to understand the fundamentals of physical systems in terms of its linear and nonlinear models and also educate on representing systems in state variable form
CO2	Ability to understand on solving linear and non–linear state equations
CO3	Ability to represent the time–invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable.
CO4	Ability to design modal concepts and design of state and output feedback controllers, state observers and estimators
CO5	Ability to understand the stability analysis of systems using Lyapunov's theory.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO2	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO3	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO4	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
C05	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3

RM1106	RESEARCH METHODOLOGY AND IPR	L	T	P	C
	Common to CSE, AE, PED, MF, MBA, BT.	2	0	0	2

Objectives

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT – I	RESEARCH PROBLEM FORMULATION	6

Meaning of research problem – Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT – II	LITERATURE REVIEW	6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT – III	TECHNICALWRITING /PRESENTATION	6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT – IV	INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)	6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – V	INTELLECTUAL PROPERTY RIGHTS (IPR)	6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Total Periods: 30

Reference Books:

1. Asimov, 'Introduction to Design', Prentice Hall, 1962.
2. Halbert, 'Resisting Intellectual Property', Taylor & Francis Ltd, 2007.
3. Mayall, 'Industrial Design', McGraw Hill, 1992.
4. Niebel, 'Product Design', McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, 'Research Methodology: A Step–by–Step Guide for beginners' 2010.

Course Outcomes (CO)	
CO1	Ability to formulate research problem
CO2	Ability to carry out research analysis
CO3	Ability to follow research ethics
CO4	Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO5	Ability to understand about IPR and filing patents in R & D

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	1	2	1	2	2	1	3	3	3	2	3	3
CO2	3	3	3	2	1	2	1	2	2	1	3	3	3	2	3	2
CO3	2	3	2	2	1	2	1	3	2	1	3	3	3	1	3	1
CO4	3	3	3	2	1	2	1	3	2	1	3	3	3	2	3	2
C05	2	3	2	2	1	2	1	3	2	1	3	3	3	1	3	2

PE1111	POWER ELECTRONIC CIRCUIT SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To understand the dynamics and different operating modes of power converters
- To analyze, design and simulate different rectifier circuits for generic load
- To simulate different DC to DC Converter topologies.
- To understand the dynamics and different operating modes of AC to AC converters
- To simulate different inverter topologies.
- To develop skills on PCB design and fabrication among the students

List of experiments

1. Simulation of Single–Phase Half Converter with different loads using MATLAB.
2. Simulation of Single–Phase Full Converter with different loads using MATLAB.
3. Simulation of Operation of Single–Phase Semi Converter with motor load using MATLAB.
4. Simulation of Three Phase Full Controlled Rectifier with R, RL loads using MATLAB.
5. Simulation of step–down chopper with different loads using MATLAB.
6. Simulation of Buck Converter using MATLAB.
7. Simulation of Boost Converter using MATLAB.
8. Simulation of Buck–Boost Converter using MATLAB.
9. Simulation of Single–phase half wave AC Voltage Controller with R load using MATLAB.
10. Simulation of Single–phase full wave AC Voltage Controller with R load using MATLAB.
11. Simulation of Three phase full wave AC Voltage Controller with R load using MATLAB.
12. Circuit Simulation of Voltage Source Inverter and study of spectrum analysis with and without filter using MATLAB.
13. PCB design and fabrication of DC power supply using any PCB design software (open source)

Total Periods:	**60 PERIODS**

LIST OF EQUIPMENT FOR A BATCH OF 25 STUDENTS

1. Personal Computers (Intel Core i3, 250 GB,1 GB RAM) – 10
2. Printer – 1
3. Server (Intel Core i3, 4 GB RAM) (High Speed Processor) – 1
4. Software MATLAB/SIMULINK/SCILAB/PSPICE Software – 10

Course Outcomes (CO)	
CO1	Comprehensive understanding on mathematical modeling of Rectifier and ability to implement the same using simulation tools
CO2	Ability to implement the DC to DC converter using simulation tools
CO3	Ability to implement the AC to AC converter using simulation tools
CO4	Ability to implement the DC to AC converter using simulation tools
CO5	Exposure to PCB designing and fabrication

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	2	1	1	1	1	1	3	3	3	2	1
CO2	3	3	3	3	3	2	1	1	1	1	1	3	3	3	2	1
CO3	3	3	3	3	3	2	1	1	1	1	1	3	3	3	2	1
CO4	3	3	3	3	3	2	1	1	1	1	1	3	3	3	2	1
C05	3	3	3	3	3	2	1	1	1	1	1	3	3	3	2	1

PE1112	POWER CONVERTERS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To provide hands on experience with power electronic converter design and testing

List of experiments

1. Single Phase Half and Full converter with R, RL, RLE loads.
2. Voltage Commutated Chopper.
3. Current Commutated Chopper.
4. IGBT based speed control of three phase induction motor using PWM technique.
5. AC voltage regulator.
6. Series Inverter.
7. Parallel Inverter.
8. McMurray–Bedford Inverter.
9. Resonant DC to DC Converter.
10. Study of Cycloconverters.

Total Periods:	**60 PERIODS**

LIST OF EQUIPMENT FOR A BATCH OF 25 STUDENTS

1. Full converter – 2
2. IGBT/MOSFET, OPAMPS/SCR – 10
3. Single phase square wave inverter – 2
4. Regulator DC Power supplies – 5
5. CROs – 10
6. Resistive load – 5
7. Inductive load – 5
8. Capacitive load – 5
9. Breadboards – 20
10. Digital Multimeter – 10
11. Digital Storage Oscilloscope – 5
12. Single phase Isolation Transformer – 5
13. Single–phase step–down transformer – 5
14. Three phase sine PWM Inverter – 5
15. Single phase sine PWM Inverter – 5
16. Single phase auto transformer – 2
17. Three phase Auto transformer – 2

Course Outcomes (CO)	
CO1	Ability to analyze about AC to DC converter circuits.
CO2	Ability to analyze about DC to DC converter circuits.
CO3	Ability to analyze about DC to AC converters.
CO4	Ability to acquire knowledge on AC to AC converters.
CO5	Ability to understand the concepts of resonant converter and its implementation in real time applications.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	2	1	1	1	1	1	2	3	3	2	1
CO2	3	3	3	3	3	2	1	1	1	1	1	2	3	3	2	1
CO3	3	3	3	3	3	2	1	1	1	1	1	2	3	3	2	1
CO4	3	3	3	3	3	2	1	1	1	1	1	2	3	3	2	1
C05	3	3	3	3	3	2	1	1	1	1	1	2	3	2	2	1

PE1201	ANALYSIS AND DESIGN OF INVERTERS	L	T	P	C
		3	0	0	3

Objectives

- To Provide the electrical circuit concepts behind the different working modes of inverters so as to enable deep understanding of their operation.
- To equip with required skills to derive the criteria for the design of inverters for UPS, drives etc.,
- To analyze and comprehend the various operating modes of different configurations of inverters.
- To design different single phase and three phase inverters.
- To impart knowledge on multilevel inverters and modulation techniques

UNIT – I	SINGLE PHASE INVERTERS	9

Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single–phase inverters using various PWM techniques – Various harmonic elimination techniques – Forced commutated thyristor inverters

UNIT – II	THREE PHASE VOLTAGESOURCE INVERTERS	9

180–degree and 120–degree conduction mode inverters with star and delta connected loads – Voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – Application to drive system

UNIT – III	CURRENT SOURCE INVERTERS	9

Operation of six–step thyristor inverter – Inverter operation modes – Load–commutated inverters – Auto sequential current source inverter (ASCI) – Current pulsations – Comparison of current source inverter and voltage source inverters – PWM techniques for current source inverters.

UNIT – IV	MULTILEVEL & BOOST INVERTERS	9

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters – Comparison of multilevel inverters – Application of multilevel inverters – PWM techniques for MLI – Single phase & Three phase Impedance source inverters.

UNIT – V	RESONANT INVERTERS AND POWER CONDITIONERS	9

Series and parallel resonant inverters – Voltage control of resonant inverters – Class E resonant inverter – Resonant DC–Link inverters – Power line disturbances – Power conditioners – UPS: offline UPS, online UPS

Total Periods:	**45**

Text Books:

1. M. H. Rashid, 'Power Electronics Circuits, Devices and Applications ', Prentice Hall India, Fourth edition, New Delhi, 2017.
2. Ned Mohan, T. M. Undeland and W. P. Robbin, 'Power Electronics: converters, Application and design' John Wiley and sons. Wiley India edition, 2007
3. P. S. Bimbra, 'Power Electronics', Khanna Publishers, Eleventh Edition, 2018

Reference Books:

1. Jai P. Agrawal, 'Power Electronics Systems', Pearson Education, Second Edition, 2002.
2. Bimal K. Bose 'Modern Power Electronics and AC Drives', Pearson Education, Second Edition, 2015.
3. Philip T. Krein, 'Elements of Power Electronics' Oxford University Press, 1998.
4. P. C. Sen, 'Modern Power Electronics', Wheeler Publishing Co, First Edition, New Delhi, 1998.

Course Outcomes (CO)

CO1	To design and analyze working modes and operation of single–Phase inverters
CO2	To design and analyze working modes and operation of three phase inverters
CO3	To design and analyze working modes and operation of current source inverter
CO4	To design and analyze working modes and operation of multi–level and boos inverter
CO5	To analyze the working modes and operation of resonant inverters and power conditioners

Course Outcomes	Program Outcomes												PSO			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	2	1	2	1	1	1	2	3	3	3	3	2
CO2	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	1
CO3	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3	2
CO4	3	3	3	3	2	1	2	1	1	1	2	3	3	3	3	2
C05	3	3	3	3	2	1	2	1	1	1	2	3	3	3	3	1

PE1202	Analysis of Electrical Drives	L	T	P	C
		3	2	0	4

Objectives

- To study and analyze the operation of the converter fed DC drives, both qualitatively and quantitatively.
- To study and analyze the operation of the chopper fed DC drives, both qualitatively and quantitatively.
- To familiarize the students on the operation of VSI and CSI fed induction motor drives.
- To understand the field–oriented control of induction machines.
- To impart knowledge on the control of synchronous motor drives.

UNIT – I	RECTIFIER CONTROL OF DC DRIVES	9

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single–phase and three–phase converters – Waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT – II	CHOPPER CONTROL OF DC DRIVES	9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper – Controlled DC motor – Performance analysis, multi–quadrant control – Chopper based implementation of braking schemes; Multi–phase chopper; Related problems

UNIT – III	CONTROL OF INDUCTION MOTOR DRIVES – STATOR SIDE AND ROTORSIDE	9

AC voltage controller circuit, six step inverter voltage control, closed loop variable frequency PWM inverter with dynamic braking, CSI fed variable frequency drives, comparison of CSI and VSI fed Drive, Static rotor resistance control, Injection of voltage in the rotor circuit, Static Scherbius drives, Power factor considerations, Modified Kramer drives.

UNIT – IV	FIELD ORIENTED CONTROL OF INDUCTION MOTOR DRIVES	9

Field oriented control of induction machines – Theory, DC drive analogy, Direct and Indirect methods, Flux vector estimation, Direct torque control of Induction Machines, Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT – V	SYNCHRONOUS MOTOR DRIVES	9

Wound field cylindrical rotor motor: Equivalent circuits, Performance equations for operation from a voltage source, Starting and braking, V curves, Self–control, Margin angle control, Torque control, Power factor control, Brushless excitation systems.

Total Periods: 45

Text Books:

1. Gopal K. Dubey, 'Fundamentals of Electrical Drives', Narosa Publishing House, New Delhi, Second Edition, 2009.
2. R. Krishnan, 'Electric Motor Drives – Modeling, Analysis and Control', Prentice–Hall of India Pvt. Ltd., New Delhi, 2010.
3. Gopal K Dubey, 'Power Semiconductor controlled Drives', Prentice Hall Inc., New Jersy, 1989.

Reference Books:

1. N.K. De., P.K. SEN' Electric drives' PHI, 2012.
2. Bimal K Bose, 'Modern Power Electronics and AC Drives', Pearson Education Asia, 2002.
3. Vedam Subramanyam, 'Electric Drives Concepts and Applications', Second Edition, McGraw Hill, 2016.
4. W. Leonhard, 'Control of Electrical Drives', Narosa Publishing House, 1992.
5. Murphy J.M.D and Turnbull, 'Thyristor Control of AC Motors', Pergamon Press, Oxford, Delhi, 2001.

Course Outcomes (CO)

CO1	Will be able to formulate, design and analyze converter fed DC drives.
CO2	Will be able to formulate, design and analyze chopper fed DC drives.
CO3	Will acquire knowledge on the operation of VSI and CSI fed induction motor drives.
CO4	Will get expertise in the field–oriented control of Induction motor drives.
CO5	Will be able to formulate the control schemes for synchronous motor drives.

Course Outcomes	Program Outcomes												PSO			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	1	2	1	1	1	1	1	3	3	2	3
CO2	3	3	3	3	3	1	2	1	1	1	1	1	3	3	2	3
CO3	3	3	3	3	3	1	2	1	1	1	1	1	3	3	2	3
CO4	3	3	3	3	3	1	2	1	1	1	1	1	3	3	2	3
C05	3	3	3	3	3	1	2	1	1	1	1	1	3	3	2	3

PE1203	Electric Vehicle and Power Management	L	T	P	C
		3	0	0	3

Objectives

- To familiarize about the significance of EV than conventional vehicles.
- To understand the concept of hybrid electric vehicles and its types with their Performance.
- To understand the EV transmission and electric propulsion using various drives.
- To understand the various converter topologies for EV vehicle.
- To understand the different strategies related to battery technology and energy storage systems.

UNIT – I	Introduction to conventional and Electric Vehicles	9

Conventional Vehicles: Internal combustion Engines – Working principle, Engine Operation Characteristics, Emission Control. EV vehicles: EV system – Configurations of EVs – Components of EV – Recent EVs and HEVs – EVs advantages – EVs market – Environmental Impact.

UNIT – II	Hybrid Electric Vehicles	9

Concept of Hybrid Electric drive, Types of Hybrids, Architectures of Hybrid Electric Drive Trains, Design of HEV, Plug–in Hybrid Electric Vehicles (PHEVs), Fuel Cell Electric Vehicles (FCEVs), Comparison of Different Vehicle Specifications

UNIT – III	Electric Trains and propulsion	9

EV Transmission configurations, Transmission components, Ideal Gearbox: Steady State Model, EV Motor Sizing. Electric Propulsion: DC motor drives, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives.

UNIT – IV	Power Converter Topologies for EV/PHEV Charging	9

Power converter topology, Grid and Photovoltaic (PV) System for EV/PHEV Charging, Design of DC/DC Converters and DC/AC Inverters for Grid/PV, Integrated converter, With and without Transformer Based Isolated Charger topology.

UNIT – V	Energy Storage and Battery management systems for EV	9

Battery Technologies – Analysis: Lead–Acid Battery, Nickel–Based Batteries, Lithium – Based Batteries – Battery parameters, Fuel cell – types and characteristics, Ultra capacitors–based energy storage and its analysis, ultra–high–speed flywheels–based energy storage and its analysis, Hybridization of energy storage devices, Battery management systems – SOC Estimation, SOH Estimation.

Total Periods:	**45**

Text Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, 'Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design', CRC Press, 2004.
2. Iqbal Husain, 'Electric and Hybrid vehicles: Design fundamentals', CRC PRESS, Boca Raton London, New York Washington, D.C, 2005.

Reference Books:

1. C. Mi, M. A. Masrur and D. W. Gao, 'Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives', John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, 'Hybrid Electric Vehicles: Energy Management Strategies', Springer, 2015.
3. Larminie, James, and John Lowry, 'Electric Vehicle Technology Explained' John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, 'The automobile, In Electric Vehicles: Prospects and Challenges', Elsevier, 2017.
5. Sheldon S. Williamson, 'Energy Management Strategies for Electric and Plug–in Hybrid Electric Vehicles', Springer, 2013.
6. Gregory L. Plett, 'Battery Management systems', ARTECH House, London, 2016.

Course Outcomes (CO)

CO1	Learned the significance of Electric Vehicle compared to conventional vehicles.
CO2	Able to understand the concept of hybrid electric vehicles architecture with their performance.
CO3	Acquired the knowledge in EV transmission and electric propulsion using various drives train.
CO4	Ability to design the various converter topologies for EV vehicle.
CO5	Concept of different strategies related to battery technology and energy storage systems are analysed.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	1	3	2	2	3	3	2	1	3	3	3	3	3
CO2	3	2	3	3	3	2	2	3	3	2	1	2	3	3	3	3
CO3	3	3	3	3	2	2	2	3	2	2	2	3	3	3	3	2
CO4	3	2	3	3	3	3	3	3	3	3	2	3	3	3	3	3
C05	3	2	2	2	3	3	3	3	3	3	2	3	3	3	3	3

PE1204	**Embedded Controllers**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To get Introduced to PIC controllers.
- To learn the concepts of ARM and DSP processors
- To learn the real–time embedded tools.
- To learn embedded –C coding of various applications
- To understand the embedded peripheral concepts with its structure and programs.

UNIT – I	**Introduction to PIC Microcontroller**	**9**
PIC 16C and PIC 16F series, PIC 18F series – Pin diagram and architecture, Pipelining, memory mapping, SFR's (Special Function Registers), Timers – Structure of timer, interrupt structure, Instruction Set – Addressing modes – Simple ASM programs.		

UNIT – II	**ARM PROCESSOR**	**9**
ARM core architecture – Cortex 9, typical Pin diagram, ARM development tools, memory hierarchy, Instruction Set – Addressing modes – ASM programs for basic arithmetic operations, Co–processor.		

UNIT – III	**DSP PROCESSOR**	**9**
DSP processors: TMS320C2407 – Architecture and pin diagram, General purpose Input/Output (GPIO) Functionality– Interrupts – A/D converter–Event Managers (EVA, EVB) – PWM signal generation.		

UNIT – IV	**Embedded tools and application programs**	**9**
Compilers – KEIL**,** Circuit Schematic Simulation software's – PROTEUS. Application Programs using C: **I**/O port handling, Keypad and multiplexer display, Timers and counters, interrupt handling, Pulse generation program, Capture and compare (CCP), A/D program.		

UNIT – V	**SYSTEM DESIGN – CASE STUDY**	**9**
Voltage regulation of DC–DC converters (buck and boost converter) – Stepper motor and DC motor control – Clarke's and parks transformation – Space vector PWM – Control of Induction Motors and PMSM.		

Total Periods:	**45**

Text Books:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey 'PIC Microcontroller and Embedded Systems using Assembly and C for PIC18', Pearson Education, 2008.
2. S. Furber, 'ARM System on Chip Architecture' Addison Wesley trade Computer Publication, 2000.
3. Hamid A. Toliyat, Steven Campbell, 'DSP based electromechanical motion control', CRC Press, 2003.

Reference Books:

1. John B. Peatman, 'Design with PIC Microcontrollers,' Pearson Education, Asia 2004.
2. John Iovine, 'PIC Microcontroller Project Book', McGraw Hill 2000.

Course Outcomes (CO)

CO1	Ability to understand the features, architectures of PIC, Ability to write the assembly language program.
CO2	Ability to understand the features, architectures of ARM Processor and ability to write the assembly language program.
CO3	Ability to understand the features, architectures of DSP Processor.
CO4	Ability to work on compiler tool and simulation software tool. Ability to develop embedded C program
CO5	Ability to grasp the embedded peripheral design concepts and its applications.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	2	3	3	1	1	3	1	3	2	3	2	2	1
CO2	3	2	2	2	3	3	1	1	3	1	3	3	3	3	2	1
CO3	3	2	2	2	3	3	1	1	3	1	3	2	3	3	2	1
CO4	3	2	2	2	3	3	1	1	3	1	2	3	3	3	2	1
C05	2	3	3	3	2	2	3	3	3	1	2	3	3	2	2	1

PE1211	EMBEDDED CONTROLLER LABOROTORY	L	T	P	C
		0	0	4	2

Objectives

- To perform simple arithmetic operations using various embedded and DSP processors.
- To perform simulation experiments of interrupts and ports interface using Keil compiler.
- To simulate circuit of power converters using Proteus along with compilation in keil compilers.

LIST OF EXPERIMENTS

1. Simple arithmetic operations using PIC, ARM, TMS320C2407
2. Experiments using Keil Compiler:
   i. I/O port handling
   ii. Timer handling using different modes
   iii. Timer as counter
   iv. External Interrupt handling program
   v. Internal interrupt handling program
3. Experiments using Proteus with keil compiler
   i) Pulse generation for DC–DC power electronic converter
   ii) Pulse generation for single phase fully controlled bridge converter
   iii) Pulse generation for H–bridge DC motor driver
   iv) Stepper motor position control.
   v) Message Display using 2–line LCD.

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 25 STUDENTS

1. PIC microcontroller (1 No)
2. ARM Processor (3 Nos)
3. TMS320C2407 – DSP Processor (1 No)
4. Keil Compiler (Open Source)
5. Proteus (Open Source)

Course Outcomes (CO)

CO1	Acquire knowledge on interfacing peripheral devices using embedded processors
CO2	Acquire practical knowledge on embedded tools and its real–time oriented application
CO3	Ability to utilize the knowledge of embedded controllers for the application in the field of Electrical Engineering.
CO4	Acquire knowledge on advanced DSP processors and programming in embedded controllers.
CO5	Acquire practical knowledge on various embedded tools and its real–time applications.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	1	2	3	2	2	3	1	1	1	3	1	1	3	3
CO2	3	3	2	3	3	2	2	3	2	1	1	3	1	1	3	3
CO3	3	3	3	3	3	2	2	3	2	1	1	3	1	1	3	3
CO4	3	2	3	3	3	2	2	3	2	1	1	3	1	1	3	3
CO5	3	3	3	3	3	2	2	3	2	2	2	3	1	1	3	3

PE1311	ELECTRICAL DRIVES LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To design and analyze the various DC and AC drives.
- To generate the firing pulses for converters and inverters using digital processors.
- Design of controllers for linear and nonlinear systems.
- Implementation of closed loop system using hardware simulation.
- To perform DSP based speed control of Switched Reluctance Motor.

LIST OF EXPERIMENTS

1. Speed control of Converter fed DC motor.
2. Speed control of Chopper fed DC motor.
3. V/f control of three–phase induction motor.
4. Micro controller–based speed control of Stepper motor.
5. Speed control of BLDC motor.
6. DSP based speed control of Switched Reluctance Motor.
7. Voltage Regulation of three–phase Synchronous Generator.
8. Cycloconverter fed Induction motor drives.
9. Single phase Multi Level Inverter based induction motor drive.
10. Study of power quality analyzer.

Total Periods:	**60**

LIST OF EQUIPMENTS FOR A BATCH OF 25 STUDENTS

1. Converter fed DC motor drive – 1
2. Chopper fed DC motor drive – 1
3. V/f control–based Induction motor devices – 1
4. Cyclo converter fed induction motor drive – 1
5. Three phase synchronous generator – 1
6. SRM Drive with DSP controller – 1
7. PMBLDC Drive – 1
8. Stepper motor drive with microprocessor–based control – 1
9. Single phase multilevel inverter fed with motor drive – 1
10. Power Quality Analyser – 1
11. Tachometers – 10
12. Ammeters – 10
13. Voltmeters – 10
14. Digital storage oscilloscope – 5

Course Outcomes (CO)	
CO1	Ability to simulate different types of machines, converters in a system.
CO2	Analyze the performance of various electric drive systems.
CO3	Ability to perform both hardware and software simulation.
CO4	To perform speed control of DSP based Switched Reluctance Motor.
CO5	To perform voltage regulation of three phase Synchronous Generator.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	2	2	3	1	1	1	1	3	2	2	3	2	2	1
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
CO4	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1
C05	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3	1

PE1251	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge about AI and Machine learning
- To learn and analyze the Fuzzy based expert system
- To study the basics of supervised learning and their applications.
- To understand unsupervised learning and deep learning algorithms
- To understand and apply the concept of AI / ML for real time applications.

UNIT – I	INTRODUCTION TO ARTIFICIAL INTELLIGENCE (AI)	9

History and evolution of artificial intelligence, strong AI and weak AI, definitions of Artificial Intelligence, emergence of AI – Technological advances, Machine Learning (ML) – Deep Learning, Functions of AI, Characteristics of AI, Applications of AI – Industry 4.0, education sector, Business and Finance Sector, society.

UNIT – II	AI – EXPERT SYSTEMS	9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Fuzzy rules – Membership function – Knowledge base – Decision–making logic – Defuzzification – Introduction to Neuro–Fuzzy system – Adaptive Fuzzy system (Qualitative analysis).

UNIT – III	SUPERVISED LEARNING	9

Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Bayesian Logistic Regression – Decision Trees – Classification Trees – Regression Trees – Pruning. Neural Networks – Feed–forward Network Functions – Error – Back propagation – Regularization – Mixture Density and Bayesian Neural Networks – Kernel Methods – Dual Representations – Radial Basis Function Networks. Ensemble methods – Bagging– Boosting (Qualitative analysis).

UNIT – IV	UNSUPERVISED LEARNING	9

Clustering – K–means – EM – Mixtures of Gaussians – The EM Algorithm in General – Model selection for latent variable models – high–dimensional spaces – The Curse of Dimensionality – Dimensionality Reduction – Factor analysis – Principal Component Analysis – Probabilistic PCA – Independent components analysis – RNN – LSTM (Qualitative analysis).

UNIT – V	REAL TIME APPLICATIONS	9

Smart cities – Vehicle Parking and Traffic Management System – smart waste and disposal management system – smart mobility – Bio–medical image processing – Inventory control – Demand Prediction for Inventory Management

Total Periods:	**45**

TEXT BOOKS:

1. S. Russell and P. Norvig, 'Artificial Intelligence: A Modern Approach', Pearson, Fourth Edition, 2020.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 4th edition, 2016.
3. Ethem Alpaydin, 'Introduction to Machine Learning', PHI learning Pvt Limited, 2015

REFERENCE BOOK:

1. Dan W. Patterson 'Introduction to Artificial Intelligence and Expert Systems', Pearson Education India, 1st Edition, 2015.
2. Kevin P. Murphy, 'Machine Learning: A Probabilistic Perspective', MIT Press, 2012
3. Hastie, Tibshirani, Friedman, 'The Elements of Statistical Learning: Data Mining, Inference, and Prediction', Second Edition (Springer Series in Statistics), 2017.
4. Stephen Marsland, 'Machine Learning – An Algorithmic Perspective', Chapman and hall/CRC Press, 2nd Edition, 2014.
5. Ren, Jingzheng; Shen, Weifeng; Man, Yi; Dong, Lichun, 'Applications of Artificial Intelligence in Process Systems Engineering', Elsevier, 1st Edition, 2021.
6. Harry Collins, 'Artifictional Intelligence: Against Humanity's Surrender to Computers', Polity, 1st Edition, 2018.
7. S.N.Sivanandam and S.N.Deepa, 'Principles of Soft computing', Wiley India Edition, 3rd Edition, 2018.
8. Peter Flach, 'Machine Learning: The Art and Science of Algorithms that Make Sense of Data', Cambridge University Press, 2012

	COURSE OUTCOMES (CO)
CO1	To understand the basics of AI, various subsets and applications.
CO2	To understand the concept of AI expert systems and the structure of the fuzzy Based expert system.
CO3	To understand the structure of the various supervised learning networks.
CO4	To understand the structure of the various unsupervised and deep learning networks.
CO5	To understand and implement the concept of the AI / ML algorithms for real time applications.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
CO2	2	2	2	3	3	1	1	2	1	2	1	2	1	1	1	1
CO3	2	2	2	3	3	1	1	2	1	2	1	2	1	1	1	1
CO4	2	2	2	3	3	1	1	2	1	2	1	2	1	1	1	1
C05	3	3	3	3	3	2	2	3	2	3	3	2	1	1	1	1

PE1252	ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING	L	T	P	C
		3	0	0	3

Objectives

- To refresh the fundamentals of Electromagnetic Field Theory.
- To provide foundation in formulation and computation of Electromagnetic Fields using analytical and numerical methods.
- To impart in–depth knowledge on Finite Element Method in solving Electromagnetic field problems.
- To introduce the concept of mathematical modeling and design of electrical apparatus.

UNIT – I	INTRODUCTION	9

Review of basic field theory – Maxwell's equations – Constitutive relationships and Continuity equations – Laplace, Poisson and Helmholtz equation – principle of energy conversion – Force / torque calculation

UNIT – II	BASIC SOLUTION METHODS FOR FIELD EQUATIONS	9

Limitations of the conventional design procedure, need for the field analysis–based design, problem definition, boundary conditions, solution by analytical methods – Direct integration method – Variable separable method – Method of images, solution by numerical methods – Finite Difference Method.

UNIT – III	FORMULATION OF FINITE ELEMENT METHOD (FEM)	9

Variational Formulation – Energy minimization – Discretization – Shape functions –Stiffness matrix – 1D and 2D planar and axial symmetry problems.

UNIT – IV	COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES	9

Basic quantities – Energy stored in Electric Field – Capacitance – Magnetic Field – Linked Flux – Inductance – Force – Torque – Skin effect – Resistance.

UNIT – V	DESIGN APPLICATIONS	9

Design of Insulators – Cylindrical magnetic actuators – Transformers – Rotating machines.

Total Periods: 45

Reference Books:

1. Matthew. N.O. Sadiku, 'Elements of Electromagnetics', Fourth Edition, Oxford University Press, First Indian Edition2007
2. K. J. Binns, P. J. Lawrenson and C.W Trowbridge, 'The analytical and numerical solution of Electric and magnetic fields', John Wiley & Sons, 1993.
3. Nicola Biyanchi , 'Electrical Machine analysis using Finite Elements', Taylor and Francis Group, CRC Publishers, 2005.
4. Nathan Ida and Joao P. A. Bastos, 'Electromagnetics and calculation of fields', Springer Verlage, 1992.
5. S. J. Salon, 'Finite Element Analysis of Electrical Machines' Kluwer Academic Publishers, London, 1995, distributed by TBH Publishers & Distributors, Chennai, India
6. Peter P. Silvester and Ronald L. Ferrari, 'Finite Elements for Electrical Engineers' Cambridge University press, 1983.

Course Outcomes (CO)

CO1	Ability to understand the fundamental concept of electromagnetic field theory.
CO2	Ability to provide basic solution methodology for field equations.
CO3	Ability to formulate the FEM method for symmetry problems.
CO4	Ability to understand the basic quantities of field theory by using FEM package.
CO5	Apply the concepts in the design of transformer and rotating machines

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	1	1	1	1	1	1	1	1	3	3	1	3	1
CO2	3	3	2	2	1	1	1	1	1	1	1	3	3	1	3	1
CO3	3	3	3	2	1	1	1	1	1	1	1	3	3	1	3	1
CO4	3	3	3	2	1	1	1	1	1	1	1	3	3	1	3	2
C05	3	3	3	2	1	1	1	1	2	2	1	3	3	1	3	2

PE1253	CONTROL SYSTEM DESIGN FOR POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Objectives

- To explore conceptual bridges between the fields of Control Systems and Power Electronics
- To Study Control theories and techniques relevant to the design of feedback controllers in Power Electronics.

UNIT – I	MODELLING OF DC–TO–DC POWER CONVERTERS	9

Modelling of Buck Converter, Boost Converter, Buck–Boost Converter, Cuk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Double Buck–Boost Converter, Boost–Boost Converter General Mathematical Model for Power Electronics Devices.

UNIT – II	SLIDING MODE CONTROLLER DESIGN	9

Variable Structure Systems. Single Switch Regulated Systems Sliding Surfaces, Accessibility of the Sliding Surface Sliding Mode Control Implementation of Boost Converter, Buck–Boost Converter, Cuk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Double Buck–Boost Converter, Boost–Boost Converter.

UNIT – III	APPROXIMATE LINEARIZATION CONTROLLER DESIGN	9

Linear Feedback Control, Pole Placement by Full State Feedback, Pole Placement Based on Observer Design, Reduced Order Observers, Generalized Proportional Integral Controllers, Passivity Based Control, Sliding Mode Control Implementation of Buck Converter, Boost Converter, Buck–Boost Converter

UNIT – IV	NONLINEAR CONTROLLER DESIGN	9

Feedback Linearization Isidori's Canonical Form, Input–Output Feedback Linearization, State Feedback Linearization, Passivity Based Control, Full Order Observers, Reduced Order Observers

UNIT – V	PREDICTIVE CONTROL OF POWER CONVERTERS	9

Basic Concepts, Theory, and Methods, Application of Predictive Control in Power Electronics, AC–DC–AC Converter System, Faults and Diagnosis Systems in Power Converters.

Total Periods:	**45**

Reference Books:

1. Hebertt Sira–Ramírez, Ramón Silva–Ortigoza, 'Control Design Techniques in Power Electronics Devices', Springer, 2012.
2. Mahesh Patil, Pankaj Rodey, 'Control Systems for Power Electronics: A Practical Guide', Springer India, 2015.
3. Blaabjerg José Rodríguez, 'Advanced and Intelligent Control in Power Electronics and Drives', Springer,2014
4. Enrique Acha, Vassilios Agelidis, Olimpo Anaya, TJE Miller, 'Power Electronic Control in Electrical Systems', Newnes, 2002
5. Marija D. Aranya Chakrabortty, Marija, 'Control and Optimization Methods for Electric Smart Grids', Springer, 2012.

Course Outcomes (CO)

CO1	Ability to understand and model the different types of DC–DC power converters.
CO2	Ability to gain knowledge on sliding mode controller design.
CO3	Ability to understand an overview on modern linear control strategies for power electronics devices
CO4	Ability to understand an overview on modern nonlinear control strategies for power electronics devices
CO5	Ability to model modern power electronic converters for industrial applications and to design appropriate controllers for modern power electronics devices.

Course Outcomes	Program Outcomes												PSO			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	1	1	1	1	1	1	3	3	3	2	3	1
CO2	3	3	3	2	1	1	1	1	1	1	3	3	3	2	3	2
CO3	3	3	3	2	2	1	1	1	1	1	2	3	3	2	3	1
CO4	3	3	3	2	2	1	1	1	1	1	2	3	3	2	3	2
C05	3	3	3	2	2	1	1	1	1	1	2	3	3	2	3	2

PE1254	ANALOG AND DIGITAL CONTROLLERS	L	T	P	C
		3	0	0	3

Objectives

- To provide an overview of the control system and converter control methodologies
- To provide an insight to the analog controllers generally used in practice
- To introduce Embedded Processers for Digital Control
- To study on the driving techniques, isolation requirements, signal conditioning and protection methods
- To implement an analog and a digital controller on a converter

UNIT – I	CONTROL SYSTEM–OVERVIEW	9

Feedback and Feed–forward control, Right Half Plane Zero, Gain margin and Phase Margin, Stability, Analysis and Transfer function of P, PI, PD and PID controllers and its effects. Voltage mode control, Peak Current mode Control, Average Current mode Control for Converters – Need, advantages and disadvantages.

UNIT – II	ANALOG CONTROLLERS	9

Major components of a controller – Op–Amp based PI and PID controller – Proportional, Integral and Differential gains in terms of Resistance and Capacitance, Error Amplifiers, PWM generator using Ramp or Triangular generator and comparator, and Driver, Voltage mode controller design using UC3524, Peak Current mode controller design using UC3842, Average Current mode controller design using UC3854.

UNIT – III	DIGITAL CONTROLLERS	9

Micro Controllers and Digital Signal Controllers for Converter Control Application, Interface Modules for Converter Control – A/D, Capture, Compare and PWM, Analog Comparators for instantaneous over current detection, interrupts, Discrete PI and PID equations, Algorithm for PI and PID implementation, Example Code for PWM generation.

UNIT – IV	SIGNAL CONDITIONING, DRIVER, ISOLATION AND PROTECTION	9

Voltage feedback sensing circuits, Hall effect sensors and Shunts for current feedback sensing, Low offset Op–Amps for signal conditioning, Single and dual supply op–amps, Totem pole drivers, need for isolated drivers, optically isolated drivers, low side drivers, high side drivers with bootstrap power supply, Vce sat sensing, CT based Device current sensing and pulse blocking.

UNIT – V	CONTROLLER IMPLEMENTATION	9

Analog and Digital Controller Design for Buck Converter – Power circuit transfer function and bode plot, PI controller bode plot, combined bode plot with required Gain and Phase margins, Implementation of Analog controller and Digital controller.

Total Periods: 45

Text Books:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 6th edition, 2018.
2. George Ellis, 'Control System Design Guide', Elsevier, (Fourth Edition), 2012.
3. Ioan Doré Landau, Gianluca Zito, 'Digital Control Systems: Design, Identification and Implementation', Springer, 2010.

Reference Books:

1. TI Application notes, Reference Manuals and Data sheets.
2. Agilent Data Sheets.
3. Microchip application notes, Reference Manuals and Data sheets.

Course Outcomes (CO)

CO1	Acquire knowledge on control system and converter control methodologies
CO2	Understand the analog controllers generally used in practice
CO3	Study the embedded Processers for Digital Control
CO4	Understand the driving techniques, isolation requirements, signal and conditioning protection methods
CO5	Implementing an analog and a digital controller on a converter

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	2	1	3	2	1	2	1	1	3	3	2	3	2
CO2	3	3	3	2	1	3	2	1	2	1	2	3	3	2	3	2
CO3	3	3	3	2	1	3	2	1	2	1	2	3	3	2	3	3
CO4	3	3	2	1	1	3	2	1	2	1	2	3	3	2	3	1
CO5	3	2	3	1	1	3	2	1	2	1	3	3	3	2	3	1

PE1255	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- The problems in AC transmission systems and establish the Flexible AC transmission systems.
- The operation and control of SVC and its applications to enhance the stability and damping.
- The different modes of operation TCSC and to model it for power flow and stability studies.
- The basic operation and control of voltage source converter–based FACTS controllers.
- The advanced FACTS controllers

UNIT – I	INTRODUCTION	9

Reactive power control in electrical power transmission lines – loads & system compensation, Uncompensated transmission line – shunt and series compensation. Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series Capacitor (TCSC)

UNIT – II	SHUNT COMPENSATION USING STATIC VAR COMPENSATOR	9

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator – Modelling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

UNIT – III	THYRISTOR CONTROLLER BASED SERIES CAPACITOR, GTO AND APPLICATIONS	9

Operation of the TCSC – Different modes of operation – Modelling of TCSC, Variable reactance model– Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping, GTO Characteristics and applications.

UNIT – IV	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS	9

Static Synchronous Compensator (STATCOM) – Principle of operation – V–I Characteristics. Applications: Steady state power transfer – Enhancement of transient stability – Prevention of voltage instability. SSSC – Operation of SSSC and the control of power flow – Modelling of SSSC in load flow and transient stability studies.

UNIT – V	ADVANCED CONTROLLERS AND COORDINATION BETWEEN FACTS CONTROLLERS	9

Interline DVR (IDVR) – Unified Power flow controller (UPFC) – Interline power flow controller (IPFC) – Unified Power quality conditioner (UPQC). FACTS Controller interactions – SVC–SVC interaction – Co–ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

Total Periods:	**45**

TEXT BOOKS:

1. R. Mohan Mathur, Rajiv K. Varma, 'Thyristor–Based Facts Controllers for Electrical Transmission Systems', IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, 'Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems', Standard Publishers Distributors, Delhi–110006, 2011.

Reference Books:

1. K.R. Padiyar, 'FACTS Controllers in Power Transmission and Distribution', New Age International (P) Limited, Publishers, New Delhi, 2008.
2. V. K. Sood, 'HVDC and FACTS controllers – Applications of Static Converters in Power System', April 2004, Kluwer Academic Publishers, 2004.

COURSE OUTCOMES (CO)

CO1	Analyse the reactive power flow in transmission networks and understand the importance of voltage stability
CO2	Analyse and understand the operation of shunt compensated devices namely SVC
CO3	Analyse and understand the operation of series compensated devices namely TCSC and GTO
CO4	Acquire knowledge about the effectiveness of active compensation and usage of SSSC
CO5	Acquire knowledge about new age compensators and their interaction with the system.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	1	1	1	1	1	1	3	1	2	1
CO2	3	3	3	1	1	1	1	1	1	1	1	1	3	2	1	1
CO3	3	2	2	3	1	1	1	1	1	1	1	1	3	3	1	1
CO4	2	3	2	1	2	1	3	1	1	1	1	1	2	2	1	1
C05	3	1	3	1	3	1	1	1	1	1	1	3	1	3	1	1

PE1256	MODERN RECTIFIERS AND RESONANT CONVERTERS	L	T	P	C
		3	0	0	3

Objectives

- To gain knowledge about the harmonic's standards and operation of rectifiers in CCM & DCM.
- To analyze and design power factor correction rectifiers for UPS applications.
- To know the operation of resonant converters for SMPS applications.
- To carry out dynamic analysis of DC– DC Converters.
- To introduce the source current shaping methods for rectifiers

UNIT – I	**POWER SYSTEM HARMONICS & LINECOMMUTATEDRECTIFIERS**	**9**

Average power – RMS value of waveform – Effect of Power factor – Current and voltage harmonics – Effect of source and load impedance – AC line current harmonic standards IEC1000 – IEEE 519 – CCM and DCM operation of single–phase full wave rectifier – Behavior of full wave rectifier for large and small values of capacitance – CCM and DCM operation of three phase full wave rectifier – 12 pulse converters – Harmonic trap filters

UNIT – II	**PULSE WIDTH MODULATED RECTIFIERS**	**9**

Properties of Ideal single–phase rectifiers – Realization of nearly ideal rectifier – Single–phase converter systems incorporating ideal rectifiers – Losses and efficiency in CCM high quality rectifiers – single–phase PWM rectifier – PWM concepts – Device selection for rectifiers – IGBT based PWM rectifier, comparison with SCR based converters with respect to harmonic content – Applications of rectifiers.

UNIT – III	**RESONANTCONVERTERS**	**9**

Soft Switching – Classification of resonant converters – Quasi resonant converters – Basics of ZVS and ZCS – Half wave and full wave operation (qualitative treatment) – Multi resonant converters – Operation and analysis of ZVS and ZCS multi resonant converter – Zero voltage transition PWM converters – Zero current transition PWM converters

UNIT – IV	**DYNAMIC ANALYSIS OFSWITCHINGCONVERTERS**	**9**

Review of linear system analysis – State Space Averaging – Basic State Space Average Model – State Space Averaged model for an ideal Buck Converter, ideal Boost Converter, ideal Buck Boost Converter and an ideal Cuk Converter. Pulse Width modulation – Voltage Mode PWM Scheme – Current Mode PWM Scheme – Design of PI controller.

UNIT – V	**SOURCE CURRENT SHAPINGOF RECTIFIERS**	**9**

Need for current shaping – Power factor – Functions of current shaper – Input current shaping methods – Passive shaping methods – Input inductor filter – Resonant input filter – Active methods – Boost rectifier employing peak current control – Average current control – Hysteresis control – Nonlinear carrier control.

Total Periods:	**45**

Reference Books:

1 Robert W. Erickson and Dragon Maksimovic, 'Fundamentals of Power Electronics', Second Edition, Springer science and Business media, 2001.
2 William Shepherd and Li zhang, 'Power Converters Circuits', CRC Press, Taylor & Francis Group, 2019.
3 Simon Ang and Alejandro Oliva, 'Power Switching Converters', Taylor & Francis Group, 2010.
4 Andrzej M. Trzynadlowski, 'Introduction to Modern Power Electronics', John Wiley & Sons, 2016.
5 Marian. K. Kazimierczuk and Dariusz Czarkowski, 'Resonant Power Converters', John Wiley & Sons limited, 2011.
6 Keng C. Wu, 'Switch Mode Power Converters – Design and Analysis', Elseveir academic press, 2006.
7 Abraham I. Pressman, Keith Billings and Taylor Morey, 'Switching Power Supply Design' McGraw–Hill, 2009
8 V. Ramanarayanan, 'Course Material on Switched Mode Power Conversion', IISC, Banglore, 2007.
9 Christophe P. Basso, Switch–Mode Power Supplies, McGraw–Hill, 2014.

Course Outcomes (CO)

CO1	Apply the concept of various types of rectifiers.
CO2	Simulate and design the operation of resonant converter and its importance.
CO3	Identify the importance of linear system, state space model, PI controller.
CO4	Design the DC power supplies using advanced techniques.
CO5	Understand the standards for supply current harmonics and its significance.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO2	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO3	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO4	3	3	4	3	3	1	3	1	1	1	1	1	3	3	3	1
C05	3	3	4	3	3	1	3	1	1	1	1	1	3	3	3	1

PE1257	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

Objectives

- To provide fundamental knowledge on electromagnetic interference and electromagnetic compatibility.
- To study the important techniques to control EMI and EMC. To expose the knowledge on testing techniques as per Indian and international standards in EMI measurement.

UNIT – I	INTRODUCTION	9

Definitions of EMI/EMC – Sources of EMI – Inter systems and Intra system – Conducted and radiated interference – Characteristics – Designing for electromagnetic compatibility (EMC) – EMC regulation typical noise path – EMI predictions and modelling, Cross talk – Methods of eliminating interferences.

UNIT – II	GROUNDING AND CABLING	9

Cabling – types of cables, mechanism of EMI emission / coupling in cables – Capacitive coupling inductive coupling – Shielding to prevent magnetic radiation – Shield transfer impedance, Grounding – Safety grounds – Signal grounds – Single point and multipoint ground systems hybrid grounds – Functional ground layout – Grounding of cable shields – Guard shields– isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding – Earth measurement Methods.

UNIT – III	BALANCING, FILTERING AND SHIELDING	9

Power supply decoupling – Decoupling filters – Amplifier filtering – High frequency filtering – EMI filters characteristics of LPF, HPF, BPF, BEF and power line filter design –Choice of capacitors, inductors, transformers and resistors, EMC design components –Shielding – Near and far fields shielding effectiveness – Absorption and reflection loss – Magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets – Windows and coatings – Grounding of shields

UNIT – IV	EMI IN ELEMENTS AND CIRCUITS	9

Electromagnetic emissions, noise from relays and switches, non–linearities in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction

UNIT – V	ELECTROSTATIC DISCHARGE, STANDARDS AND TESTING	9

Static Generation – Human body model – Static discharges – ESD versus EMC, ESD protection in equipment's – Standards – FCC requirements – EMI measurements – Open area test site measurements and precautions – Radiated and conducted interference measurements, Control requirements and testing methods.

Total Periods:	**45**

Reference Books:

1. V.P. Kodali, 'Engineering Electromagnetic Compatibility', S. Chand, 1996.
2. Henry W. Ott, 'Noise reduction techniques in electronic systems', John Wiley & Sons, 1989.
3. Bernhard Keiser, 'Principles of Electro–magnetic Compatibility', Artech House, Inc. 1987.
4. J. E. Bridges, J. Milleta and L. W. Ricketts., 'EMP Radiation and Protective techniques', John Wiley and sons, USA, 1976.
5. G. William Duff, & R. J. Donald White, 'A handbook Series on Electromagnetic Interference and Compatibility', Interference Control Technologies, Inc. 1988.
6. A. Weston David, 'Electromagnetic Compatibility, Principles and Applications', CRC Press, 2006.

Course Outcomes (CO)

CO1	To understand the basic definition, sources of EMI and the design of EMC.
CO2	To understand the design of cabling and grounding for EMC.
CO3	To understand the various EMI filters and the shielding design for EMC.
CO4	To understand the various sources of EMI in power systems and its effect.
CO5	To understand the electrostatic discharge, standards and various measurement techniques of EMI.

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**I**	**j**	**k**	**L**	**1**	**2**	**3**	**4**
CO1	3	3	2	2	1	1	1	1	1	1	3	3	1	1	3	3
CO2	3	3	2	2	2	1	1	1	1	1	3	3	1	1	3	3
CO3	3	3	3	3	2	1	2	1	1	1	3	3	1	1	3	3
CO4	3	2	3	3	3	1	2	1	1	1	3	3	1	1	3	2
C05	3	2	3	3	3	1	3	1	1	1	3	3	1	1	3	2

PE1258	MEMS TECHNOLOGY	L	T	P	C
		3	0	0	3

Objectives

- To teach the students properties of materials, micro structure and fabrication methods.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS devices.
- To involve Discussions / Practice / Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT – I	MICRO–FABRICATION, MATERIALS AND ELECTRO–MECHANICAL CONCEPTS	9

Overview of micro fabrication – Silicon and other material–based fabrication processes – Concepts: Conductivity of semiconductors–Crystal planes and orientation–stress and strain–flexural beam bending analysis – Torsional deflections – Intrinsic stress – Resonant frequency and quality factor.

UNIT – II	ELECTROSTATIC SENSORS AND ACTUATION	9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators – Applications

UNIT – III	THERMAL SENSING AND ACTUATION	9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors – Applications.

UNIT – IV	PIEZOELECTRIC SENSING AND ACTUATION	9

Piezoelectric effect – Cantilever piezoelectric actuator model – Properties of piezoelectric materials – Applications.

UNIT – V	CASE STUDIES	9

Piezo resistive sensors, Magnetic actuation, Micro fluidics applications, medical applications, Optical MEMS – NEMS Devices
Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench: on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

Total Periods:	**45**

Reference Books:

1. Chang Liu, 'Foundations of MEMS', Pearson International Edition,2 006.
2. Marc Madou, 'Fundamentals of micro fabrication', CRC Press,1997.
3. Boston, 'Micro machined Transducers Sourcebook', WCB McGraw Hill,1998.
4. M. H. Bao 'Micromechanical transducers: Pressure sensors, accelerometers and gyroscopes', Elsevier, New york, 2000.

Course Outcomes (CO)

CO1	Understand basics of micro fabrication, develop models and simulate electrostatic and electromagnetic sensors and actuators.
CO2	Understand material properties important for MEMS system performance, analyze dynamics of resonant micro mechanical structures.
CO3	The learning process delivers insight onto design of micro sensors, embedded sensors & actuators in power aware systems like grid.
CO4	Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical micro systems.
CO5	Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	1	1	1	1	1	2	3	3	2	3	2
CO2	3	3	3	3	2	1	1	1	1	1	2	3	3	2	3	2
CO3	3	3	3	3	2	1	1	1	1	1	2	3	3	2	3	2
CO4	3	3	3	3	2	1	1	1	1	1	2	3	3	2	3	2
C05	3	3	3	3	2	1	1	1	1	1	2	3	3	2	3	2

PE1259	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

Objectives

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration

UNIT – I	INTRODUCTION	9

Conventional power generation: advantages and disadvantages, Energy crises, Non–conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro–turbines, biomass, and tidal sources.

UNIT – II	DISTRIBUTED GENERATIONS (DG)	9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra–capacitors, flywheels. Captive power plants.

UNIT – III	IMPACT OF GRID INTEGRATION	9

Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT – IV	BASICS OF A MICROGRID	9

Concept and definition of Microgrid, Microgrid drivers and benefits, review of sources of Microgrids, typical structure and configuration of a Microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC Microgrids.

UNIT – V	CONTROL AND OPERATION OF MICROGRID	9

Modes of operation and control of Microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti–islanding schemes: passive, active and communication–based techniques, Microgrid communication infrastructure, Power quality issues in Microgrids, regulatory standards, Microgrid economics, Introduction to smart Microgrids.

Total Periods:	**45**

Reference Books:

1. Amirnaser Yezdani, and Reza Iravani, 'Voltage Source Converters in Power Systems: Modeling, Control and Applications', IEEE John Wiley Publications, 2010.
2. Dorin Neacsu, 'Power Switching Converters: Medium and High Power', CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, 'Solar Photo Voltaics', PHI learning Pvt. Ltd., NewDelhi,2009
4. J.F. Manwell, J.G. McGowan 'Wind Energy Explained, theory design and applications', Wiley publication2010.
5. D. D. Hall and R. P. Grover, 'Biomass Regenerable Energy', John Wiley, New York, 1987.
6. John Twidell and Tony Weir, 'Renewable Energy Resources' Taylor and Francis Publications, Second edition 2006.

Course Outcomes (CO)

CO1	Understand the various conventional and non conventional sources of electrical energy.
CO2	Understand the various topologies, standards and energy storage elements of the distributed generations.
CO3	Understand the grid integration, stability and power quality issues of distributed generations.
CO4	Understand the different configurations and interfaces of the Microgrid.
CO5	Understand the control of Microgrids and the concept of smart Microgrids.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO2	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO3	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO4	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
C05	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3

PE1351	**HIGH VOLTAGE DIRECT CURRENT TRANSMISSION**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To impart knowledge on operation, modelling and control of HVDC link.
- To perform steady state analysis of AC/DC system.
- To expose various HVDC simulators.

UNIT – I	**DC POWER TRANSMISSION TECHNOLOGY**	**9**

Introduction – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

UNIT – II	**THYRISTOR BASED HVDC CONVERTERS AND HVDC SYSTEM CONTROL**	**9**

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics – Characteristics of a twelve–pulse converter – Detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Generation of harmonics and filtering – Power control – Higher level controllers – Valve tests

UNIT – III	**MULTI TERMINAL DC SYSTEMS**	**9**

Introduction – Potential applications of MTDC systems – Types of MTDC systems – Control and protection of MTDC systems – Study of MTDC systems

UNIT – IV	**POWER FLOW ANALYSIS IN AC/DC SYSTEMS**	**9**

Per unit system for DC Quantities – Modelling of DC links – Solution of DC load flow – Solution of AC–DC power flow – Unified, Sequential and Substitution of power injection method

UNIT – V	**SIMULATION OF HVDC SYSTEMS**	**9**

Introduction – DC LINK Modelling, Converter Modeling and State Space Analysis, Philosophy and tools – HVDC system simulation, online and off–line simulators – Dynamic interactions between DC and AC systems

Total Periods:	**45**

Text Books:

1. P. Kundur, 'Power System Stability and Control', McGraw–Hill,1993
2. K. R. Padiyar, 'HVDC Power Transmission Systems', New Age International (P) Ltd., New Delhi, 2002.
3. S. Rao, 'EHV–AC, HVDC Transmission and Distribution Engineering', Third Edition. 2013.

Reference Books:

1 J. Arrillaga, 'High Voltage Direct Current Transmission', Peter Pregrinus, London, 1983.
2 Erich Uhlmann, 'Power Transmission by Direct Current', BS Publications, 2004.
3 V. K. Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, April 2004, Kluwer Academic Publishers

Course Outcomes (CO)

CO1	Ability to understand the DC power Transmission technology and their related components.
CO2	Ability to understand the analysis of HVDC converters principles and control
CO3	Ability to understand about the Multi Terminal HVDC Systems
CO4	Ability to understand the power flow analysis in DC system
CO5	Ability to model and simulate the HVDC systems

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	2	1	2	1	1	1	2	3	2	1	2
CO2	3	2	2	1	1	2	1	2	1	1	1	2	3	2	1	2
CO3	3	2	2	1	1	2	1	2	1	1	1	2	3	2	1	2
CO4	3	2	2	1	1	2	1	2	1	1	1	2	3	2	1	2
CO5	3	3	3	3	3	2	1	2	1	1	1	2	3	2	1	2

PE1352	SOLAR AND ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To Study about solar modules and PV system design and their applications.
- To Deal with grid connected PV systems.
- To Discuss about different energy storage systems.

UNIT – I	INTRODUCTION	9

Characteristics of sunlight – Semiconductors and P–N junctions – Behaviour of solar cells – Cell properties – PV cell interconnection.

UNIT – II	STAND ALONE PV SYSTEM	9

Solar modules – Storage systems – Power conditioning and regulation – MPPT– Protection – Stand–alone PV systems design – Sizing.

UNIT – III	GRID CONNECTED PV SYSTEMS	9

PV systems in buildings – Design issues for central power stations – Safety – Economic aspect – Efficiency and performance – International PV programs.

UNIT – IV	ENERGY STORAGE SYSTEMS	9

Impact of intermittent generation – Battery energy storage – Solar thermal energy storage – Pumped hydroelectric energy storage.

UNIT – V	APPLICATIONS	9

Water pumping – Battery chargers – Solar car – Direct–drive applications – Space – Telecommunications.

Total Periods: 45

Text Books:

1. Solanki C.S., 'Solar Photovoltaics: Fundamentals, Technologies and Applications', PHI Learning Pvt. Ltd., 2015.
2. Stuart R. Wenham, Martin A. Green, Muriel E. Watt and Richard Corkish, 'Applied Photovoltaics', Third edition, 2012, Earthscan, UK.

Reference Books:

1. Eduardo Lorenzo G. Araujo, 'Solar electricity engineering of photovoltaic systems', Progensa, 1994.
2. Frank S. Barnes & Jonah G. Levine, 'Large Energy storage Systems Handbook', CRC Press, 2011.

3. McNeils, Frenkel, Desai, 'Solar & Wind Energy Technologies', Wiley Eastern, 1990.
4. S. P. Sukhatme, 'Solar Energy', Fourth edition, Tata McGraw Hill Education, 2017.

Course Outcomes (CO)

CO1	Students will develop more understanding on solar radiation and solar cell interconnections.
CO2	Students will develop basic knowledge on standalone PV system.
CO3	Students will understand the issues in grid connected PV systems.
CO4	Students will study about the modelling of different energy storage systems and their performances.
CO5	Students will attain more on different applications of solar energy.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	3	3	3	2	2	1	2	3	2	2	2
CO2	2	3	3	3	3	3	3	3	3	3	1	2	2	3	3	3
CO3	2	2	3	3	3	2	2	3	3	3	1	2	1	2	3	3
CO4	3	3	2	3	3	3	3	3	2	2	1	2	3	3	3	2
CO5	3	3	3	3	2	2	3	3	2	2	1	2	3	2	2	2

PE1353	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To learn basic scientific working principles, various parts design and efficiency computation theories of wind turbine.
- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed wind energy conversion systems.
- To understand the concepts of variable speed wind energy conversion systems.
- To analyze the grid integration and its issues.

UNIT – I	**INTRODUCTION**	**9**

Components of WECS – WECS schemes – Power obtained from wind – Simple momentum theory – Power coefficient – Sabinin's theory – Aerodynamics of Wind turbine.

UNIT – II	**WIND TURBINES**	**9**

HAWT – VAWT – Power developed – Thrust–Efficiency – Rotor selection – Rotor design considerations – Tip speed ratio – No. of Blades – Blade profile – Power Regulation – Yaw control – Pitch angle control – Stall control – Schemes for maximum power extraction.

UNIT – III	**FIXED SPEED SYSTEMS**	**9**

Generating Systems – Constant speed constant frequency systems – Choice of Generators– Deciding factors – Synchronous Generator – Squirrel Cage Induction Generator – Model of Wind Speed – Model wind turbine rotor – Drive Train model – Generator model for Steady state and Transient stability analysis.

UNIT – IV	**VARIABLESPEED SYSTEMS**	**9**

Need of variable speed systems – Power–wind speed characteristics – Variable speed constant frequency systems synchronous generator – DFIG – PMSG – Variable speed generators modeling Variable speed variable frequency schemes.

UNIT – V	**GRID CONNECTED SYSTEMS**	**9**

Wind interconnection requirements, Low–Voltage Ride Through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady – state and dynamic performance of the power system including modeling issue.

Total Periods:	**45**

Reference Books:

1. L. L. Freris, 'Wind Energy conversion Systems', Prentice Hall, 1990.
2. S. N. Bhadra, D. Kastha, S. Banerjee, 'Wind Electrical Systems', Oxford University Press, 2010.
3. Ion Boldea, 'Variable speed generators', Taylor & Francis group, 2006.
4. E. W. Golding, 'The generation of Electricity by wind power', Redwood burn Ltd., Trowbridge, 1976.
5. N. Jenkins, 'Wind Energy Technology', John Wiley & Sons, 1997.
6. S. Heir, 'Grid Integration of WECS', Wiley 1998.

Course Outcomes (CO)

CO1	Acquire knowledge on the basic concepts of Wind energy conversion system.
CO2	Understand the mathematical modeling and control of the Wind turbine
CO3	Develop more understanding on the design of Fixed speed system.
CO4	Study about the need of Variable speed system and its modeling.
CO5	Able to learn about Grid integration issues and current practices of wind interconnections with power system.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO2	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO3	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
CO4	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1
C05	3	3	3	3	3	1	3	1	1	1	1	1	3	3	3	1

PE1354	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

Objectives

- To study the concepts behind economic analysis and Load management.
- To emphasize the energy management on various electrical equipment and metering.
- To Illustrate the concept of lighting systems and cogeneration.

UNIT – I	INTRODUCTION	9

Need for energy management – Energy basics – Designing and starting an energy management program – Energy accounting – Energy monitoring, targeting and reporting – Energy audit process.

UNIT – II	ENERGY COST AND LOAD MANAGEMENT	9

Important concepts in an economic analysis – Economic models – Time value of money – Utility rate structures – Cost of electricity – Loss evaluation – Load management: Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

UNIT – III	ENERGY MANAGEMENT FOR MOTORS, SYSTEMS AND ELECTRICAL EQUIPMENT	9

Systems and equipment – Electric motors – Transformers and reactors – Capacitors and synchronous machines.

UNIT – IV	METERING FOR ENERGY MANAGEMENT	9

Relationships between parameters – Units of measure – Typical cost factors – Utility meters –Timing of meter disc for kilowatt measurement – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multitasking solid – State meters – Metering location vs. requirements – Metering techniques and practical examples.

UNIT – V	LIGHTING SYSTEMS & COGENERATION	9

Concept of lighting systems – The task and the working space – Light sources – Ballasts – Luminaries – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics on power quality – Cost analysis techniques – Lighting and energy standards Cogeneration: Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

Total Periods:	**45**

Reference Books:

1 Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, 'Guide to Energy Management', Fifth Edition, The Fairmont Press, Inc.,2006
2 Eastop T.D & Croft D.R, 'Energy Efficiency for Engineers and Technologists', Logman Scientific & Technical,1990.
3 Reay D.A, 'Industrial Energy Conservation', 1st edition, Pergamon Press,1977.
4 'IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities', IEEE,1996
5 Amit K. Tyagi, 'Handbook on Energy Audits and Management', TERI,2003.

Course Outcomes (CO)

CO1	Students will develop the ability to learn about the need for energy management and auditing process.
CO2	Learners will learn about basic concepts of economic analysis and load management.
CO3	Students will understand the energy management on various electrical equipment.
CO4	Students will have knowledge on the concepts of metering and factors influencing cost function.
CO5	Students will be able to learn about the concept of lighting systems, light sources and various forms of cogeneration.

Course Outcomes	Program Outcomes												PSO			
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	1	1	1	1	1	1	3	3	3	1	3	3
CO2	3	3	3	3	1	1	1	1	1	1	3	3	3	1	3	3
CO3	3	3	3	3	1	1	1	1	1	1	3	3	3	2	3	3
CO4	3	3	3	2	1	1	1	1	1	1	2	3	3	2	3	2
C05	3	3	3	2	1	1	1	1	1	1	3	3	3	2	3	2

PE1355	NON–LINEAR DYNAMICS FOR POWER ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

Objectives

- To understand the non–linear behaviour of power electronic converters
- To understand the techniques for investigation on non – linear behaviour of power electronic converters
- To analyze the non – linear phenomena in DC to DC converters
- To analyze the non – linear phenomena in AC and DC Drives
- To introduce the control techniques for control of non – linear behaviour in power electronic systems

UNIT – I	BASICS OF NON–LINEAR DYNAMICS	9

Basics of Nonlinear Dynamics: System, state and state space model, Vector field – Modelling of Linear, nonlinear and Linearized systems, Attractors, chaos, Poincare map, Dynamics of Discrete time system, Lyapunov Exponent, Bifurcations, Bifurcations of smooth map, Bifurcations in piece wise smooth maps, border crossing and border collision bifurcation.

UNIT – II	TECHNIQUES FOR INVESTIGATION OF NON–LINEAR PHENOMENA	9

Techniques for experimental investigation, Techniques for numerical investigation, Computation of averages under chaos, Computations of spectral peaks, Computation of the bifurcation and analyzing stability.

UNIT – III	NON–LINEAR PHENOMENA IN DC–DC CONVERTERS	9

Border collision in the Current Mode controlled Boost Converter, Bifurcation and chaos in the Voltage controlled Buck Converter with latch, Bifurcation and chaos in the Voltage controlled Buck Converter without latch, Bifurcation and chaos in Cuk Converter. Nonlinear phenomenon in the inverter under tolerance band control.

UNIT – IV	NON–LINEAR PHENOMENA IN DRIVES	9

Nonlinear Phenomenon in Current controlled and voltage–controlled DC Drives, Nonlinear Phenomenon in PMSM Drives.

UNIT – V	CONTROL OF CHAOS	9

Hysteresis control, sliding mode and switching surface control, OGY Method, Pyragas method, Time Delay control. Application of the techniques to the Power electronics circuit and drives.

Total Periods: 45

Reference Books:

1. Steven H Strogatz, Nonlinear Dynamics and Chaos, West view Press, 2001.
2. C.K.TSE Complex Behaviour of Switching Power Converters, CRC Press, 2003.
3. George C. Vargheese, July 2001 Wiley – IEEE Press S Banerjee, Nonlinear Phenomena in Power Electronics, IEEE Press 3.

Course Outcomes (CO)

CO1	Ability to comprehend the non – linear behaviour of power electronic converters
CO2	Ability to understand the techniques for investigation on non – linear behaviour of power electronic converters
CO3	To analyse the non–linear phenomena in DC to DC converters
CO4	To analyse the non–linear phenomena in AC and DC Drives
CO5	Ability to explain the control techniques for control of non–linear behaviour in power electronic systems

Course Outcomes	Program Outcomes										PSO			
	a	b	c	d	e	f	g	h	i	j	1	2	3	4
CO1	3	3	2	3	3	1	1	1	1	1	3	3	3	2
CO2	3	3	2	3	3	1	1	1	1	1	3	3	3	2
CO3	3	3	2	3	3	1	1	1	1	1	3	3	3	2
CO4	3	3	2	3	3	1	1	1	1	1	3	3	3	2
C05	3	3	2	3	3	1	1	1	1	1	3	3	3	2

PS1356	SMART GRID	L	T	P	C
		3	0	0	3

Objectives

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high–performance computing for Smart Grid application

UNIT – I	INTRODUCTION TO SMART GRID	9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid

UNIT – II	SMART GRID TECHNOLOGIES	9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High–Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV)

UNIT – III	SMART METERS AND ADVANCED METERING INFRASTRUCTURE	9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection

UNIT – IV	POWER QUALITY MANAGEMENT INSMART GRID	9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit

UNIT – V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid

Total Periods:	**45**

Text Books:

1. Stuart Borlase 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press, 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley, 2012.

Reference Books:

1. Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati and Gerhard P. Hancke, 'Smart Grid Technologies: Communication Technologies and Standards', IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang, 'Smart Grid – The New and Improved Power Grid: A Survey', IEEE Transaction on Smart Grids, Vol. 14, 2012.

Course Outcomes (CO):

CO1	Learners will develop more understanding on the concepts of Smart Grid and its present developments.
CO2	Learners will study about different Smart Grid technologies.
CO3	Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
CO4	Learners will have knowledge on power quality management in Smart Grids
CO5	Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	1	2	1	1	2	2	1	1	1	1	1	3	1	1	1
CO2	3	1	2	1	1	2	2	1	1	1	1	1	3	1	1	1
CO3	3	1	2	1	1	2	2	1	1	1	1	1	3	1	1	1
CO4	3	1	2	1	1	2	2	1	1	1	1	1	3	1	1	1
C05	3	1	2	1	1	2	2	1	1	1	1	1	3	1	1	1

PE1357	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms

UNIT – I	INTRODUCTION	9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost–GHG Emission) – Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems: operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems – Control strategy, operating area.

UNIT – II	ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION	9

Review of reference theory fundamentals – Principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT – III	POWER ELECTRONICS FOR SOLAR	9

Block diagram of solar photo voltaic system: line commutated converters (inversion–mode) – Boost and buck–boost converters – Selection of inverter, battery sizing, array sizing – Standalone PV systems – Grid tied and grid interactive inverters – Grid connection issues.

UNIT – IV	POWER ELECTRONICS FOR WIND	9

Three phase AC voltage controllers – AC–DC–AC converters: uncontrolled rectifiers, PWM Inverters, matrix converters – Standalone operation of fixed and variable speed wind energy conversion systems – Grid connection Issues – Grid integrated PMSG and SCIG Based WECS.

UNIT – V	HYBRID RENEWABLE ENERGY SYSTEMS	9

Need for Hybrid Systems – Range and type of Hybrid Systems – Case studies of Wind – PV– Maximum Power Point Tracking (MPPT).

Total Periods:	**45**

Text Books:

1 S. N. Bhadra, D. Kastha, & S. Banerjee 'Wind Electrical Systems', Oxford University Press, 2009.
2 M. H. Rashid, 'Power electronics Hand book', Academic press, 2001.
3 G.D. Rai, 'Non–conventional energy sources', Khanna publishes, 1993.
4 G.D. Rai, 'Solar energy utilization', Khanna publishes, 1993.

Reference Books:

1 Gray, L. Johnson, 'Wind energy system', Prentice Hall linc, 1995.
2 B. H. Khan, 'Non–conventional Energy sources', Tata McGraw Hill Publishing Company.
3 P.S. Bimbhra, 'Power Electronics', Khanna Publishers, 3rd Edition, 2003.
4 Fang Lin Luo Hong Ye, 'Renewable Energy systems', Taylor & Francis Group, 2013.
5 R. Seyezhai and R. Ramaprabha, 'Power Electronics for Renewable Energy Systems', Scitech Publications, 2015.

Course Outcomes (CO)

CO1	Discuss and analyze the various types of renewable energy sources
CO2	Analyze the performance of IG, PMSG, SCIG AND DFIG
CO3	Design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy sources
CO4	Analyze various operating modes of wind electrical generators and solar energy systems
CO5	Develop maximum power point tracking algorithms

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO2	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO3	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO4	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
C05	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3

PE1358	ROBOTICS AND CONTROL	L	T	P	C
		3	0	0	3

Objectives

- To introduce robot terminologies and robotic sensors
- To educate direct and inverse kinematic relations
- To educate on formulation of manipulator Jacobians and introduce path planning techniques
- To educate on robot dynamics
- To introduce robot control techniques

UNIT – I	**INTRODUCTION AND TERMINOLOGIES**	**9**

Definition – Classification – History – Robot's components – Degrees of freedom – Robot joints – Coordinates – Reference frames – Workspace – Robot languages – Actuators – Sensors: Position, Velocity, Acceleration, Torque, Tactile, Touch, Proximity and range sensors – Vision system – Social issues.

UNIT – II	**KINEMATICS**	**9**

Mechanism – Matrix representation – Homogenous transformation – DH representation – Inverse kinematics solution and programming – Degeneracy and Dexterity

UNIT – III	**DIFFERENTIAL MOTION AND PATH PLANNING**	**9**

Jacobian – Differential motion of frames – Interpretation – Calculation of Jacobian – Inverse Jacobian – Robot Path planning.

UNIT – IV	**DYNAMIC MODELLING**	**9**

Lagrangian mechanics – Two–DOF manipulator – Lagrange – Euler formulation – Newton – Euler formulation – Inverse dynamics

UNIT – V	**ROBOT CONTROL SYSTEM**	**9**

Linear control schemes – Joint actuators – Decentralized PID control – Computed torque control – Force control – Hybrid position force control – Impedance / Torque control

Total Periods: 45

Text Books:

1. R.K. Mittal and I J Nagrath, 'Robotics and Control', Tata MacGraw Hill, Fourth edition.
2. Saeed B. Niku, 'Introduction to Robotics', Pearson Education, 2002.

Reference Books:

1. K. S. Fu, R.C. Gonzalez and C.S.G. Lee, 'Robotics: Control, Sensing, Vision and Intelligence' McGraw Hill Education India, 1986.

2. R. D. Klafter, TA Chmielewski and Michael Negin, 'Robotic Engineering, An Integrated approach', Prentice Hall of India, 2003.
3. R.D. Klafter, T. A. Chmielewski and M. Negin, 'Robotic Engineering – An Integrated Approach', Prentice Hall, 2003.
4. M. P. Groover, 'Industrial Robotics – Technology Programming and Applications', McGraw Hill, 2001.

Course Outcomes (CO)

CO1	Ability to understand the components and basic terminology of Robotics
CO2	Ability to understand the basics of kinematics relations
CO3	Ability to model the motion of Robots and analyze the workspace and trajectory panning of robots
CO4	Ability to develop application–based Robots
CO5	Ability to formulate models for the control of mobile robots in various industrial applications

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2	1
CO5	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1	1

PE1359	NON–LINEAR CONTROL	L	T	P	C
		3	0	0	3

Objectives

- To impart knowledge on phase plane analysis of non–linear systems.
- To impart knowledge on Describing function–based approach to non–linear systems.
- To educate on stability analysis of systems using Lyapunov's theory.
- To introduce the concept of sliding mode control.

UNIT – I	PHASE PLANE ANALYSIS	9

Concepts of phase plane analysis – Phase portraits – Singular points – Symmetry in phase plane portraits – Constructing Phase Portraits – Phase plane Analysis of Linear and Nonlinear Systems – Existence of Limit Cycles. simulation of phase portraits in MATLAB.

UNIT – II	DESCRIBING FUNCTION	9

Describing Function Fundamentals – Definitions – Assumptions – Computing Describing Functions – Common Nonlinearities and its Describing Functions – Nyquist Criterion and its Extension – Existence of Limit Cycles – Stability of limit Cycles. Simulation of limit cycles in MATLAB.

UNIT – III	LYAPUNOV THEORY	9

Nonlinear Systems and Equilibrium Points – Concepts of Stability – Linearization and Local Stability – Lyapunov's Direct Method – Positive definite Functions and Lyapunov Functions – Equilibrium Point Theorems – Invariant Set Theorems – LTI System Analysis based on Lyapunov's Direct Method – Krasovski's Method – Variable Gradient Method – Physically – Control Design based on Lyapunov's Direct Method.

UNIT – IV	FEEDBACK LINEARIZATION	9

Feedback Linearization and the Canonical Form–Mathematical Tools – Input–State Linearization of SISO Systems – input–Output Linearization of SISO Systems – Generating a Linear Input – Output Relation – Normal Forms – The Zero–Dynamics – Stabilization and Tracking – Inverse Dynamics and Non–Minimum–Phase Systems – Feedback Linearization of MIMO Systems Zero–Dynamics and Control Design. Simulation of tracking problems in MATLAB.

UNIT – V	SLIDING MODE CONTROL	9

Sliding Surfaces – Continuous approximations of Switching Control laws – The Modelling / Performance Trade – Offs – MIMO Systems. Simulation of sliding mode controller in MATLAB.

Total Periods: 45

Text Books:

1 J. A. E. Slotine and W. Li, Applied Nonlinear control, PHI,1991.
2 K. P. Mohandas, Modern Control Engineering, Sanguine, India,2006.
3 Hasan Khalil, 'Nonlinear systems and control', Prentice Hall, 2002.

Reference Books:

1 S H Zak, 'Systems and control', Oxford University Press, 2003.
2 Torkel Glad and Lennart Ljung, 'Control Theory – Multivariable and Nonlinear Methods', Taylor& Francis, 2002.
3 G. J. Thaler, 'Automatic control systems', Jaico publishers, 2006.

Course Outcomes (CO)

CO1	Ability to understand the phase plane analysis of non–linear systems.
CO2	Ability to understand the function–based approach to non–linear systems
CO3	Ability to understand the stability analysis of systems using Lyapunov's theory.
CO4	Ability to understand about feedback linearization.
CO5	Ability to introduce the concept of sliding mode control.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO2	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO3	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
CO4	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3
C05	3	3	3	1	2	1	1	2	1	1	3	2	1	1	3	3

OE1001	Business Data Analytics	L	T	P	C
		2	0	0	0

Objectives

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT – I	OVERVIEW OF BUSINESS ANALYTICS	9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real–time decision–making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT – II	ESSENTIALS OF BUSINESS ANALYTICS	9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, Z–Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT – III	**MODELING UNCERTAINTY AND STATISTICAL INFERENCE**	**9**

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and
- Hypothesis testing.
- Converting real–time decision–making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT – IV	**ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK**	**9**

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map–Reduce: Matrix–Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web–based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT – V	**OTHER DATA ANALYTICAL FRAMEWORKS**	**9**

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map–Reduce Tasks and Result Projection

Total Periods: 45

Reference Books:

1. Vignesh Prajapati, 'Big Data Analytics with R and Hadoop', Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, 'Business Analytics Using R – A Practical Approach', A press, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, 'Mining of Massive Datasets', Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, 'Essentials of Business Analytics', Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, 'Business Analytics: The Science of Data–Driven Decision Making', Wiley, 2017.
6. A. Ohri, 'R for Business Analytics', Springer, 2012
7. Rui Miguel Forte, 'Mastering Predictive Analytics with R', Packt Publication, 2015.

Course Outcomes (CO)

CO1	Identify the real–world business problems and model with analytical solutions.
CO2	Solve analytical problem with relevant mathematics background knowledge.
CO3	Convert any real–world decision–making problem to hypothesis and apply suitable statistical testing.
CO4	Write and demonstrate simple applications involving analytics using Hadoop and MapReduce
CO5	Use open–source frameworks for modeling and storing data and apply suitable visualization technique using R for visualizing voluminous data

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2	1
CO2	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2	1
CO3	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2	1
CO4	3	3	3	3	2	2	1	1	2	1	2	1	2	2	2	1
C05	3	3	3	3	3	2	1	1	2	1	2	1	2	2	2	1

OE1002	INDUSTRIAL SAFETY	L	T	P	C
		2	0	0	0

Objectives

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT – I	INTRODUCTION	9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps / procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT – II	FUNDAMENTALS OF MAINTENANCE ENGINEERING	9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III	WEAR AND CORROSION AND THEIR PREVENTION	9

Wear– types, causes, effects, wear reduction methods, lubricants–types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT – IV	FAULT TRACING	9

Fault tracing–concept and importance, decision tree concept, need and applications, sequence of fault–finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V	PERIODIC AND PREVENTIVE MAINTENANCE	9

Periodic inspection–concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Total Periods: 45

Reference Books:

1. Audels, 'Pump–hydraulic Compressors', Mcgrew Hill Publication, 1978.
2. H. P. Garg, 'Maintenance Engineering', S. Chand and Company, 1987.
3. Hans F. Winterkorn, 'Foundation Engineering Handbook', Chapman & Hall London, 2013.
4. Higgins & Morrow,' Maintenance Engineering Handbook', Eighth Edition, 2008.

Course Outcomes (CO)

CO1	Ability to summarize basics of industrial safety
CO2	Ability to describe fundamentals of maintenance engineering
CO3	Ability to explain wear and corrosion
CO4	Ability to illustrate fault tracing
CO5	Ability to identify preventive and periodic maintenance

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	2	2	1	2	2	1	1	1	1	2	3	2	2	1
CO2	3	2	2	2	1	2	2	1	2	1	1	2	3	2	2	1
CO3	3	3	3	2	1	2	2	1	1	1	1	2	3	2	2	1
CO4	3	3	3	2	1	2	2	1	2	1	1	2	3	2	2	1
C05	3	3	3	2	1	2	2	1	2	1	1	2	3	2	2	1

OE1003	OPERATIONS RESEARCH	L	T	P	C
		2	0	0	0

Objectives

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT – I	LINEAR PROGRAMMING	9

Introduction to Operations Research – assumptions of linear programming problems – Formulations of linear programming problem – Graphical method

UNIT – II	ADVANCES IN LINEAR PROGRAMMING	9

Solutions to LPP using simplex algorithm – Revised simplex method – Primal dual relationships – Dual simplex algorithm – Sensitivity analysis

UNIT – III	NETWORK ANALYSIS – I	9

Transportation problems – Northwest corner rule, least cost method, Voges's approximation method – Assignment problem – Hungarian algorithm

UNIT – IV	NETWORK ANALYSIS – II	9

Shortest path problem: Dijkstra's algorithms, Floyd's algorithm, systematic method – CPM / PERT

UNIT – V	NETWORK ANALYSIS – III	9

Scheduling and sequencing – Single server and multiple server models – Deterministic inventory models – Probabilistic inventory control models

Total Periods: 45

Reference Books:

1. Harvey M Wagner, 'Principles of Operations Research', Prentice Hall of India, 2010.
2. Hitler Libermann, 'Operations Research', McGraw Hill Pub. 2009.
3. J. C. Pant, 'Introduction to Optimisation: Operations Research', Jain Brothers, Delhi, 2008.
4. Pannerselvam, 'Operations Research', Prentice Hall of India 2010.
5. H. A. Taha, 'Operations Research, An Introduction', PHI, 2008.

Course Outcomes (CO)	
CO1	To formulate linear programming problem and solve using graphical method.
CO2	To solve LPP using simplex method
CO3	To formulate and solve transportation, assignment problems
CO4	To solve project management problems
CO5	To solve scheduling problems

Course Outcomes	**Program Outcomes**												**PSO**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	2	2	2	2	1	2	1	1	2	3	2	2	2	1
CO2	3	2	2	2	2	2	1	2	1	1	2	3	2	2	2	1
CO3	3	3	3	2	2	2	1	2	1	1	2	3	1	3	2	1
CO4	3	3	3	2	2	2	1	2	1	1	2	3	1	2	2	1
C05	3	3	3	2	2	2	1	2	1	1	2	3	1	2	2	1

OE1004	COST MANAGEMENTOF ENGINEERING PROJECTS	L	T	P	C
		2	0	0	0

Objectives

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT – I	INTRODUCTION TO COSTING CONCEPTS	9

Objectives of a Costing System; Cost concepts in decision–making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT – II	INTRODUCTION TO PROJECT MANAGEMENT	9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT – III	PROJECT EXECUTION AND COSTING CONCEPTS	9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break–even Analysis, Cost–Volume–Profit Analysis, Various decision–making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT – IV	COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL	9

Just–in–time approach, Material Requirement Planning, Enterprise Resource Planning, Activity– Based Cost Management, Bench Marking; Balanced Score Card and Value–Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero–based budgets.

UNIT – V	QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT	9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

Total Periods:	**45**

Reference Books:

1. Ashish K. Bhattacharya, 'Principles & Practices of Cost Accounting' A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, 'Advanced Management Accounting', Pearson Prentice Hall, 1988.
3. Charles T. Horngren et. Al. 'Cost Accounting A Managerial Emphasis', Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan and Anthony A. Alkinson, 'Management & Cost Accounting', Pearson Prentice Hall, 2003.
5. N. D. Vohra, 'Quantitative Techniques in Management', Tata McGraw Hill Book Co. Ltd, 2007.

Course Outcomes (CO)

CO1	Understand the costing concepts and their role in decision making
CO2	Understand the project management concepts and their various aspects in selection
CO3	Interpret costing concepts with project execution
CO4	Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5	Become familiar with quantitative techniques in cost management

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	J	k	l	1	2	3	4
CO1	3	3	3	2	3	2	2	3	3	1	3	3	2	2	2	1
CO2	3	3	3	2	3	2	1	2	3	1	3	3	2	2	2	1
CO3	3	3	3	2	3	3	1	2	2	1	3	3	2	2	1	1
CO4	3	3	3	2	3	2	3	1	2	1	3	3	2	2	1	1
C05	3	3	3	2	3	3	3	1	2	1	3	3	2	2	1	1

OE1005	COMPOSITE MATERIALS	L	T	P	C
		2	0	0	0

Objectives

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT – I	INTRODUCTION	9

Definition – Classification and characteristics of Composite materials – Advantages and application of composites – Functional requirements of reinforcement and matrix – Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II	REINFORCEMENTS	9

Preparation–layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers – Properties and applications of whiskers, particle reinforcements – Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures – Isostrain and Isostress conditions.

UNIT – III	MANUFACTURING OF METAL MATRIX COMPOSITES	9

Casting – Solid State diffusion technique – Cladding – Hot Isostatic pressing – Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving – Properties and applications.

UNIT – IV	MANUFACTURING OF POLYMER MATRIX COMPOSITES	9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding – Properties and applications.

UNIT – V	STRENGTH	9

Laminar Failure Criteria–strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure–insight strength; Laminate strength–ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Total Periods:	**45**

Reference Books:

1. R. W. Cahn, 'Material Science and Technology', Vol. 13, Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, 'Materials Science and Engineering, An introduction', John Wiley & Sons, NY, Indian edition, 2007.
3. K. K. Chawla, 'Composite Materials', 2013.
4. G. Lubin, Hand Book of Composite Materials, 2013.

Course Outcomes (CO)

CO1	Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2	Know the various reinforcements used in composite materials.
CO3	Understand the manufacturing processes of metal matrix composites.
CO4	Understand the manufacturing processes of polymer matrix composites.
CO5	Analyze the strength of composite materials.

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	2	2	2	1	1	1	2	2	2	2	2	1
CO2	3	3	3	3	3	2	2	1	1	1	3	2	2	2	2	1
CO3	3	2	3	3	3	2	3	1	1	1	3	1	2	2	1	1
CO4	3	2	3	3	3	2	3	1	1	1	3	2	2	2	1	1
C05	3	2	2	3	3	2	3	1	1	1	2	2	2	2	1	1

OE1006	WASTE TO ENERGY	L	T	P	C
		2	0	0	0

Objectives

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio–energy systems and their features

UNIT – I	INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE	9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste – MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT – II	BIOMASS PYROLYSIS	9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – III	BIOMASS GASIFICATION	9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT – IV	BIOMASS COMBUSTION	9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation – Operation of all the above biomass combustors.

UNIT – V	BIO ENERGY	9

Properties of biogas (Calorific value and composition), Biogas plant technology and status – Bio energy system – Design and constructional features – Biomass resources and their classification – Biomass conversion processes – Thermo chemical conversion – Direct combustion – biomass gasification – pyrolysis and liquefaction – biochemical conversion – anaerobic digestion – Types of biogas Plants – Applications – Alcohol production from biomass – Bio diesel production – Urban waste to energy conversion – Biomass energy programme in India.

Total Periods:	**45**

Reference Books:

1. K. C. Khandelwal and S. S. Mahdi, 'Biogas Technology – A Practical Hand Book – Vol. I & II', Tata McGraw Hill Publishing Co. Ltd., 1983.
2. C. Y. WereKo–Brobby and E. B. Hagan, 'Biomass Conversion and Technology', John Wiley & Sons, 1996.
3. D. S. Challal, 'Food, Feed and Fuel from Biomass', IBH Publishing Co. Pvt. Ltd., 1991.
4. Ashok V. Desai, 'Non–Conventional Energy', Wiley Eastern Ltd., 1990.

Course Outcomes (CO)

CO1	Understand the various types of wastes from which energy can be generated
CO2	Gain knowledge on biomass pyrolysis process and its applications
CO3	Develop knowledge on various types of biomass gasifiers and their operations
CO4	Gain knowledge on biomass combustors and its applications on generating energy
CO5	Understand the principles of bio–energy systems and their features

Course Outcomes	Program Outcomes												PSO			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	3	2	2	2	2	1	1	1	2	3	3	2	1	1
CO2	3	2	3	2	2	2	2	1	1	1	2	3	2	2	1	1
CO3	3	3	3	2	3	2	3	1	1	1	2	3	2	2	1	1
CO4	3	3	3	2	3	2	2	1	1	1	2	3	3	2	1	1
C05	3	3	3	2	3	2	2	1	1	1	2	3	2	2	1	1

AX1001	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

Objectives

- Teach how to improve writing skills and level of readability.
- Tell about what to write in each section.
- Summarize the skills needed when writing a title.
- Infer the skills needed when writing the conclusion.
- Ensure the quality of paper at very first–time submission.

UNIT – I	INTRODUCTION TO RESEARCH PAPER WRITING	6

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT – II	PRESENTATION SKILLS	6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT – III	TITLE WRITING SKILLS	6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT – IV	RESULT WRITING SKILLS	6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT – V	VERIFICATION SKILLS	6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first–time submission.

Total Periods:	**30**

Reference Books:

1. Adrian Wallwork, 'English for Writing Research Papers', Springer New York Dordrecht Heidelberg London, 2011.
2. R. Day, 'How to Write and Publish a Scientific Paper', Cambridge University Press, 2006.
3. R. Goldbort, 'Writing for Science', Yale University Press, 2006.
4. N. Highman, 'Handbook of Writing for the Mathematical Sciences', SIAM, Highman's book, 1998.

Course Outcomes (CO)

CO1	Understand that how to improve your writing skills and level of readability
CO2	Learn about what to write in each section
CO3	Understand the skills needed when writing a Title
CO4	Understand the skills needed when writing the Conclusion
CO5	Ensure the good quality of paper at very first–time submission

AX1002	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

Objectives

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches.

UNIT – I	INTRODUCTION	6

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT – II	REPERCUSSIONS OF DISASTERS AND HAZARDS	6

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides And Avalanches, Man–made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

UNIT – III	DISASTER PRONE AREAS IN INDIA	6

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post–Disaster Diseases and Epidemics

UNIT – IV	DISASTER PREPAREDNESS AND MANAGEMENT	6

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT – V	RISK ASSESSMENT	6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co–Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

Total Periods: 30

Reference Books:

1. S. L. Goel, 'Disaster Administration and Management Text And Case Studies', Deep & Deep Publication, Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, A. K. Singh, 'Disaster Management in India: Perspectives, issues and strategies', New Royal book Company, 2007.
3. Sahni, Pardeep, Et. Al., 'Disaster Mitigation Experiences And Reflections', Prentice Hall of India, New Delhi, 2001.

Course Outcomes (CO)

CO1	Ability to summarize basics of disaster
CO2	Ability to explain critical understanding of key concepts in disaster risk reduction and humanitarian response
CO3	Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5	Ability to develop the strengths and weaknesses of disaster management approaches

Course Outcomes	Program Outcomes												PSO				
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1
C05	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AX1003	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
		2	0	0	0

Objectives

- Understand value of education and self–development
- Imbibe good values in students
- Let the students know about the importance of character

UNIT – I		**6**

Values and self–development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non–moral valuation. Standards and principles. Value judgements

UNIT – II		**6**

Importance of cultivation of values. Sense of duty. Devotion, Self–reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

UNIT – III		**6**

Personality and Behavior Development–Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self–destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT – IV		**6**

Character and Competence – Holy books vs Blind faith. Self–management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self–control. Honesty, Studying effectively.

Total Periods:	**30**

Reference Books:

1. Chakroborty, S.K.'Values and Ethics for organizations Theory and practice', Oxford University Press, New Delhi

Course Outcomes (CO)

CO1	Knowledge of self–development
CO2	Learn the importance of Human values
CO3	Developing the overall personality.
CO4	Developing the competence and self–control

Course Outcomes	Program Outcomes												PSO				
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1	1	1

AX1004	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.

UNIT – I	HISTORY OF MAKING OF THE INDIAN CONSTITUTION	5

History, Drafting Committee, (Composition & Working)

UNIT – II	PHILOSOPHY OF THE INDIAN CONSTITUTION	5

Preamble, Salient Features

UNIT – III	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	5

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT – IV	ORGANS OF GOVERNANCE	5

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT – V	LOCAL ADMINISTRATION	5

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT – VI	ELECTION COMMISSION	5

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners – Institute and Bodies for the welfare of SC/ST/OBC and women.

Total Periods:	**30**

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar 'Framing of Indian Constitution', 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes (CO)

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4	Discuss the passage of the Hindu Code Bill of 1956.

Course Outcomes	Program Outcomes												PSO				
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1	1	1

AX1005	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

Objectives

- Review existing evidence on their view topic to inform programme design and policy
- Making under taken by the DFID, other agencies and researchers.
- Identify critical evidence gaps to guide the development

UNIT – I	INTRODUCTION AND METHODOLOGY	6

Aims and rationale, Policy background, Conceptual framework and terminology – Theories of learning, Curriculum, Teacher education – Conceptual framework, Research questions – Overview of methodology and Searching.

UNIT – II	THEMATIC OVERVIEW	6

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries – Curriculum, Teacher education.

UNIT – III	EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES	6

Methodology for the in–depth stage: quality assessment of included studies – How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? – Theory of change – Strength and nature of the body of evidence for effective pedagogical practices – Pedagogic theory and pedagogical approaches – Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT – IV	PROFESSIONAL DEVELOPMENT	6

Professional development: alignment with classroom practices and follow up support – Peer support – Support from the head teacher and the community – Curriculum and assessment – Barriers to learning: limited resources and large class sizes.

UNIT – V	RESEARCH GAPS AND FUTURE DIRECTIONS	6

Research design – Contexts – Pedagogy – Teacher education – Curriculum and assessment – Dissemination and research impact.

Total Periods:	**30**

Reference Books:

1. J. Ackers, F. Hardman, 'Classroom interaction in Kenyan primary schools', Compare, Vol. 31, No. 2, Page: 245–261, 2001.
2. M. Agrawal, 'Curricular reform in schools: The importance of evaluation', Journal of Curriculum Studies, Vol. 36, No. 3, Page: 361–379, 2004.
3. K. Akyeampong, 'Teacher training in Ghana–does it count? Multi–site teacher education research project' (MUSTER) Country report 1, London, 2003.
4. K. Akyeampong, K. Lussier, J. Pryor and J. Westbrook, 'Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?' International Journal Educational Development, Vol. 33, No. 3, Page: 272–282, 2013.
5. R. J. Alexander 'Culture and pedagogy: International comparisons in primary education', Oxford and Boston: Blackwell, 2001.
6. M. Chavan, 'Read India: Amass scale, rapid, 'learning to read' campaign', 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes (CO)

CO1	Students will be able to understand what pedagogical practices are being used by teachers in informal and informal classrooms in developing countries.
CO2	Students will be able to understand the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
CO3	Students will be able to understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

Course Outcomes	Program Outcomes												PSO				
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1	1	1

AX1006	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

Objectives

- To achieve overall health of body and mind
- To overcome stress

UNIT – I **10**

Definitions of Eight parts of yoga. (Ashtanga)

UNIT – II **10**

Yam and Niyam – Do`s and Don't's in life – i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT – III **10**

Asan and Pranayam – Various yoga poses and their benefits for mind & body – Regularization of breathing techniques and its effects – Types of pranayam

Total Periods: 30

Reference Books:

1. 'Yogic Asanas for Group Tarining–Part–I', Janardan Swami Yoga bhyasi Mandal, Nagpur.
2. 'Rajayoga or conquering the Internal Nature, by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Course Outcomes (CO)

CO1	Students will be able to develop healthy mind in a healthy body thus improving social health also
CO2	Improve efficiency

Course Outcomes	Program Outcomes												PSO				
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1

AX1007	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT – I **10**

Neetisatakam – holistic development of personality – Verses–19,20,21,22 (wisdom) – Verses–29,31,32 (pride & heroism) – Verses–26,28,63,65 (virtue) – Verses–52,53,59 (dont's) – Verses–71,73,75,78 (do's)

UNIT – II **10**

Approach to day–to–day work and duties – Shrimad Bhagwad Geeta: Chapter 2 – Verses 41, 47,48 – Chapter 3 – Verses 13, 21, 27, 35 Chapter 6–Verses 5,13,1

UNIT – III **10**

Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2 – Verses 56, 62, 68 Chapter 12 – Verses 13, 14, 15, 16,17, 18 – Personality of role model – Shrimad Bhagwad Geeta – Chapter2 – Verses 17, Chapter 3 – Verses 36,37,42 – Chapter 4 – Verses 18, 38,39 Chapter18 – Verses 37,38,63

Total Periods: 30

Reference Books:

1. Gopinath, P. Rashtriya Sanskrit Sansthanam, 'Bhartrihari's Three Satakam', Niti–sringar–vairagya, New Delhi, 2010.
2. Swami Swarupananda, 'Srimad Bhagavad Gita', Advaita Ashram, Publication Department, Kolkata, 2016.

Course Outcomes (CO)

CO1	Students will be able to study the Shrimad–Bhagwad–Geeta that will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

Course Outcomes	Program Outcomes												PSO				
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4	5
CO1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. JOSEPH'S GROUP OF INSTITUTIONS

OMR. CHENNAI - 119

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021

(CHOICE BASED CREDIT SYSTEM)

(REVISED)

For the Batch Admitted in the Academic Year 2024-2025

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1109	Problem Solving and Programming in C	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1110	Programming in C Laboratory	ESC	4	0	0	4	2
9	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**31**	**19**	**0**	**12**	**25**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
7	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	CS1302	Data Structures	ESC	3	3	0	0	3
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course - II	PEC	3	3	0	0	3
5	---	Professional Elective Course - III	PEC	3	3	0	0	3
6	---	Open Elective Course - I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course - V	PEC	3	3	0	0	3
6	---	Open Elective Course - II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**28**	**18**	**0**	**10**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
7	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1109	Problem Solving and Programming in C	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1110	Programming in C Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
13	CS1302	Data Structures	ESC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
2	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
3	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
4	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
5	ME1401	Thermal Engineering	PCC	3	3	0	0	3
6	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
5	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing#	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology#	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles#	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS108	Introduction to Python Programming	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	7	-	-	-	-	-	3	14	7.69
2	BSC	12	4	4	4	-	-	-	-	24	13.19
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	3	9	16	18	15	13	-	74	40.66
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**25**	**25**	**22**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC	-	Humanities and Social Sciences including Management Courses
BSC	-	Basic Science Courses
ESC	-	Engineering Science Courses
PCC	-	Professional Core Courses
EEC	-	Employability Enhancement Courses
PEC	-	Professional Elective Courses
OEC	-	Open Elective Courses
IS	-	Internship
AC	-	Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	7	2	-	-	-	-	9
2	II	7	2	-	-	-	-	9
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

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CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
		PRACTICALS						
8	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
9	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**31**	**19**	**0**	**12**	**25**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
7	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
		PRACTICALS						
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course - II	PEC	3	3	0	0	3
5	---	Professional Elective Course - III	PEC	3	3	0	0	3
6	---	Open Elective Course - I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course - V	PEC	3	3	0	0	3
6	---	Open Elective Course - II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**28**	**18**	**0**	**10**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
5	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing#	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology#	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles#	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	4	7	-	-	-	-	-	3	14	7.69
2	BSC	12	7	4	4	-	-	-	-	27	14.84
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	-	9	16	18	15	13	-	71	39.01
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**25**	**25**	**22**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC	-	Humanities and Social Sciences including Management Courses
BSC	-	Basic Science Courses
ESC	-	Engineering Science Courses
PCC	-	Professional Core Courses
EEC	-	Employability Enhancement Courses
PEC	-	Professional Elective Courses
OEC	-	Open Elective Courses
IS	-	Internship
AC	-	Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	7	2	-	-	-	-	9
2	II	7	2	-	-	-	-	9
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. JOSEPH'S GROUP OF INSTITUTIONS

OMR. CHENNAI - 119

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021
(CHOICE BASED CREDIT SYSTEM)
(REVISED)
For the Batch Admitted in the Academic Year 2022-2026

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
		PRACTICALS						
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**30**	**18**	**0**	**12**	**24**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
7	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
		PRACTICALS						
8	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**29**	**20**	**1**	**8**	**25**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
6	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**28**	**17**	**1**	**10**	**23**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course - II	PEC	3	3	0	0	3
5	---	Professional Elective Course - III	PEC	3	3	0	0	3
6	---	Open Elective Course - I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course - V	PEC	3	3	0	0	3
6	---	Open Elective Course - II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**28**	**18**	**0**	**10**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 182

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	GE1209	தமிழர் மரபு / Heritage of Tamils	HSMC	1	1	0	0	1
3	HS1201	Professional English	HSMC	3	3	0	0	3
4	GE1210	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	1	0	0	1
5	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
6	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
5	ME1709	Technical Seminar – III (Design)	EEC	2	0	0	2	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing#	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology#	EEC	3	1	0	2	2
9	MV0003	Electrical Harness and Routing Design for Electric Vehicles#	EEC	3	1	0	2	2
10	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)
SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	3	7	1	-	-	-	-	3	14	7.69
2	BSC	12	7	4	4	-	-	-	-	27	14.84
3	ESC	9	11	8	5	-	-	-	-	33	18.13
4	PCC	-	-	9	16	18	15	13	-	71	39.01
5	PEC	-	-	-	-	3	6	6	3	18	9.89
6	OEC	-	-	-	-	-	3	3	-	6	3.30
7	EEC	-	-	1	-	-	2	-	10	13	7.14
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**24**	**25**	**23**	**25**	**21**	**26**	**22**	**16**	**182**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	6	2	-	-	-	-	8
2	II	7	2	-	-	-	-	9
3	III	6	3	-	-	-	-	9
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**44**	**16**	**1**	**1**	**1**	**1**	**64**

HOD **Dean - Academics** **Principal**

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. JOSEPH'S GROUP OF INSTITUTIONS

OMR. CHENNAI - 119

DEPARTMENT OF MECHANICAL ENGINEERING

B.E. MECHANICAL ENGINEERING

REGULATIONS - 2021

(CHOICE BASED CREDIT SYSTEM)

(REVISED)

For the Batch Admitted in the Academic Year 2021-2025

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
3	PH1103	Engineering Physics	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics	ESC	6	2	0	4	4
		PRACTICALS						
7	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
			Total	**30**	**18**	**0**	**12**	**24**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1	HS1201	Professional English	HSMC	3	3	0	0	3
2	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3	PH1254	Materials Science	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
		PRACTICALS						
7	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	4	0	0	4	2
			Total	**28**	**19**	**1**	**8**	**24**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2	EE1352	Electrical Drives and Controls	ESC	3	3	0	0	3
3	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
4	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
5	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
PRACTICALS								
6	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
7	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
8	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
3	ME1401	Thermal Engineering	PCC	3	3	0	0	3
4	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
5	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
6	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
PRACTICALS								
7	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
			Total	**33**	**19**	**0**	**14**	**25**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
2	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
3	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
4	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
5	---	Professional Elective Course - I	PEC	3	3	0	0	3
6	---	Audit Course*	AC	2	2	0	0	0
PRACTICALS								
7	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
8	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
9	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
			Total	**30**	**17**	**1**	**12**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
2	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
3	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
4	---	Professional Elective Course - II	PEC	3	3	0	0	3
5	---	Professional Elective Course - III	PEC	3	3	0	0	3
6	---	Open Elective Course - I	OEC	3	3	0	0	3
PRACTICALS								
7	ME1607	CAD /CAM Laboratory	PCC	4	0	0	4	2
8	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
9	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
			Total	**32**	**18**	**2**	**12**	**26**

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
2	ME1702	Mechatronics	PCC	3	3	0	0	3
3	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
4	---	Professional Elective Course - IV	PEC	3	3	0	0	3
5	---	Professional Elective Course - V	PEC	3	3	0	0	3
6	---	Open Elective Course - II	OEC	3	3	0	0	3
PRACTICALS								
7	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
8	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2
9	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
10	ME1710	Internship**	EEC	0	0	0	0	1
			Total	**28**	**18**	**0**	**10**	**22**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1	MG1801	Industrial Economics	HSMC	3	3	0	0	3
2	---	Professional Elective Course - VI	PEC	3	3	0	0	3
PRACTICALS								
3	ME1807	Project Work	EEC	20	0	0	20	10
			Total	**26**	**6**	**0**	**20**	**16**

* Audit Course is optional.

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 180

HUMANITIES AND SOCIAL SCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	HS1201	Professional English	HSMC	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	MG1801	Industrial Economics	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MA1102	Engineering Mathematics – I	BSC	4	4	0	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
6	PH1254	Materials Science	BSC	3	3	0	0	3
7	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
8	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1252	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	3	0	0	3
5	GE1206	Engineering Mechanics	ESC	4	3	1	0	4
6	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
7	BE1258	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	2	0	0	4	2
8	EE1301	Electrical Drives and Controls	ESC	3	3	0	0	3
9	EE1358	Electrical Engineering Laboratory	ESC	4	0	0	4	2
10	CE1401	Strength of Materials for Mechanical Engineers	ESC	3	3	0	0	3
11	CE1301	Fluid Mechanics and Machinery	ESC	3	3	0	0	3
12	CE1409	Strength of Materials and Fluid Mechanics and Machinery Laboratory	ESC	4	0	0	4	2

PROFESSIONAL CORE COURSES (PCC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1301	Engineering Thermodynamics	PCC	4	3	1	0	4
2	ME1302	Manufacturing Processes	PCC	3	3	0	0	3
3	ME1307	Manufacturing Processes Laboratory	PCC	4	0	0	4	2
4	ME1401	Thermal Engineering	PCC	3	3	0	0	3
5	ME1402	Kinematics of Machinery	PCC	3	3	0	0	3
6	ME1403	Engineering Metallurgy	PCC	3	3	0	0	3
7	ME1404	Metal Cutting and Machine Tools	PCC	3	3	0	0	3
8	ME1407	Internal Combustion Engineering Laboratory	PCC	4	0	0	4	2
9	ME1408	Machine Tools Laboratory	PCC	4	0	0	4	2
10	ME1501	Computer Aided Design and Manufacturing	PCC	3	3	0	0	3
11	ME1502	Design of Machine Elements	PCC	4	3	1	0	4
12	ME1503	Metrology and Measurements (Lab Integrated)	PCC	5	3	0	2	4
13	ME1504	Dynamics of Machinery	PCC	3	3	0	0	3
14	ME1506	Computer Aided Machine Drawing Laboratory	PCC	4	0	0	4	2
15	ME1507	Kinematics and Dynamics Laboratory	PCC	4	0	0	4	2
16	ME1601	Design of Transmission Systems	PCC	4	3	1	0	4
17	ME1602	Finite Element Analysis	PCC	3	3	0	0	3
18	ME1603	Heat and Mass Transfer	PCC	4	3	1	0	4
19	ME1607	CAD / CAM Laboratory	PCC	4	0	0	4	2
20	ME1608	Heat Transfer and Refrigeration and Air-Conditioning Laboratory	PCC	4	0	0	4	2
21	ME1701	Process Planning and Cost Estimation	PCC	3	3	0	0	3
22	ME1702	Mechatronics	PCC	3	3	0	0	3
23	ME1703	Power Plant Engineering	PCC	3	3	0	0	3
24	ME1707	Simulation and Analysis Laboratory	PCC	4	0	0	4	2
25	ME1708	Mechatronics Laboratory	PCC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2	ME1409	Technical Seminar - I (Manufacturing)	EEC	2	0	0	2	0
3	ME1508	Technical Seminar - II (Thermal Sciences)	EEC	2	0	0	2	0
4	ME1609	Design and Fabrication Project	EEC	4	0	0	4	2
5	ME1709	Technical Seminar - III (Design)	EEC	2	0	0	2	0
6	ME1710	Internship**	EEC	0	0	0	0	1
7	MV0001	3D Printing#	EEC	3	1	0	2	2
8	MV0002	Entrepreneurship in Solar PV Technology#	EEC	3	1	0	2	2
9	ME1807	Project Work	EEC	20	0	0	20	10

** Students will undergo Industrial Training / Internship during 6th semester vacation and the credits earned will be over and above the total credit to be earned by the students.

Students will undergo any one Value Added Courses mentioned above and the credits earned will be over and above the total credit to be earned by the students.

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1511	Design of Heat Exchangers	PEC	3	3	0	0	3
2	ME1512	Energy Conservation and Auditing	PEC	3	3	0	0	3
3	ME1513	Experimental Design and Analysis	PEC	3	3	0	0	3
4	ME1514	Gas Dynamics and Jet Propulsion	PEC	3	3	0	0	3
5	ME1515	Refrigeration and Air conditioning	PEC	3	3	0	0	3
6	ME1516	Turbomachines	PEC	3	3	0	0	3
7	ME1517	Bioenergy Conversion Technologies	PEC	3	3	0	0	3
8	ME1518	Energy Efficient Buildings	PEC	3	3	0	0	3
9	ME1519	Energy Storage Technologies	PEC	3	3	0	0	3
10	ME1520	Renewable Powered off Highway Vehicles and Emission Control Technology	PEC	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1621	Applied Hydraulics and Pneumatics	PEC	3	3	0	0	3
2	ME1622	Design of Jigs, Fixtures and Press Tools	PEC	3	3	0	0	3
3	ME1623	Fluid Power Automation	PEC	3	3	0	0	3
4	ME1624	Low Cost Automation	PEC	3	3	0	0	3
5	ME1625	Product Design Engineering and Management	PEC	3	3	0	0	3
6	ME1626	Vibration and Noise Control Techniques for Machines and Automobiles	PEC	3	3	0	0	3
7	ME1627	Design Thinking	PEC	3	3	0	0	3
8	ME1628	New Product Development	PEC	3	3	0	0	3
9	ME1629	Product Life Cycle Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - III

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1631	Additive Manufacturing	PEC	3	3	0	0	3
2	ME1632	Non Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	ME1633	Polymers and Composites	PEC	3	3	0	0	3
4	ME1634	Testing and Characterization of Materials	PEC	3	3	0	0	3
5	ME1635	Unconventional Machining Processes	PEC	3	3	0	0	3
6	ME1636	Welding Technology	PEC	3	3	0	0	3
7	ME1637	Green Manufacturing Design and Practices	PEC	3	3	0	0	3
8	ME1638	Green Supply Chain Management	PEC	3	3	0	0	3
9	ME1639	Industry 4.0 for Mechanical Engineering	PEC	3	3	0	0	3
10	ME1640	Lean Manufacturing	PEC	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE COURSE - IV

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	MG1003	Applied Operations Research	PEC	3	3	0	0	3
2	ME1741	Computer Integrated Manufacturing Systems and Automation	PEC	3	3	0	0	3
3	ME1742	Maintenance Engineering	PEC	3	3	0	0	3
4	EC1008	MEMS and NEMS	PEC	3	3	0	0	3
5	ME1743	Safety Engineering and Disaster Management	PEC	3	3	0	0	3
6	ME1744	Total Quality Management and Reliability Engineering	PEC	3	3	0	0	3
7	ME1745	Design for Manufacturing	PEC	3	3	0	0	3
8	ME1746	Digital Manufacturing and IoT	PEC	3	3	0	0	3
9	ME1747	Precision Manufacturing	PEC	3	3	0	0	3
10	ME1748	Surface Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSE - V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1751	Advanced Internal Combustion Engines	PEC	3	3	0	0	3
2	ME1752	Automobile Technology	PEC	3	3	0	0	3
3	ME1753	Computational Fluid Dynamics	PEC	3	3	0	0	3
4	GE1004	Fundamentals of Nano Science	PEC	3	3	0	0	3
5	ME1754	Mechanics of Composite Materials	PEC	3	3	0	0	3
6	MG1001	Principles of Management	PEC	3	3	0	0	3
7	ME1755	Carbon Footprint Estimation and Reduction Techniques	PEC	3	3	0	0	3
8	ME1756	Industrial Safety	PEC	3	3	0	0	3
9	ME1757	Thermal Management of Batteries and Fuel Cells	PEC	3	3	0	0	3
10	ME1758	Value Engineering	PEC	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE COURSE - VI

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	ME1861	Entrepreneurship Development	PEC	3	3	0	0	3
2	ME1862	Industrial Tribology	PEC	3	3	0	0	3
3	GE1001	Intellectual Property Rights	PEC	3	3	0	0	3
4	ME1863	Lean Six Sigma	PEC	3	3	0	0	3
5	ME1864	Production Planning and Control	PEC	3	3	0	0	3
6	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
7	ME1865	Advanced Vehicle Engineering	PEC	3	3	0	0	3
8	ME1866	Design Codes and Standards	PEC	3	3	0	0	3
9	ME1867	Design of Pressure Vessels	PEC	3	3	0	0	3
10	ME1868	Power Generation Equipment Design	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER VI

OPEN ELECTIVE COURSE - I

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OEC103	Basics of Embedded Systems and IOT	OEC	3	3	0	0	3
2	OCS102	Programming and Data Structures	OEC	3	3	0	0	3
3	OEE104	Electric Vehicle Technology	OEC	3	3	0	0	3
4	OCE103	Environmental Impact Assessment	OEC	3	3	0	0	3
5	OCH101	Fundamentals of Combustion	OEC	3	3	0	0	3
6	OEE108	Renewable Energy Technologies	OEC	3	3	0	0	3
7	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
8	OEI104	Internet of Things	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE COURSE - II

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
3	OCS103	Introduction to Cloud Computing	OEC	3	3	0	0	3
4	OEI102	Robotics	OEC	3	3	0	0	3
5	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
6	OEE107	Solar and Wind Energy Systems	OEC	3	3	0	0	3
7	OEE102	Drone Technologies	OEC	3	3	0	0	3
8	OCS107	Machine Learning for Intelligent Systems	OEC	3	3	0	0	3

AUDIT COURSES (AC)

SEMESTER V

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	3	6	0	-	-	-	-	3	12	6.67
2	BSC	12	7	4	4	-	-	-	-	27	15.00
3	ESC	9	11	8	5	-	-	-	-	33	18.33
4	PCC	-	-	9	16	18	15	13	-	71	39.45
5	PEC	-	-	-	-	3	6	6	3	18	10.00
6	OEC	-	-	-	-	-	3	3	-	6	3.33
7	EEC	-	-	1	-	-	2	-	10	13	7.22
8	IS	-	-	-	-	-	-	1**	-	0	0.00
9	AC	-	-	-	-	-	-	-	-	0	0.00
Total		**24**	**24**	**22**	**25**	**21**	**26**	**22**	**16**	**180**	**100**

HSMC - Humanities and Social Sciences including Management Courses
BSC - Basic Science Courses
ESC - Engineering Science Courses
PCC - Professional Core Courses
EEC - Employability Enhancement Courses
PEC - Professional Elective Courses
OEC - Open Elective Courses
IS - Internship
AC - Audit Course

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project	Project	IS	AC	Total
1	I	6	2	-	-	-	-	8
2	II	6	2	-	-	-	-	8
3	III	5	3	-	-	-	-	8
4	IV	6	3	-	-	-	-	9
5	V	5	2	-	-	-	1	8
6	VI	6	2	1	-	-	-	9
7	VII	6	2	-	-	1	-	9
8	VIII	2	-	-	1	-	-	3
Total		**42**	**16**	**1**	**1**	**1**	**1**	**62**

HOD **Dean - Academics** **Principal**

HS1101	COMMUNICATIVE ENGLISH	L T P C
		3 0 0 3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT - I SHARING INFORMATION RELATED TO ONESELF/ FAMILY & FRIENDS **9**

Reading - critical reading - finding key information in a given text - shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts - short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development - voices - Wh - Questions- asking and answering - yes or no questions - parts of speech. Vocabulary development - prefixes - suffixes - articles - Polite Expressions. CO1

UNIT - II GENERAL READING AND FREE WRITING **9**

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types - Writing - paragraph writing - topic sentence - main ideas - free writing, short narrative descriptions using some suggested vocabulary and structures -. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking - describing a simple process - asking and answering questions - Language development - prepositions, clauses. Vocabulary development - guessing meanings of words in context - use of sequence words. CO2

UNIT - III GRAMMAR AND LANGUAGE DEVELOPMENT **9**

Reading - short texts and longer passages (close reading) & making a critical analysis of the given text Writing - types of paragraph and writing essays - rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking - role plays - asking about routine actions and expressing opinions. Language development - degrees of comparison - pronouns - Direct vs. Indirect Questions. Vocabulary development - idioms and phrases- cause & effect expressions, adverbs. CO3

UNIT - IV READING AND LANGUAGE DEVELOPMENT **9**

Reading- comprehension-reading longer texts - reading different types of texts- magazines. Writing - letter writing, informal or personal letters - e-mails - conventions of personal email - Listening: Listening comprehension (IELTS, TOEFL and others). Speaking - Speaking about friends/places/hobbies - Language development - Tenses- simple present-simple past - present continuous and past continuous- conditionals - if, unless, in case, when and others Vocabulary development - synonyms - antonyms - Single word substitutes - Collocations. CO4

UNIT - V EXTENDED WRITING **9**

Reading: Reading for comparisons and contrast and other deeper levels of meaning - Writing - brainstorming - writing short essays - developing an outline- identifying main and subordinate ideas - dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs - present/past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2 Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5 Identify topics and formulate questions for productive inquiry

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2021.
2. Sanjay Kumar & Pushp Lata, Communication Skills, Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.

REFERENCE BOOKS:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges, Cengage Learning ,USA: 2007.
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student‘s Book & Workbook) Cambridge University Press, New Delhi: 2005.
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013.
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

MA1102	ENGINEERING MATHEMATICS - I	L	T	P	C
		4	0	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of single variable and multivariable calculus which plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT - I MATRICES **12**

Eigen values and Eigenvectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms CO1

UNIT - II CALCULUS OF ONE VARIABLE **12**

Limit of a function - Continuity - Derivatives - Differentiation rules - Interval of increasing and decreasing functions - Maxima and Minima - Intervals of concavity and convexity. CO2

UNIT - III CALCULUS OF SEVERAL VARIABLES **12**

Partial differentiation - Homogeneous functions and Euler's theorem - Total derivative - Change of variables - Jacobians - Partial differentiation of implicit functions - Taylor's series for functions of two variables - Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers. CO3

UNIT - IV INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. CO4

UNIT - V MULTIPLE INTEGRALS **12**

Double integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Change of variables from Cartesian to polar in double integrals - Triple integrals - Volume of solids. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Have a clear idea of matrix algebra pertaining to Eigen values and Eigenvectors in addition to dealing with quadratic forms.
- CO2 Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
- CO3 Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
- CO4 Understand the concept of integration through the fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
- CO5 Do double and triple integration so that they can handle integrals of higher order which are applied in the engineering field.

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units II & IV - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics - I, McGraw Hill Education; First edition 2017

PH1103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity.
- Principles of laser and fiber optics and its various technological applications.
- Thermal conduction in solids, heat exchangers and its applications in various devices.
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques.

UNIT - I PROPERTIES OF MATTER **9**

Elasticity - Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength - torsional stress and deformations - twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - Practical applications of modulus of elasticity - I shaped girders - stress due to bending in beams. CO1

UNIT - II LASER AND FIBER OPTICS THERMAL PHYSICS **9**

Lasers: population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Nd-YAG Laser-Semiconductor lasers: homo junction and hetero junction - Industrial and medical applications of Laser - Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) - losses associated with optical fibers - Fabrication of Optical fiber - Double crucible method - fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber - Endoscopy - Fiber optic communication system. CO2

UNIT - III LASER AND FIBER OPTICS THERMAL PHYSICS **9**

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conductions in solids - thermal conductivity - Rectilinear flow of heat- conduction through compound media (series and parallel) - Lee's disc method: theory and experiment - Radial flow of heat - thermal insulation - applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters. CO3

UNIT IV QUANTUM PHYSICS **9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory and experimental verification - wave particle duality - electron diffraction - concept of wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - particle in a one-dimensional rigid box - Electron microscope - tunnelling (qualitative) - scanning tunnelling microscope - Applications of electron microscopy. CO4

UNIT V CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - Graphite structure - crystal imperfections: point defects, line defects - Burger vectors, stacking faults - growth of single crystals: solution and melt growth techniques - Epitaxial growth-Applications of Single crystal (Qualitative). CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

CO1 The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young's modulus by various methods.

CO2 Principle of laser, Einstein's coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.

CO3 The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee's disc method and radial flow of heat.

CO4 The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunnelling electron microscopy and its applications.

CO5 The importance of various crystal structures, Miller indices and various growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2013.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2014.

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students conversant with

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non-conventional energy sources and energy storage device

UNIT – I WATER AND ITS TREATMENT **9**

Hardness of water - Types - Expression of hardness - Units - Estimation of hardness by EDTA method - Numerical problems on EDTA method - Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) - Treatment of boiler feed water - Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) - External treatment - Ion exchange process, Zeolite process - Desalination of brackish water by Reverse Osmosis. CO1

UNIT – II SURFACE CHEMISTRY AND CATALYSIS **9**

Surface chemistry : Types of adsorption - Adsorption of gases on solids - Adsorption of solute from solutions - Adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - Kinetics of uni-molecular surface reactions - Adsorption in chromatography - Applications of adsorption in pollution abatement using PAC. CO2

Catalysis: Catalyst - Types of catalysis - Criteria - Contact theory - Catalytic poisoning and catalytic promoters - Industrial applications of catalysts - Catalytic convertor - Auto catalysis - Enzyme catalysis - Michaelis-Menten equation.

UNIT – III PHASE RULE AND ALLOYS **9**

Phase rule: Introduction - Definition of terms with examples - One component system - Water system - Reduced phase rule - Thermal analysis and cooling curves - Two component systems - Lead-silver system - Pattinson process.
Alloys: Introduction - Definition - Properties of alloys - Significance of alloying - Functions and effect of alloying elements - Nichrome, Alnico, Stainless steel (18/8) - Heat treatment of steel - Non-ferrous alloys - Brass and bronze. CO3

UNIT – IV FUELS AND COMBUSTION **9**

Fuels: Introduction - classification of fuels - Comparison of solid, liquid, gaseous fuels - Coal - Analysis of coal (proximate and ultimate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method) - Petroleum - Cracking - Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) - Knocking - Octane number - Diesel oil - Cetane number - Compressed natural gas (CNG) - Liquefied petroleum gases (LPG) - Power alcohol and biodiesel.
Combustion of fuels: Introduction - Calorific value - Higher and lower calorific values - Theoretical calculation of calorific value - Ignition temperature - Spontaneous ignition temperature - Explosive range - Flue gas analysis by Orsat Method. CO4

UNIT – V NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy - Fission and fusion reactions - Differences - Chain reactions - Nuclear reactors - Classification of reactors - Light water nuclear reactor for power generation - Breeder reactor - Solar energy conversion - Solar cells - Wind energy - Fuel cells - Hydrogen-oxygen fuel cell.
Batteries - Types of batteries - Alkaline batteries - Lead-acid, Nickel-cadmium and Lithium batteries. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.

CO2 Understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.

CO3 Recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.

CO4 Identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.

CO5 Understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

TEXT BOOKS:

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17^{th} Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi(2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd., Chennai, (2009).

REFERENCE BOOKS:

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, (2015).
5. Pahari, B. Chauhan, “Engineering Chemistry”, Firewall Media, New Delhi., (2010).
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT - I ALGORITHMIC PROBLEM SOLVING	**9**
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	CO1
UNIT - II INTRODUCTION TO PYTHON	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.	CO2
UNIT - III CONTROL FLOW, FUNCTIONS AND STRINGS	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.	CO3
UNIT - IV LISTS, TUPLES, DICTIONARIES	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.	CO4
UNIT - V FILES, MODULES, PACKAGES	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(), readline(), readlines(),write(), writelines(), tell(), seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.	CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop algorithmic solutions to simple computational problems
CO2 Develop simple console application in python
CO3 Develop python program by applying control structure and decompose program into functions.
CO4 Represent compound data using python lists, tuples, and dictionaries.
CO5 Read and write data from/to files in Python.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016
2. (http://greenteapress.com/wp/thinkpython/)
3. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python - Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS:

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction.

GE1106	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To inculcate drawing practice in standardized form whenever technical drawing is needed.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning. **1**

UNIT - I PLANE CURVES AND FREEHAND SKETCHING 7 + 12

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloidal curves - construction of involutes of square and circle - Drawing of tangents and normal to the above curves. CO1

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three-Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6 + 12

Orthographic projection - principles-Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. CO2

UNIT - III PROJECTION OF SOLIDS 5 + 12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes when the solid is simply suspended by rotating object method. CO3

UNIT - IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5 + 12

Sectioning of simple solids like prisms, pyramids, cylinder, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other - obtaining true shape of section.
Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points. CO4

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 + 12

Principles of isometric projection - isometric scale -Isometric projections and isometric views of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.
Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method. CO5

TOTAL PERIODS: 90

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the fundamentals and standards of Engineering graphics.
CO2 Perform freehand sketching of basic geometrical constructions and multiple views of objects.
CO3 Understand the concept of orthographic projections of lines and plane surfaces.
CO4 Draw projections of the section of solids and development of surfaces.
CO5 Visualize and to project isometric and perspective sections of simple solids.

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty ninth edition 2017
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.
3. S. Ramachandran and K. Pandian, “Engineering Graphics” Airwalk Publications; 8th edition 2014

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

GE1109 PROBLEM SOLVING AND PROGRAMMING IN C

(Common to all branches of B.E./B.Tech Programmes)

L	T	P	C
3	0	0	3

OBJECTIVES

- To know the problem solving and develop C Programs using basic programming constructs.
- To develop C programs using decision control and looping statements, functions and arrays.
- To develop applications in C using strings and pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT- I PROBLEM SOLVING AND BASICS OF C PROGRAMMING **9**

Introduction, Algorithms, building blocks of algorithms, Algorithmic problem-solving steps; Simple Strategies and notation for developing algorithms: Control flow, Flow charts, Pseudo codes, Programming languages; Introduction to C; Structure of a C Program; Compiling and Executing C Programmes, C Tokens and character set, Keywords, Identifiers, Basic Data types, Variables, Constants, Input/Output statements, Operators, Type conversion and Type Casting. CO1

UNIT – II DECISION CONTROL, LOOPING STATEMENTS, FUNCTIONS AND ARRAYS **9**

Conditional Branching statements, Iterative statements, Nested loops, The Break and continue statements, Goto statements; Introduction to Functions: Function declaration, Function definition, Function call, return statement, passing parameters to the function, Recursive Functions; Introduction to Arrays: Declaration, Accessing the Elements, storing values, operations on arrays, Passing Arrays to functions, two-dimensional array, Multidimensional arrays. CO2

UNIT – III STRINGS AND POINTERS **9**

String: Introduction to String, Suppressing Input, String Taxonomy, String operation; Pointers: Introduction to Pointers, declaring pointers variables, Pointer expression and Pointer arithmetic, passing arguments to Function using Pointers, Pointers and Arrays, Array of pointers; Function Pointers, Pointers to Pointers, memory allocation in C Programs, Dynamic memory allocation; Drawbacks of pointers. CO3

UNIT – IV STRUCTURES, UNIONS AND ENUMERATED DATA TYPE **9**

Structure: declaration and initialization, accessing members of structure; Nested structures; Array of structures; Structures and functions; Self-referential structures; Union: declaration and initialization, Accessing members of Union; Array of Union variable; Unions inside Structures, Structures inside unions, Enumerated Data type. CO4

UNIT – V FILE PROCESSING **9**

Introduction to files, using files in C, read data from files, Writing Data to files, Detecting the End of file, Error Handling during file operations; Accepting Command line arguments, Function for selecting a record randomly, Remove and renaming the File, Creating temporary file, Preprocessor directives. CO5

TOTAL PERIODS: 45

TEXT BOOKS

1. Reema Thareja, Programming in C, Oxford University Press, Third Edition, 2023.
2. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill, 2017.
3. Kernighan, B.W and Ritchie, D.M, The C Programming language, Second Edition, Pearson Education, 2015.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, How to Program, Ninth edition, Pearson Publication 2022.
2. Dhabal Prasad Sethi and Manoranjan, Concepts and Techniques of Programming In C, Wiley India,2020.
3. Mamta Bhusry, C Concepts & Programming, Wiley India, 2019
4. Dr. Rupinder Singh, Inderpreet Kaur, and Davinder Kaur, C programming Beginners guide, Notion Press, 2020.
5. M.T. Somashekara, D. S. Guru and K. S. Manjunatha, Problem Solving with C, PHI Learning, 2018.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple applications in C using basic constructs.
CO2 Design and implement applications using arrays, strings and functions.
CO3 Develop and implement applications in C using pointers.
CO4 Develop applications in C using structures and union.
CO5 Design applications using sequential and random-access file processing.

GE1209	**தமிழர் மரபு**	**L**	**T**	**P**	**C**
	(Common for all Branches of B.E. / B. Tech Programmes)	**1**	**0**	**0**	**1**

அலகு - I மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு - II மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசை கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு - III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம் தமிழர்களின் விளையாட்டுகள்.

அலகு - IV தமிழர்களின் திணைக் கோட்பாடுகள் 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு - V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு - இந்தியாவின பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ் புத்தகங்களின் அச்சு வரலாறு.

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1209 HERITAGE OF TAMILS

(Common for all Branches of B.E. / B. Tech Programmes)

L	T	P	C
1	0	0	1

UNIT – I LANGUAGE AND LITERATURE **3**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT – II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE **3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils

UNIT – III FOLK AND MARTIAL ARTS **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT – IV THINAI CONCEPT OF TAMILS **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT – V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3 **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs .
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1.	Write an algorithm and draw flowchart illustrating mail merge concept.	
2.	Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	
3.	Scientific problem-solving using decision making and looping. ➢ Armstrong number, palindrome of a number, Perfect number.	CO1
4.	Simple programming for one dimensional and two-dimensional arrays. ➢ Transpose, addition, multiplication, scalar, determinant of a matrix	
5.	Program to explore string functions and recursive functions.	CO2

6. Utilizing ‘Functions’ in Python
   - Find mean, median, mode for the given set of numbers in a list.
   - Write a function dups to find all duplicates in the list.
   - Write a function unique to find all the unique elements of a list.
   - Write function to compute gcd, lcm of two numbers.
7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.
9. To sort the ‘n’ numbers using: Selection, Merge sort and Insertion Sort.
10. Find the most frequent words in a text of file using command line arguments.
11. Demonstrate Exceptions in Python. CO3
12. Applications**:** Implementing GUI using turtle, pygame.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple console applications through python with control structure and functions

CO2 Use python built in data structures like lists, tuples, and dictionaries for representing compound data.

CO3 Read and write data from/to files in Python and applications of python.

REFERENCE BOOKS:

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , “ Think Python: How to Think Like a Computer Scientist”, Second Edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016.
3. Shroff “Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES:

1. http://www.edx.org

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The properties of matter
- The optical properties, characteristics of lasers & optical fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

A minimum of 5 experiments to be performed from the given list

1. Determination of Young’s modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.

3. Determination of wavelength of mercury spectra using Spectrometer and grating.
4. Determination of dispersive power of prism using Spectrometer.
5. (a) Determination of wavelength and particle size using a laser.
   (b) Determination of numerical aperture and acceptance angle of an optical fibre.
   (c) Determination of width of the groove of compact disc using laser
6. Determination of Young's modulus of the material of the given beam by uniform bending method.
7. Determination of energy band gap of the semiconductor.
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.

Demonstration Experiment

1. Determination of thickness of a thin sheet / wire - Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

A minimum of 5 experiments to be performed from the given list

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Conductometric titration of strong acid vs strong base.

Demonstration Experiments

1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
2. Estimation of sodium and potassium present in water using flame photometer.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concept about the basic properties of matter like stress, strain and types of moduli.
Understand the procedure to estimate the amount of dissolved oxygen present in the water.

CO2 Understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
Understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.

CO3 Understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor.
Understand the principle and procedure involved in the amount of chloride present in the given sample of water.

CO4 Understand the concept of microscope and its applications in determining the moduli.
Understand the concept of determining the emf values by using potentiometer.

CO5 Calculate the particle size of poly crystalline solids.
Understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

GE1110	PROGRAMMING IN C LABORATORY	L	T	P	C
	(Common to all branches of B.E./B.Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS

1. C programming using simple statements and expressions.
2. Scientific problem-solving using decision making and looping.
3. Generating different patterns using multiple control statements. CO1
4. Problems solving using one dimensional array.
5. Mathematical problem solving using two dimensional arrays.
6. Solving problems using string functions.
7. Solving problems with user defined functions.
8. Solving problems using recursive function. CO2
9. Solving problems with dynamic memory allocation.
10. Realtime application using structures and unions.
11. Realtime problem solving using sequential and random-access file.
12. Solving problems with command line argument. CO2

TOTAL PERIODS: 60

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by Jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
6. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop C programs for simple applications making use of basic constructs.
CO2 Develop C programs involving string, functions, recursion, pointers, andstructures.
CO3 Design applications using sequential and random-access fileprocessing.

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

OBJECTIVES

The course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT – I	**INTRODUCTION PROFESSIONAL ENGLISH**	**9**	
	Listening: Listening to technical talks with comprehension tasks - Speaking - conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading - reading short technical texts from journals- newspapers - Writing- purpose statements - extended definitions - writing instructions - checklists-recommendations - Vocabulary Development - technical vocabulary Language Development - tenses - subject verb agreement - compound words		CO1
UNIT – II	**READING AND STUDY SKILLS**	**9**	
	Listening - Listening comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). - Speaking - describing a process - Reading: Practice in chunking and speed reading – Paragraphing - Writing- interpreting charts, graphs - Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs - easily confused words Language Development- impersonal passive voice, numerical adjectives.		CO2
UNIT – III	**TECHNICAL WRITING AND GRAMMAR**	**9**	
	Listening - listening to conversation - effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking - mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		CO3
UNIT – IV	**REPORT WRITING**	**9**	
	Listening - Model debates & documentaries and making notes. Speaking - expressing agreement/ disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette - job application - cover letter - Résumé preparation (via email and hard copy) - analytical essays and issue based essays - Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		CO4
UNIT – V	**GROUP DISCUSSION AND JOBAPPLICATIONS**	**9**	
	Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking - participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others) - Writing reports- minutes of a meeting- accident and survey - Writing a letter/ sending an email to the Editor - cause and effect sentences - Vocabulary Development - verbal analogies. Language Development - reported speech.		CO5
	TOTAL PERIODS:	**45**	

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

TEXT BOOKS:

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS:

1. Raman, Meenakshi and Sharma, Sangeetha, Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad, 2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading

MA1202	**ENGINEERING MATHEMATICS – II**	**L**	**T**	**P**	**C**
		4	**0**	**0**	**4**

OBJECTIVES

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. Vector calculus can be widely used for modelling the various laws of physics.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT - I ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters- Homogenous equation of Euler‘s and Legendre‘s type - System of simultaneous first order linear differential equations with constant coefficients CO1

UNIT - II VECTOR CALCULUS **12**

Gradient and directional derivative - Divergence and curl - Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems - Verification and simple application in evaluating line, surface and volume integrals. CO2

UNIT - III COMPLEX VARIABLES **12**

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties - Harmonic conjugates - Construction of analytic function (Milne-Thomphson method) - Conformal mapping - Standard transformations W = Z + C, CZ, 1/Z - Bilinear transformation. CO3

UNIT - IV COMPLEX INTEGRATION **12**

Cauchy integral theorem - Cauchy integral formula - Taylor and Laurent series - Singularities - Residues - Cauchy Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semi circular contour(excluding poles on the real line) CO4

UNIT - V LAPLACE TRANSFORMS **12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - transforms of derivatives and integrals -Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem - Application to solution of linear second order ordinary differential equations with constant coefficients. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

CO1 The students were imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems

CO2 The student were acquainted with the concepts of vector calculus-like Gradient, Divergence, Curl, Directional derivative, Irrational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.

CO3 To develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current .

CO4 The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.

CO5 To make the students to appreciate the purpose of using transforms to create new domain in which it is easier to handle the problem that is being investigated.

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCE BOOKS:

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics - II, McGraw Hill Education; First edition 2017.

PH1254	MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the essential principles of materials science for mechanical and related engineering applications

UNIT - I PHASE DIAGRAMS **9**

Solid solutions - Hume Rothery's rules - the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions - free energy composition curves for binary systems - microstructural change during cooling. CO1

UNIT - II FERROUS ALLOYS **9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws of diffusion- mechanisms of diffusion, temperature dependence of diffusivity - steady and non-steady state diffusion - factors that influence diffusion - Properties and applications of copper alloys, aluminium alloys and titanium alloys. Phase transformations - T-T-T-diagram for eutectoid steel - pearlitic, baintic and martensitic transformations - tempering of martensite. CO2

UNIT - III MECHANICAL PROPERTIES **9**

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination- Fatigue failure - fatigue tests - hardness - Rockwell and Brinell hardness - Knoop and Vickers micro hardness. Steps in materials selection process, Factors influencing materials selection, Case studies CO3

UNIT - IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS **9**

Ferromagnetism - domain theory - types of energy - hysteresis - hard and soft magnetic materials - ferrites - dielectric materials - types of polarization – Langevin - Debye equation - frequency effects on polarization - dielectric breakdown - insulating materials - Ferroelectric materials - superconducting materials and their properties. CO4

UNIT - V NEW MATERIALS **9**

Historical perspective- Material properties and qualities, Classification of Materials - Ceramics - types and applications - composites: classification, role of matrix and reinforcement, processing of fibre reinforced plastics - metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudo elastic effect, NiTi alloy, applications – nano materials: preparation (bottom up and top down approaches), properties and applications. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the various forms of solid solutions, equilibrium, and different phase diagrams and their applications in materials system.

CO2 Understand the Fe - Fe_3C phase diagram, invariant reactions, diffusion of solids, mechanism, factors that influence diffusion, properties of copper, aluminium and titanium alloys and various microstructures of ferrous and their alloys.

CO3 Understand the mechanical properties of materials, measurement and materials selections process and their case studies.

CO4 Understand the properties of different types of magnetic materials - Ferromagnetic, Anti ferro magnetic, Ferrites. Understand the phenomenon of superconductivity, and its properties of superconductors and .the properties of dielectric materials, various types of polarization and loss in dielectric materials.

CO5 Understand the importance of various newer materials, like ceramics, composite materials, metallic glass, SMA, Nano materials. Their historical perspective, properties, classification and fabrication and apply to develop alloys of various composition with desirable properties

TEXT BOOKS:

1. Balasubramaniam, R. Callister’s Materials Science and Engineering. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. Physical Metallurgy: Principles and Practice. PHI Learning, 2015.
3. Raghavan, V. Materials Science and Engineering: A First course. PHI Learning, 2015.

REFERENCE BOOKS:

1. Askeland, D. Materials Science and Engineering. Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. Materials Science and Engineering. Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT - I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY **11**

Definition, scope and importance of environment - need for public awareness - Role of Individual in Environment protection - Concept of an ecosystem-structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem.

Biodiversity-definition-genetic species and ecosystem diversity. Value of biodiversity-consumptive use, productive use, social, ethical, aesthetic and option values. - Biodiversity at global, national and local levels - India as a mega-diversity nation - Hot spots of biodiversity. Threats to biodiversity-habitat loss, poaching of wild life, human-wildlife conflicts. Wildlife protection act and forest conservation act. Endangered and endemic species. Conservation of biodiversity in-situ and ex-situ conservation of biodiversity. CO1

UNIT - II ENVIRONMENTAL POLLUTION **9**

Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes- problems of e-waste - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone, Tsunami and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural. CO2

UNIT - III NATURAL RESOURCES **9**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and overutilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets - river / forest / grassland / hill / mountain. CO3

UNIT - IV SOCIAL ISSUES AND THE ENVIRONMENT **8**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization - environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - Principles of Green Chemistry - environment CO4 protection act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation- central and state pollution control boards- National Green Tribunal - Public awareness.

UNIT - V HUMAN POPULATION AND THE ENVIRONMENT **8**

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - COVID 19 - women and child welfare - role of information technology in environment and human health - Case studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Obtain knowledge about environment, ecosystems and biodiversity.
- CO2 Take measures to control environmental pollution.
- CO3 Gain knowledge about natural resources and energy sources.
- CO4 Find and implement scientific, technological, economic and political solutions to environmental problems.
- CO5 Understand the impact of environment on human population.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCE BOOKS:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt, Ltd, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

BE1252	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- Electric circuit laws, single and three phase circuits and wiring
- Working Principles of Electrical Machines
- Various Electronic Devices and Measuring Instruments

UNIT - I ELECTRICAL CIRCUITS **9**

Basic circuit components, Ohms Law - Kirchoff's Law - Instantaneous Power - Inductors - Capacitors - Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis - Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem, Linearity and Superposition Theorem. CO1

UNIT - II AC CIRCUITS **9**

Introduction to AC circuits - waveforms and RMS value - power and power factor, single phase and three-phase balanced circuits - Three phase loads - housing wiring, industrial wiring, materials of wiring. CO2

UNIT - III ELECTRICAL MACHINES **9**

Principles of operation and characteristics of; DC machines, Transformers (single and three phase), Synchronous machines , three phase and single phase induction motors. CO3

UNIT - IV ELECTRONIC DEVICES AND CIRCUITS		**9**
Types of Materials - Silicon & Germanium - N type and P type materials - PN Junction - Forward and Reverse Bias -Semiconductor Diodes - Bipolar Junction Transistor - Characteristics - Field Effect Transistors - Transistor Biasing - Introduction to operational Amplifier - Inverting Amplifier - Non Inverting Amplifier - DAC - ADC .		CO4
UNIT - V MEASUREMENTS AND INSTRUMENTATION		**9**
Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - Classification of instruments - Types of indicating Instruments - multimeters – Oscilloscopes - three-phase power measurements - instrument transformers (CT and PT)		CO5
	TOTAL PERIODS:	**45**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the basic laws and theorems used in Electrical circuits
CO2	Impart knowledge on single phase and three phase AC circuit and wiring
CO3	Comprehend the construction and working principle of Electrical machines
CO4	Explain the fundamentals of semiconductor and applications.
CO5	Impart knowledge on different measuring instruments

TEXT BOOKS:

1. Leonard S Bobrow, “Foundations of Electrical Engineering”, Oxford University Press, 2013 2.
2. D.P.Kothari and I.J.Nagarath, “Electrical Machines “Basic Electrical and Electronics Engineering”, McGraw Hill Education(India) Private Limited, Third Reprint, 2016 3.
3. Thereja.B.L., “Fundamentals of Electrical Engineering and Electronics”, S. Chand & Co. Ltd., 2008

REFERENCE BOOKS:

1. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007
2. John Bird, “Electrical Circuit Theory and Technology”, Elsevier, First Indian Edition, 2006
3. Allan S Moris, “Measurement and Instrumentation Principles”, Elsevier, First Indian Edition,2006
4. Rajendra Prasad, “Fundamentals of Electrical Engineering”, Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, “Basic Electrical Engineering”, Universities Press (India)Private Limited 2016

GE1206	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop capacity to predict the effect of force.
- To develop motion in the course of carrying out the design functions of Engineering.

UNIT - I STATICS OF PARTICLES	**12**
Introduction - Units and Dimensions - Laws of Mechanics - Lami’s theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility.	CO1

UNIT - II EQUILIBRIUM OF RIGID BODIES		**12**
Free body diagram - Types of supports -Action and reaction forces - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force -Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions.		CO2
UNIT - III PROPERTIES OF SURFACES AND SOLIDS		**12**
Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, - Angle section, Hollow section by using standard formula - Theorems of Pappus - Area moments of inertia of plane areas - Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia -mass moment of inertia for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia.		CO3
UNIT - IV DYNAMICS OF PARTICLES		**12**
Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's laws of motion - Work Energy Equation- Impulse and Momentum - Impact of elastic bodies.		CO4
UNIT - V FRICTION AND RIGID BODY DYNAMICS		**12**
Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction - wedge friction-. Rolling resistance -Translation and rotation of rigid bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.		CO5
	TOTAL PERIODS:	**60**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Illustrate the vectorial and scalar representation of forces and moments
CO2	Analyse the rigid body in equilibrium
CO3	Evaluate the properties of surfaces and solids
CO4	Calculate dynamic forces exerted in rigid body
CO5	Determine the friction and the effects by the laws of friction

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 12th Edition, Tata McGraw-Hill Publishing company, (2017).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2018).

REFERENCE BOOKS:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 2017.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics - Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., "Engineering Mechanics - Statics" - John Wiley & Sons, 2017.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2018.

GE1210 **தமிழரும் தொழில்நுட்பமும்** **L T P C**

(Common for all Branches of B.E. / B. Tech Programmes) **1 0 0 1**

GE1210	**தமிழரும் தொழில்நுட்பமும்**	**L**	**T**	**P**	**C**
	(Common for all Branches of B.E. / B. Tech Programmes)	**1**	**0**	**0**	**1**

அலகு - I <u>நெசவு மற்றும் பானைத் தொழில்நுட்பம்</u> 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு - II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் சுட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு - III உற்பத்தித் தொழில் நுட்பம் 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு - IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு - V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி -கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1210	TAMILS AND TECHNOLOGY	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT - IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT - V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL PERIODS : 15

TEXT CUM REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE1207 ENGINEERING PRACTICES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **18**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making - Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

GROUP B (ELECTRICAL & ELECTRONICS))

III ELECTRICAL ENGINEERING PRACTICE **13**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE **16**

1. Study of electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of clock signal.
4. Soldering practice - Components devices and circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Fabricate carpentry components and pipe connections including plumbing works.

CO2 Use welding equipments to join the structures, carry out the basic machining operations, and make the models using sheet metal works.

CO3 Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.

CO4 Carry out basic home electrical works and appliances, measure the electrical quantities.

CO5 Elaborate on the electronic components and gates, soldering practices.

BE1258	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's voltage and current laws.
2. Verification of Thevenin's and Norton's theorem.
3. Verification of superposition theorem.
4. Verification of Maximum power transfer theorem.
5. Study of CRO and measurement of AC signals.
6. Measurement of three phase power by two-Watt meter method.
7. Characteristics of LVDT.
8. Half wave rectifier with capacitive filter.
9. Characteristics of PN Diode
10. Characteristics of BJT
11. RTD and thermistor
12. Transistor based application circuits

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and experimentally verify the basics of electric circuit laws
CO2	Understand and apply circuit theorems and concepts in engineering applications
CO3	Analyze the AC signals, understand the three phase electric networks and study the instruments used for commercial measurement of electrical power.
CO4	Understand and analyze the characteristics of diode, transistor and implement transistor based application
CO5	Understand and analyze the characteristics of different transducers

MA1301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

OBJECTIVES

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of different equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT - I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations - Singular integrals - Solutions of standard types of first order partial differential equations (except) - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types CO1

UNIT - II FOURIER SERIES 12

Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series - General Fourier series - Odd and even functions - Half range sine series -Half range cosine series - Complex form of Fourier series - Parseval's identity - Harmonic analysis. CO2

UNIT - III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE - Method of separation of variables - Fourier Series Solutions of one-dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two dimensional equation of heat conduction. CO3

UNIT - IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem - Fourier transform pair - Fourier sine and Cosine transforms - Properties - Transforms of simple functions - Convolution theorem - Parseval's identity. CO4

UNIT - V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties - Inverse Z-transform (using partial fraction and residues) -Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand how to solve the partial differential equations and apply these concepts in the field of engineering.

CO2 Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.

CO3 Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.

CO4 Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.

CO5 Learn to use effective mathematical tools like Z- transform for solving difference equations in discrete time signals etc.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

REFERENCE BOOKS:

1. Dass, H.K., and Er.RajnishVerma, "Higher Engineering Mathematics", S.Chand Private Ltd.,2011.
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012
3. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

EE1352	ELECTRICAL DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of different types of electrical machines.
- To impart knowledge on performance characteristics of drive motors.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state speed control of DC drives.
- To study the conventional and solid-state speed control of AC drives.

UNIT - I INTRODUCTION **8**

Basic elements - Types of electric drives - factors influencing the choice of electrical drives - heating and cooling curves - Loading conditions and classes of duty - Selection of power rating for drive motors with regard to thermal overloading and Load variation factors. CO1

UNIT - II DRIVE MOTOR CHARACTERISTICS **9**

Mechanical characteristics - Speed-Torque characteristics of various types of load and drive motors - Braking of electrical motors - DC motors: Shunt, series and compound - single phase and three phase induction motors - V and inverted V curve of synchronous motor - Regulation of alternator by EMF & MMF method. CO2

UNIT - III STARTING METHODS **8**

Types of DC Motor starters - Typical control circuits for shunt and series motors - Types of A.C Motor starters - Three phase squirrel cage and slip ring induction motors. CO3

UNIT - IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES **10**

Speed control of DC series and shunt motors - Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers -applications. CO4

UNIT - V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES **10**

Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip power recovery scheme - Using inverters and AC voltage regulators - applications. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the basic concepts of different types of electrical machines

CO2 Understand and analyze different drive motors characteristics

CO3 Understand the different methods of starting DC motors and induction motors

CO4 Analyze the conventional and solid-state speed control of DC drives

CO5 Analyze the conventional and solid-state speed control of AC drives

TEXT BOOKS:

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2006.
2. Vedam Subrahmanyam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010

REFERENCE BOOKS:

1. Partab. H., “Art and Science and Utilisation of Electrical Energy”, Dhanpat Rai and Sons, 2017
2. Pillai.S.K, “A First Course on Electric Drives”, Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2006

CE1301 FLUID MECHANICS AND MACHINERY

L	T	P	C
3	0	0	3

OBJECTIVES

- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

UNIT - I FLUID PROPERTIES AND FLOW CHARACTERISTICS **9**

Units and dimensions - Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation. CO1

UNIT - II FLOW THROUGH CIRCULAR CONDUITS **9**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli - Boundary layer concepts - types of boundary layer thickness - Darcy Weisbach equation - friction factor- Moody diagram- commercial pipes- minor losses - Flow through pipes in series and parallel. CO2

UNIT - III DIMENSIONAL ANALYSIS **9**

Need for dimensional analysis - methods of dimensional analysis - Similitude - types of similitude - Dimensionless parameters - application of dimensionless parameters - Model analysis. CO3

UNIT - IV PUMPS **9**

Impact of jets - Euler's equation - Theory of roto-dynamic machines - various efficiencies - velocity components at entry and exit of the rotor - velocity triangles - Centrifugal pumps - working principle - work done by the impeller - performance curves - Reciprocating pump - working principle - Rotary pumps -classification. CO4

UNIT - V HYDRAULIC TURBINES **9**

Classification of turbines - heads and efficiencies - velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines - governing of turbines. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2 Analyze and calculate major and minor losses associated with pipe flow in piping networks.
CO3 Mathematically predict the nature of physical quantities
CO4 Analyze critically the performance of pumps
CO5 Analyze critically the performance of turbines

TEXT BOOKS:

1. Modi P.N. and Seth, S.M., "Hydraulics and Fluid Mechanics Including Hydraulics Machines", Standard Book House, New Delhi 2019.
2. Bansal R. K., "Fluid Mechanics and Hydraulics Machines ", Lakshmi Publications India Pvt. Ltd., India 2018

REFERENCE BOOKS:

1. Kumar K. L., "Engineering Fluid Mechanics", S.Chand& Company Pvt. Ltd, 2016
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
3. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010.

ME1301 ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

OBJECTIVES

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behaviour and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

UNIT - I BASIC CONCEPTS AND FIRST LAW **12**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics - concept of temperature and thermal equilibrium- relationship between temperature scales - new temperature scales. First law of thermodynamics -application to closed and open systems - steady and unsteady flow processes. CO1

UNIT - II SECOND LAW AND AVAILABILITY ANALYSIS **12**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle and Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency. CO2

UNIT - III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE **12**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. P-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles. CO3

UNIT - IV IDEAL AND REAL GASES,THERMODYNAMIC RELATIONS **12**

Properties of Ideal gas - Ideal and real gas comparison - Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. Generalised Compressibility Chart and its use. Maxwell relations, TDS Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations. CO4

UNIT - V GAS MIXTURES AND PSYCHROMETRY **12**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture - Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions
CO2	Apply second law of thermodynamics to open and closed systems and calculate entropy and availability
CO3	Apply Rankine cycle to steam power plant and compare few cycle improvement methods
CO4	Derive simple thermodynamic relations of ideal and real gases
CO5	Calculate the properties of gas mixtures and moist air and its use in psychrometric processes

TEXT BOOKS:

1. R.K.Rajput, "A Text Book of Engineering Thermodynamics", Fifth Edition, 2017.
2. Yunus A. Cengel, Michael A. Boles and Mehmet Kanoglu, "Thermodynamics - An Engineering Approach", Tata McGraw-Hill, 9th edition 2019

REFERENCE BOOKS:

1. P.K. Nag, "Engineering Thermodynamics", Tata McGraw-Hill, 6th Edition, 2017
2. C.P. Arora, "Thermodynamics", Tata McGraw-Hill, 12th Edition, 2007
3. Claus Borgnakke& Richard E. Sonnatag, "Fundamental of Thermodynamics", Wiley Publications 10th Edition, 2019.
4. Chattopadhyay.P, "Engineering Thermodynamics", Oxford University Press, 2nd Edition, 2016.
5. Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, Margaret B. Bailey, "Fundamentals of Engineering Thermodynamics", 8th Edition, 2014.

ME1302 MANUFACTURING PROCESSES

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I METAL CASTING PROCESSES **9**

Sand Casting: Sand Mould - Type of patterns - Pattern Materials - Pattern allowances - Moulding sand Properties and testing - Cores -Types and applications - Moulding machines - Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - CO_2 process - Stir casting; Defects in Sand casting. CO1

UNIT - II JOINING PROCESSES **9**

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure. CO2

UNIT - III METAL FORMING PROCESSES **9**

Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - forging operations. Rolling of metals- Types of Rolling - Flat strip rolling - shape rolling operations - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion CO3

UNIT - IV SHEET METAL PROCESSES **9**

Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods -special forming processes-Working principle and applications - Hydroforming - Rubber pad forming - Metal spinning- Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming - Micro forming. CO4

UNIT - V MANUFACTURE OF PLASTIC COMPONENTS **9**

Types and characteristics of plastics - Moulding of thermoplastics - working principles and typical applications - injection moulding - Plunger and screw machines - Compression moulding, Transfer Moulding - Typical industrial applications - introduction to blow moulding - Rotational moulding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain different metal casting processes, associated defects, merits and demerits
CO2	Understand different metal joining processes.
CO3	Summarize various hot working and cold working methods of metals.
CO4	Explain various sheet metal making processes.
CO5	Understand various methods of manufacturing plastic components.

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", Volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008.
2. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2013.

REFERENCE BOOKS:

1. S. Gowri, P. Hariharan, A.SureshBabu, "Manufacturing Technology I", Pearson Education, 2008.
2. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice - Hall of India, 1997.
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, TMH-2013.
4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
5. Sharma, P.C., "A Textbook of Production Technology", S.Chand and Co. Ltd., 2014.
6. J. Beddoes, M. Bibby., "Principles of Metal Manufacturing Processes", Elsevier India, 2011.

EE1358 ELECTRICAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To validate the principles studied in theory by performing experiments in the laboratory

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Perform DC shunt and series motor characteristics and to analyse the speed control behaviour of DC shunt Motor.

CO2 Perform the characteristics of DC Shunt generator on O.C and load conditions.

CO3 Perform open circuit, short circuit and load test on single phase transformer.

CO4 Perform regulation characteristics on the alternator and to analyse the V-curve and Inverted V-curve of a synchronous motor.

CO5 Perform the speed control behaviour of an induction motor and also to know the working principles of AC and DC motor starters.

ME1307 MANUFACTURING PROCESSES LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

LIST OF EXPERIMENTS

1. Machining and Machining time estimations for:

a) Taper Turning
b) External Thread cutting
c) Internal Thread Cutting
d) Eccentric Turning
e) Knurling

2. Casting and Joining processes

a) Joining of plates by horizontal, vertical and overhead welding (arc welding)
b) Joining of plates and pipes using gas metal arc welding/ arc welding /submerged arc welding
c) Preparation of green sand moulds for various patterns
d) Manufacturing of simple sheet metal components using shearing and bending operations.
e) Manufacturing of sheet metal components using metal spinning on a lathe.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate the safety precautions exercised in the mechanical workshop.
CO2 Make the work piece as per given dimensions and calculate machining time for different operations in lathe.
CO3 Join two metals using arc welding
CO4 Use sheet metal fabrication tools and make simple tray and funnel
CO5 Use different moulding tools, patterns and prepare sand moulds

HS1310 PROFESSIONAL SKILLS LABORATORY

L	T	P	C
0	0	2	1

OBJECTIVES

- Enhance the employability and career skills of students
- Orient the students towards grooming as a professional
- Make them employable graduates
- Develop their confidence and help them attend interviews successfully.

UNIT - I

Introduction to Soft Skills - Hard skills & soft skills - employability and career Skills - Grooming as a professional with values - Making an Oral Presentation-Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.

UNIT – II

Introduction to Group Discussion - Participating in group discussions - understanding group dynamics - brainstorming the topic - questioning and clarifying -GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc.

UNIT – III

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette - dress code - body language - attending job interviews - telephone/skype interview -one to one interview & panel interview - Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

UNIT – IV

Self-Introduction - organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice - Making a Power Point Presentation - Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation - Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language.

UNIT – V

Recognizing differences between groups and teams- managing time-managing stress - networking professionally - respecting social protocols-understanding career management - developing a long-term career plan - making career changes.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Make effective presentations

CO2 Participate confidently in group discussions

CO3 Attend job interviews and be successful in them

CO4 Develop adequate soft skills required for the workplace

CO5 Develop their speaking skills to enable them speak fluently in real contexts

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. Orient Balck Swan: Hyderabad, 2016.
3. E.Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S.Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010.

MA1401	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		4	0	0	4

OBJECTIVES

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquire the knowledge of testing hypotheses for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the Interpolation operators and numerical techniques of interpolation in various intervals, numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit CO1

UNIT - II DESIGN OF EXPERIMENTS 12

One way and two-way classifications - Completely randomized design - Randomized block design - Latin square design - 2^2 factorial design. CO2

UNIT – III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method. CO3

UNIT – IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **12**

Interpolation operators (Forward, Backward, shifting operators and its Properties) -- Newton's forward and backward difference interpolation for equal intervals - Lagrange's and Newton's divided difference interpolation for unequal intervals - Approximation of derivatives using interpolation polynomials - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules CO4

UNIT - V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

.Finite difference methods for solving second order two - point linear boundary value problems Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Students will gain knowledge on large samples and small samples. These concepts are very useful in biological, electric power management, social experiments and also in all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.

CO2 ANOVA's statistical significance result is independent of constant bias and scaling of errors. It is used in testing the difference between several treatments in the design of experiments. It checks the impact of one or more factors in any experiment in Engineering.

CO3 Students will learn nonlinear (algebraic or transcendental) equations and linear equations. Students learn to solve the eigen value problem of a matrix numerically when analytical methods tend to fail to give solution and apply all these in the fields like vibrating systems, fluid dynamics.

CO4 Students will learn to construct approximate polynomials that can be used in data representation using interpolation techniques to find the intermediate values. In particular, interpolation methods are extensively applied in the models of the different phenomena where experimental data must be used in computer studies where expressions of those data are required. The learners are introduced to numerical differentiation and integration techniques. The techniques are useful when the function in the analytical form is complicated.

CO5 Students get an insight on ordinary differential equations which will be useful in solving engineering problems. Students learn about the different methods for solving first order and second order differential equations. It will be useful in attempting to solve any engineering problems. ODE is applied in specific mathematical fields like electrical, geometry, analytical mechanics, celestial mechanics and weather modelling.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCE BOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists" 8^{th} edition, Pearson Education, Asia, 2007

CE1401	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external ·loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS **9**

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains - Stresses on inclined planes - principal stresses and principal planes - Mohr's circle of stress. CO1

UNIT - II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM **9**

Beams - types transverse loading on beams - Shear force and bending moment in beams - Cantilevers - Simply supported beams and over - hanging beams. Theory of simple bending - bending stress distribution - Load carrying capacity - Proportioning of sections - Flitched beams - Shear stress distribution. CO2

UNIT - III TORSION **9**

Torsion formulation stresses and deformation in circular and hollows shafts - Stepped shafts - Deflection in shafts fixed at the both ends - Stresses in helical springs - Deflection of helical springs, carriage springs. CO3

UNIT - IV DEFLECTION OF BEAMS **9**

Double Integration method - Macaulay's method - Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy - Maxwell's reciprocal theorems. CO4

UNIT - V THIN CYLINDERS, SPHERES AND THICK CYLINDERS **9**

Stresses in thin cylindrical shell due to internal pressure, circumferential and longitudinal stresses and deformation in thin and thick cylinders - spherical shells subjected to internal pressure - Deformation in spherical shells - Lame's theorem. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.

CO2 Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3 Apply basic equation of simple torsion in designing of shafts and helical spring.

CO4 Calculate the slope and deflection in beams using different methods.

CO5 Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCE BOOKS:
1. Egor. P.Popov, “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing ‘co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

ME1401	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES
- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam Turbines, Compressors and Refrigeration and Air conditioning systems
  (Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT I GAS POWER CYCLES **9**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Comparison of cycles. CO1

UNIT - II INTERNAL COMBUSTION ENGINES **9**

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburettor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation. CO2

UNIT - III STEAM NOZZLES AND TURBINES **9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations -Governors. CO3

UNIT - IV AIR COMPRESSOR **9**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling - work of multistage air compressor CO4

UNIT - V REFRIGERATION AND AIR CONDITIONING **9**

Refrigerants - Vapour compression refrigeration cycle- superheat, sub cooling - Performance calculations - working principle of vapour absorption system, Ammonia - Water, Lithium bromide - water systems (Description only). Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Cooling Load calculations. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and analyse the gas power cycles (Otto, Diesel, Dual and Brayton cycle)
CO2	Understand the working principle of IC engines, its components and compute its performance.
CO3	Design and analyse the steam nozzle & turbines
CO4	Understand the various types of compressor and compute its performance.
CO5	Understand the basic concepts of different types of refrigeration and air conditioning systems, and to compute cooling load calculations

TEXT BOOKS:

1. R.K. Rajput, “Thermal Engineering” Lakshmi Publishers, 2017
2. Kothandaraman C.P., Domkundwar. S, Domkundwar A.V., “A Course in Thermal Engineering”, Fifth Edition, ”Dhanpat Rai & sons , 2002

REFERENCE BOOKS:

1. Sarkar, B.K, “Thermal Engineering” Tata McGraw-Hill Publishers, 2007
2. C.P. Arora, “Refrigeration and Air Conditioning”, 3rd Edition, Tata McGraw-Hill Publishers 2017
3. V. Ganesan “Internal Combustion Engines”, Third Edition, Tata Mcgraw-Hill 2012
4. R. Rudramoorthy, “Thermal Engineering”, Tata McGraw-Hill, New Delhi,2003
5. K. K. Ramalingam, "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2011.

ME1402	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I BASICS OF MECHANISMS **9**

Classification of mechanisms - Basic kinematic concepts and definitions - Degree of freedom, Mobility - Kutzbach criterion, Gruebler’s criterion - Grashof’s Law - Kinematic inversions of four-bar chain and slider crank chains - Limit positions - Mechanical advantage - Transmission Angle - Description of some common mechanisms - Quick return mechanisms, Straight line generators, Universal Joint - rocker mechanisms. CO1

UNIT - II KINEMATICS OF LINKAGE MECHANISMS **9**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method-Velocity and acceleration polygons - Velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms - Coincident points - Coriolis component of Acceleration - Introduction to linkage synthesis problem. CO2

UNIT – III KINEMATICS OF CAM MECHANISMS **9**

Classification of cams and followers - Terminology and definitions - Displacement diagrams - Uniform velocity, parabolic, simple harmonic and cycloidal motions - Derivatives of follower motions - Layout of plate cam profiles - Specified contour cams - Circular arc and tangent cams - Pressure angle and undercutting - sizing of cams. CO3

UNIT – IV GEARS AND GEAR TRAINS **9**

Law of toothed gearing - Involutes and cycloidal tooth profiles -Spur Gear terminology and definitions - Gear tooth action - contact ratio - Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value - Parallel axis gear trains - Epicyclic Gear Trains. CO4

UNIT – V FRICTION IN MACHINE ELEMENTS **9**

Surface contacts - Sliding and Rolling friction - Friction drives - Friction in screw threads - Bearings and lubrication - Friction clutches - Belt and rope drives - Friction in brakes - Band and block brakes. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the basics of mechanism

CO2 Calculate velocity and acceleration in simple mechanisms

CO3 Develop CAM profiles

CO4 Solve problems on gears and gear trains

CO5 Examine friction in machine elements

TEXT BOOKS:

1. F.B. Sayyad, "Kinematics of Machinery", MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
2. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2017.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 1961.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
3. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2008.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
6. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005.

ME1403	**ENGINEERING METALLURGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys - Solid solutions, substitutional and interstitial - phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron - carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application. CO1

UNIT - II HEAT TREATMENT 9

Definition - Full annealing, stress relief, recrystallisation and spheroidising - normalising, hardening and Tempering of steel. Isothermal transformation diagrams - cooling curves superimposed I.T. diagram CCR - Hardenability, Jominy end quench test - Austempering, martempering - case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening. CO2

UNIT - III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel- α and β stabilisers- stainless and tool steels - HSLA, Maraging steels - Cast Iron - Grey, white, malleable, spheroidal - alloy cast irons, Copper and copper alloys Brass, Bronze and Cupronickel - Aluminium and Al-Cu - precipitation strengthening treatment - Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys. CO3

UNIT - IV NON-METALLIC MATERIALS **9**

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers - Urea and Phenol formaldehydes)- Engineering Ceramics - Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and SIALON -Composites- Classifications- Metal Matrix and FRP - Applications of Composites. CO4

UNIT - V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS **9**

Mechanisms of plastic deformation, slip and twinning - Types of fracture - Testing of materials under tension, compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test- izod and charpy, fatigue and creep failure mechanisms. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Identify the material constituents from phase diagrams and to understand the classification of steels and cast iron.
- CO2 Understand the classification of various heat treatment processes.
- CO3 Understand the effects of alloying elements and Engineering applications of ferrous and non-ferrous metals
- CO4 Understand the engineering applications of non-metallic materials.
- CO5 Understand the various deformation mechanisms and testing of various mechanical properties of materials

TEXT BOOKS:

1. Avner, S.H., “Introduction to Physical Metallurgy”, McGraw Hill Education; 2nd edition July 2017.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition2014.

REFERENCE BOOKS:

1. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt.Ltd.,2015.
2. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley,2012
3. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited,2010.
4. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006.

ME1404 METAL CUTTING AND MACHINE TOOLS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping, milling, drilling, grinding, broaching and allied machines.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming.

UNIT I THEORY OF METAL CUTTING **9**

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools- nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability. CO1

UNIT - II TURNING MACHINES **9**

Centre lathe, constructional features, specification, operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Semi automatic lathe- Capstan and turret lathes- tool layout - automatic lathes: - single spindle : Swiss type, screw type - multi spindle automatic lathe- types. CO2

UNIT - III SHAPER, MILLING AND GEAR CUTTING MACHINES **9**

Shaper - Types of operations. Drilling ,reaming, boring, Tapping. Milling operations-types of milling cutter Gear Manufacturing - forming and generation principle - construction of gear milling ,hobbing and gear shaping processes -finishing of gears. CO3

UNIT - IV ABRASIVE PROCESS AND BROACHING **9**

Abrasive processes: grinding wheel - specifications and selection, types of grinding process - cylindrical grinding, surface grinding, centreless grinding and internal grinding - Typical applications - concepts of surface integrity, broaching machines: broach construction - push, pull, surface and continuous broaching machines. CO4

UNIT - V CNC MACHINING **9**

Numerical Control (NC) machine tools - CNC types, constructional details, special features, machining centre, part programming fundamentals CNC - manual part programming - micromachining - wafer machining. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the mechanism of material removal processes, cutting fluids, cutting tool materials, Machinability.

CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.

CO3 Describe the constructional and operational features of shaper, milling, drilling, Gear forming and generating process.

CO4 Explain the types of grinding, broaching and other super finishing processes.

CO5 Summarize NC, CNC machine tools and write a part program.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol. II., Media Promoters, 2014.
2. Rao. P.N “Manufacturing Technology - Metal Cutting and Machine Tools", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE BOOKS:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White “Machine Tool Practices”, Prentice Hall of India, 1998
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Roy. A. Lindberg, “Process and Materials of Manufacture,” Fourth Edition, PHI/Pearson Education 2006.

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML, MECHATRONICS- Semester III , ECE, MECHANICAL, Semester IV	3	1	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT - I LINEAR DATA STRUCTURES – LIST **9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation - singly linked lists- circularly linked lists- doubly-linked lists – applications of lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal). **CO1**

UNIT – II LINEAR DATA STRUCTURES – STACKS, QUEUES **9**

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues. **CO2**

UNIT - III NON-LINEAR DATA STRUCTURES – TREES **9**

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap. **CO3**

UNIT - IV NON-LINEAR DATA STRUCTURES – GRAPHS **9**

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph. **CO4**

UNIT – V SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. ReemaThareja, Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

CE1409 STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

STRENGTH OF MATERIALS LABORATORY

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    i. Unhardened specimen
    ii. Quenched Specimen and
    iii. Quenched and tempered specimen.
11. Microscopic Examination of
    i. Hardened samples and
    ii. Hardened and tempered samples.

FLUID MECHANICS AND MACHINES LABORATORY

1. Determination of the coefficient of discharge of a given orifice meter.
2. Determination of the coefficient of discharge of a given venturi meter.
3. Calculation of the rate of flow using rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of submergible pump.
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of gear pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel turbine.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.
11. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL PERIODS: 60

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1 Perform tension, torsion, hardness, compression, and deformation test on solid materials.
CO2 Use the measurement equipments for flow measurement.
CO3 Perform test on different fluid machineries.
CO4 To study the properties of mild steel specimen in hardened condition.
CO5 Ability to study the micro structural behaviour different of ferrous and nonferrous material.

ME1407 INTERNAL COMBUSTION ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study valve timing diagram for a 4 stroke diesel engine and port timing diagram for a 2 stroke petrol engine
- To study performance and heat balance test on of IC Engines
- To study the characteristics of fuels/lubricates used in IC Engines

LIST OF EXPERIMENTS

1. Valve timing diagram for a 4 stroke diesel engine.
2. Port timing diagram for a 2 stroke petrol engine
3. Actual p-V diagrams of IC engines.
4. Performance test on 4 - stroke petrol engine.
5. Performance test on 4 - stroke diesel engine.
6. Heat balance test on 4 - stroke diesel engine.
7. Morse test on multi-cylinder petrol engine.
8. Retardation test on a diesel engine.
9. Determination of flash point and fire point of various fuels / lubricants.
10. Determination viscosity of various fuels / lubricants

TOTAL PERIODS: 60

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1 Draw valve timing of a 4-stroke engine and port timing diagram of a 2-stroke engine.
CO2 Conduct experiments on an engine to establish performance characteristics.
CO3 Conduct experiments on an engine to draw heat balance sheet.
CO4 Conduct Morse test and retardation test in internal combustion engines.
CO5 Study the fuel and lubricant characteristics.

ME1408 MACHINE TOOLS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry.

LIST OF EXPERIMENTS

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical gear cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine

6. Square head shaping
7. Plain surface grinding
8. Cylindrical grinding
9. Centreless grinding
10. Tool angle grinding with tool and cutter grinder
11. Measurement of cutting forces in milling / turning Process
12. CNC part programming

TOTAL PERIODS: 60

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Use different milling machine tools.
CO2	Use different machine tools to manufacture gears.
CO3	Use different machine tools for finishing operations
CO4	Manufacture tools using cutter grinder
CO5	Develop CNC part programming

ME1501	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES
- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

UNIT - I INTRODUCTION **9**

Product cycle - Design process- sequential and concurrent engineering - Computer aided design - CAD system architecture- Computer graphics - coordinate systems - 2D and 3D transformations- homogeneous coordinates - Line drawing – Clipping - viewing transformation - Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM -CAD/CAM concepts - Types of production - Manufacturing models and Metrics - Mathematical models of Production Performance CO1

UNIT - II GEOMETRIC MODELING **9**

Representation of curves - Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modeling - surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep **CO2**

UNIT - III CAD STANDARDS **9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards. CO3

UNIT - IV FUNDAMENTAL OF CNC AND PART PROGRAMING **9**

Introduction to NC systems and CNC - Machine axis and Coordinate system - CNC machine tools- Principle of operation CNC - Construction features including structure - Drives and CNC controllers - 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes - Cutting Cycles, Loops, Sub program and Macros - Introduction of CAM package. CO4

UNIT - V	**CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)**	**9**
Group Technology (GT), Part Families - Parts Classification and coding - Simple Problems in Opitz Part Coding system - Production flow Analysis - Cellular Manufacturing - Composite part concept - Types of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning and Control - Quantitative analysis in FMS.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.
CO2	Explain the fundamentals of parametric curves, surfaces and Solids.
CO3	Summarize the different types of Standard systems used in CAD.
CO4	Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines.
CO5	Summarize the different types of techniques used in Cellular Manufacturing and FMS.

TEXT BOOKS:

1. Radhakrishnan P, SubramanyanS.and Raju V., “CAD/CAM/CIM”, New Age International (P) Ltd, New Delhi,2015.
2. Ibrahim Zeid, Sivasubramanian R., “CAD/CAM: Theory and Practice”McGraw Hill Education; 2nd edition, 2009.
3. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
4. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007.

REFERENCE BOOKS:

1. R.S. Prasad “Computer Aided Design”, Satya Prakashan, Tech India Publications, New Delhi, 2021.
2. Subash L. Gadhave, Kashinath H. Munde, “Computer Aided Manufacturing”, Technical publications, 2021.
3. Bi, Zhuming, Wang, Xiaoqin “Computer Aided Design and Manufacturing” First Edition, Wiley - ASME Press Series; John Wiley & Sons, 2020.
4. Ken Evans “Programming of CNC Machines”, Fourth Edition, Industrial Press Inc., 2016.
5. Foley, Wan Dam, Feiner and Hughes - "Computer Graphics Principles & Practice" Pearson Education, 2009.
6. Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing Management “ Fifth Edition, Pearson Education, 2008.

		L	T	P	C
ME1502	**DESIGN OF MACHINE ELEMENTS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

- To familiarize the various steps involved in the design process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

(Use of P S G Design Data Book is permitted)

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS **15**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances - Direct, Bending and torsional stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - curved beams - crane hook and 'C' frame- Factor of safety - theories of failure - Design based on strength and stiffness - stress concentration - Design for variable loading. CO1

UNIT - II SHAFTS AND COUPLINGS **9**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys, keyways and splines - Couplings- Rigid and flexible couplings. CO2

UNIT - III TEMPORARY AND PERMANENT JOINTS **12**

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints - Welded joints, riveted joints for structures - theory of bonded joints. CO3

UNIT - IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS **15**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods , Crank shafts and Piston CO4

UNIT - V BEARINGS **9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfield Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand and analyze stresses and strains in machine elements.

CO2 Analyze and design the components for power transmission.

CO3 Analyze the various stresses developed in temporary and permanent joints.

CO4 Design the energy storing elements, like springs & flywheel and engine components.

CO5 Design and implement the various types of standard bearings.

TEXT BOOKS:

1. Bhandari .V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, Latest Edition.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", Latest Edition, Tata McGraw-Hill.

REFERENCE BOOKS:

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo. (Schaum's Outline), 2010.
2. Ansel Ugural, "Mechanical Design Co, -An Integral Approach", 1st Edition, Tata McGraw-Hill Book, 2003.
3. P.C. Gope, "Machine Design - Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011
5. Sundararajamoorthy T. V, Shanmugam.N, "Machine Design", Anuradha Publications, Chennai, 2015.
6. R.S.Khurmi and Guptha, " Machine Design", Latest Edition

ME1503	METROLOGY AND MEASUREMENTS (Lab Integrated)	L T P C
		3 0 2 4

OBJECTIVES

- To provide knowledge on various metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To familiar with different metrological equipment's and use of this in industry for quality inspection.

UNIT - I BASICS OF METROLOGY 9

Introduction to Metrology - Need - Elements - Work piece, Instruments - Persons - Environment - their effect on Precision and Accuracy - Errors - Errors in Measurements - Types - Control - Types of standards. CO1

UNIT – II LINEAR AND ANGULAR MEASUREMENTS 9

Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design - terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring instruments - Types - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator - Applications. CO2

UNIT – III ADVANCES IN METROLOGY 9

Basic concept of lasers Advantages of lasers - laser Interferometers - types - DC and AC Lasers interferometer - Applications - Straightness - Alignment. Basic concept of CMM - Types of CMM- Constructional features - Probes - Accessories - Software - Applications - Basic concepts of Machine Vision System - Element - Applications. CO3

UNIT – IV FORM MEASUREMENT 9

Principles and Methods of straightness - Flatness measurement - Thread measurement, gear measurement, surface finish measurement, Roundness measurement - Applications. CO4

UNIT – V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 9

Force, torque, power, speed - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer, Non Contact Temperature Measurement - Reliability and Calibration - Readability and Reliability. CO5

PRACTICAL COURSE 15

1. Calibration and use of measuring instruments - Vernier caliper, micrometer, Vernier height gauge - using gauge blocks
2. Calibration and use of measuring instruments - bore gauge, telescopic gauge
3. Measurement of linear dimensions using comparators
4. Measurement of angles using bevel protractor and sine bar
5. Measurement of screw thread parameters -Two wire method '(floating carriage micrometer)
6. Measurement of gear parameters - disc micrometers, gear tooth vernier caliper
7. Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
8. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
9. Non-contact (optical) measurement using Toolmaker's microscope, Profile projector and Video measurement system.
10. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
11. Machine tool metrology - Level tests using precision level; Testing of straightness of a machine tool guide way using autocollimator, spindle tests.
12. Measurement of displacement, force, torque and temperature

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Describe the concepts of measurements to apply in various metrological instruments

CO2 Outline the principles of linear and angular measurement tools used for industrial Applications

CO3 Explain the procedure for conducting computer aided inspection

CO4 Demonstrate the techniques of form measurement used for industrial components

CO5 Discuss various measuring techniques of mechanical properties in industrial applications

TEXT BOOKS:

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.

REFERENCE BOOKS:

1. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education , 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th Edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra, Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

ME1504	DYNAMICS OF MACHINERY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism
- To understand the effect of Dynamics of undesirable vibrations

  To understand the principles in mechanisms used for speed control and stability control

UNIT I FORCE ANALYSIS

Dynamic force analysis - Inertia force and Inertia torque- D Alembert's principle -Dynamic Analysis in reciprocating engines - Gas forces - Inertia effect of connecting rod- Bearing loads - Crank shaft torque - Turning moment diagrams -Fly Wheels - Flywheels of punching presses- Dynamics of Cam- follower mechanism CO1

UNIT - II

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder engine - Balancing of Multi-cylinder inline, V-engines - Partial balancing in engines - Balancing of linkages - Balancing machines-Field balancing of discs and rotors CO2

UNIT - III FREE VIBRATION

Basic features of vibratory systems - Degrees of freedom - single degree of freedom - Free vibration- Equations of motion - Natural frequency - Types of Damping - Damped vibration- Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems **CO3**

UNIT - IV FORCED VIBRATION

Response of one degree freedom systems to periodic forcing - Harmonic disturbances - Disturbance caused by unbalance - Support motion -transmissibility - Vibration isolation vibration measurement CO4

UNIT - V MECHANISM FOR CONTROL

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling force curves. Gyroscopes -Gyroscopic forces and torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Calculate static and dynamic forces of mechanisms

CO2 Calculate the balancing masses and their locations of reciprocating and rotating masses

CO3 Compute the frequency of free vibration

CO4 Compute the frequency of forced vibration and damping coefficient

CO5 Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes

TEXT BOOKS:

1. F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2011
2. Rattan, S.S, “Theory of Machines”, 4 Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014

REFERENCE BOOKS:

1. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006
3. Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005
4. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002

ME1506	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems

UNIT I DRAWING STANDARDS FITS AND TOLERANCES 9

Code of practice for Engineering Drawing, BIS specifications - Welding symbols, riveted joints, keys, fasteners - Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits - Tolerancing of individual dimensions - Specification of Fits - Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning and tolerancing CO1

UNIT - II INTRODUCTION TO 2D DRAFTING 9

Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailed Drawing-Bearings - Bush bearing, Plummer block, Valves - Safety and non-return valves CO2

UNIT - III 3D GEOMETRIC MODELING AND ASSEMBLY 27

Sketcher - Datum planes - Protrusion - Holes - Part modeling - Extrusion - Revolve - Sweep - Loft - Blend - Fillet - Pattern - Chamfer - Round - Mirror - Section - Assembly OF Couplings - Flange, Universal, Oldham's, Muff, Gear couplings- Joints - Knuckle, Gib& cotter, strap, sleeve & cotter joints -Engine parts - Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch- Miscellaneous machine components - Screw jack, machine vice, tail stock, chuck, vane and gear pump CO3 CO4 CO5

Note:

25% of assembly drawings must be done manually and the remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the engineering drawing standards and tolerances
CO2	Develop skills to generate 2D sketching of mechanical elements
CO3	Develop skills to generate 3D modeling of mechanical elements
CO4	Develop skills to make functional assemblies and generate 2D drafting
CO5	Apply design and assembly evaluation techniques using commercial software

TEXT BOOKS:

1. Gopalakrishnan K.R, Machine Drawing", 23nd Edition, Subhas Stores Book Corner, Bangalore, Karnataka, India

REFERENCE BOOKS:

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 50th Edition, Charotar Publishers, 2016.
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2007
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", 10th Edition, published by Tata Mcgraw Hill,2017.

S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 20082

ME1507 KINEMATICS AND DYNAMICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To supplement the principles learnt in kinematics and dynamics of machinery
- To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. Study of gear parameters.
2. Experimental study of velocity ratios of simple, compound, epicyclic and differential gear trains.
3. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker, oscillating cylinder mechanisms.
4. Kinematics of single and double universal joints.
5. Determination of mass moment of inertia of Fly wheel and Axle system.
6. Determination of mass moment of inertia of axisymmetric bodies using Turn Table apparatus. Determination of mass moment of inertia using bifilar suspension and compound pendulum.
7. Motorized gyroscope - Study of gyroscopic effect and couple.

8. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
9. Cams - Cam profile drawing, Motion curves and study of jump phenomenon
10. Single degree of freedom Spring Mass System - Determination of natural Frequency and verification of Laws of springs – Damping coefficient
11. determination. b) Multi degree freedom suspension system - Determination of influence coefficient.
12. Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and Damped Natural frequencies.
13. Vibration Absorber - Tuned vibration absorber.
14. Vibration of Equivalent Spring mass system - undamped and damped vibration.
15. Whirling of shafts - Determination of critical speeds of shafts with concentrated loads.
16. Balancing of rotating masses.
17. Balancing of reciprocating masses.
18. Transverse vibration of Free-Free beam - with and without concentrated masses.
19. Forced Vibration of Cantilever beam - Mode shapes and natural frequencies.
20. Determination of transmissibility ratio using vibrating table.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Demonstrate the principles of kinematics of machinery.

CO2 Demonstrate the principles of dynamics of machinery.

CO3 Use the measuring devices for dynamic testing

CO4 Study the parameters of kinematics of machinery.

CO5 Study the parameters of dynamics of machinery.

ME1601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To gain knowledge on the principles and procedure for the design of mechanical power Transmission components.
- To understand the standard procedure available for design of transmission of mechanical elements
- To learn to use standard data and catalogues

(Use of P S G Design Data Book permitted)

UNIT - I DESIGN OF FLEXIBLE ELEMENTS 12

Design of Flat belts and pulleys - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets CO1

UNIT - II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials - Design of straight tooth spur & helical gears based on strength and wear considerations - Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears. CO2

UNIT - III BEVEL, WORM AND CROSS HELICAL GEARS 12

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears. CO3

UNIT - IV GEAR BOXES **12**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. - Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications. CO4

UNIT - V CAMS, CLUTCHES AND BRAKES **12**

Cam Design: Types - pressure angle and under cutting base circle determination - forces and surface stresses. Design of plate clutches - axial clutches -cone clutches - internal expanding rim clutches - Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoe brake. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Design flexible drive elements like belt, chain and rope drives.

CO2 Design parallel axis helical gears like spur gears.

CO3 Design bevel, worm and cross helical gears.

CO4 Design multi speed gear box for mechanical applications.

CO5 Design cam, clutches and brakes for automotive and mechanical applications.

TEXT BOOKS:

1. Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008

REFERENCE BOOKS:

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements", 8th Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005.
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

ME1602	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of mathematical modeling of engineering problems.
- To appreciate the use of FEM to a range of engineering problems

UNIT - I INTRODUCTION **9**

Historical Background - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems - Weighted Residual Methods - Variational Formulation of Boundary Value Problems - Ritz Technique - Basic concepts of the Finite Element Method. CO1

UNIT - II ONE-DIMENSIONAL PROBLEMS **9**

One Dimensional Second Order Equations - Discretization - Element types - Linear and Higher order Elements - Derivation of Shape functions and Stiffness matrices and force vectors - Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation - Transverse deflections and Natural frequencies of beams. CO2

UNIT - III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS **9**

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation - Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non circular shafts - Quadrilateral elements - Higher Order Elements. CO3

UNIT - IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS **9**

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects - Stress calculations - Plate and shell elements. CO4

UNIT - V ISOPARAMETRIC FORMULATION **9**

Natural co-ordinate systems - Isoparametric elements - Shape functions for iso parametric elements - One and two dimensions - Serendipity elements - Numerical integration and application to plane stress problems - Matrix solution techniques - Solutions Techniques to Dynamic problems - Introduction to Analysis Software. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basic concepts of finite element method.
CO2	Apply the finite element method for one dimensional problems
CO3	Understand the finite element method for two dimensional scalar variable problems
CO4	Understand the finite element method for two dimensional vector variable problems
CO5	Gain the knowledge on isoparametric formulation, numerical integration and dynamic Problems.

TEXT BOOKS:

1. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCE BOOKS:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

ME1603	HEAT AND MASS TRANSFER	L	T	P	C
		3	1	0	4

OBJECTIVES

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer. (Use of Standard HMT data book permitted)

UNIT - I CONDUCTION **12**

General differential equation of heat conduction - Cartesian and polar Coordinates - One dimensional steady state heat conduction - plane and composite systems - Conduction with internal heat generation - Extended surfaces - Unsteady heat conduction - Lumped analysis - Semi infinite and infinite solids - Use of Heisler's charts. CO1

UNIT - II CONVECTION **12**

Free and forced convection - Hydrodynamic and thermal boundary layer. Free and forced convection during external flow over plates and cylinders and internal flow through tubes. CO2

UNIT - III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS **12**

Nusselt's theory of condensation - Regimes of pool boiling and flow boiling. Correlations in boiling and condensation. Heat exchanger types - Overall heat transfer coefficient - Fouling factors - Analysis - LMTD method - NTU method CO3

UNIT - IV RADIATION **12**

Black body radiation - Grey body radiation - Shape factor - Electrical analogy - Radiation shields. Radiation through gases. CO4

UNIT - V MASS TRANSFER **12**

Basic concepts - Diffusion mass transfer - Fick's law of diffusion - Steady state molecular diffusion - Convective mass transfer - Momentum, heat and mass transfer analogy - Convective mass transfer correlations. CO5

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems

CO2 Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems

CO3 Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems

CO4 Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems

CO5 Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

TEXT BOOKS:

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2010
2. Yunus A. Cengel, "Heat Transfer - A Practical Approach", Tata McGraw Hill, 5th Edition 2015

REFERENCE BOOKS:
1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2010.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2011
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 2010.

ME1607	CAD/CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES
- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC machine tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC vertical machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

LIST OF EXPERIMENTS

1. 3D GEOMETRIC MODELLING **30**

1. Introduction of 3D Modelling Software

Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange coupling
3. Plummer block
4. Screw jack
5. Lathe tailstock
6. Universal joint
7. Machine vice
8. Stuffing box
9. Crosshead
10. Safety valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

* Students may also be trained in manual drawing of some of the above components

2. Manual Part Programming. **20**

(i) Part Programming - CNC Machining Centre
  (a) Linear Cutting.
  (b) Circular cutting.
  (c) Cutter Radius Compensation.
  (d) Canned Cycle Operations.

(ii) Part Programming - CNC Turning Centre
  (a) Straight, Taper and Radius Turning.
  (b) Thread Cutting.
  (c) Rough and Finish Turning Cycle. d) Drilling and Tapping Cycle.

3. Computer Aided Part Programming **10**

e) CL Data and Post process generation using CAM packages.
f) Application of CAPP in Machining and Turning Centre

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop 2D Part Models using Modeling Software.

CO2 Develop 3D Part Models using Modeling Software.

CO3 Assemble 3D Models using Modeling Software.

CO4 Understand the CNC Control in Modern Manufacturing System.

CO5 Prepare CNC Part Programming and Perform Manufacturing.

ME1608 HEAT TRANSFER AND REFRIGERATION AND AIR-CONDITIONING LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To study the heat transfer phenomena, predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

HEAT TRANSFER LAB :

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
3. Determination of heat transfer coefficient under forced convection from a tube.
4. Determination of thermal conductivity of composite wall.
5. Heat transfer from pin-fin apparatus (natural & forced convection modes)
6. Determination of Stefan - Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of parallel / counter flow heat exchanger.

REFRIGERATION AND AIR CONDITIONING LAB :

1. Determination of COP of a refrigeration system
2. Experiments on psychrometric processes
3. Performance test on a reciprocating air compressor
4. Performance test in a HC refrigeration System
5. Performance test in a fluidized bed cooling tower

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Determine the thermal conductivity, heat transfer coefficient, Stefan Boltzmann constant and emissivity of a grey surface

CO2 Determine the effectiveness of a heat exchanger

CO3 Determine the COP of an AC and refrigeration system

CO4 Conduct experiments on an air compressor and study the performance characteristics.

CO5 Conduct experiments on cooling tower and study the performance characteristics.

ME1609 DESIGN AND FABRICATION PROJECT

L	T	P	C
0	0	4	2

OBJECTIVES

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate a sound technical knowledge of their selected project topic.
CO2	Undertake problem identification, formulation and solution.
CO3	Design engineering solutions to complex problems utilising a systems approach and conduct a engineering project.
CO4	Communicate with engineers and the community at large in written an oral forms.
CO5	Demonstrate the knowledge, skills and attitudes of a professional engineer.

ME1701 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT – I INTRODUCTION TO PROCESS PLANNING 9

Introduction - Methods of process planning - Drawing interpretation - Material evaluation - steps in process selection - Production equipment and tooling selection CO1

UNIT - II PROCESS PLANNING ACTIVITIES 9

Process parameters - Calculation for various production processes - Selection of jigs and fixtures selection of quality assurance methods - Set of documents for process planning - Economics of process planning - Case studies. CO2

UNIT - III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation - methods of costing - elements of cost estimation - Types of estimates - Estimating procedure - Estimation of labour cost, material cost - allocation of overhead charges - CNC machine hour rate calculation - Calculation of depreciation cost. CO3

UNIT - IV PRODUCTION COST ESTIMATION 9

Estimation of different types of jobs - Estimation of forging shop, Estimation of welding shop, Estimation of foundry shop CO4

UNIT - V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Select the process, equipment and tools for various industrial products.
CO2 Prepare process planning activity charts.
CO3 Explain the concept of cost estimation.
CO4 Compute the job order cost for different types of shop floor.
CO5 Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter Scalon, "Process planning, Design/Manufacture Interface", Elsevier science technology Books, Dec 2002.
2. Sinha B.P, "Mechanical Estimating and Costing", Tata-McGraw Hill publishing co, 1995.
3. M. Adithan,"Process Planning and the cost Estimation:, New Age International Publishers, 2007.

REFERENCE BOOKS:

1. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 2nd Edition, PHI, 2002.
2. Ostwalal P.F.and Munez J.,"Manufacturing Processes and Systems",9th Edition, JohnWiley, 1998.
3. Russell R.S and Tailor B.W, "Operations Management", 4th Edition, PHI, 2003
4. Mikell P. Groover, "Automation, Production, Systems and Computer Integrated Manufacturing", Pearson Education 2001
5. K.C. Jain & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers 1990.
6. R.Kesavan, C.Elanchezian, B.VijayRamanth, "Process Planning and Cost Estimation", New Age International Ltd , 2009.

ME1702	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge about the elements and techniques involved in mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT - I INTRODUCTION	**9**	
Introduction to mechatronics - Systems - Concepts of mechatronics approach - Need for mechatronics - Emerging areas of mechatronics - Classification of mechatronics. Sensors and Transducers: Static and dynamic characteristics of sensor, Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors.		CO1
UNIT - II MICROPROCESSOR AND MICROCONTROLLER	**9**	
Introduction - Architecture of 8085 - Pin Configuration - Addressing Modes -Instruction set, Timing diagram of 8085 - Concepts of 8051 microcontroller - Block diagram.		CO2
UNIT - III PROGRAMMABLE PERIPHERAL INTERFACE	**9**	
Introduction - Architecture of 8255, Keyboard interfacing, LED display - interfacing, ADC and DAC interface, Temperature control - Stepper motor control - Traffic control interface.		CO3
UNIT - IV PROGRAMMABLE LOGIC CONTROLLER	**9**	
Introduction - Basic structure - Input and output processing - Programming - Mnemonics - Timers, counters and internal relays - Data handling - Selection of PLC.		CO4
UNIT - V ACTUATORS AND MECHATRONIC SYSTEM DESIGN	**9**	
Types of stepper and servo motors - Construction - Working principle - Advantages and disadvantages. Design process - stages of design process - Traditional and mechatronics design concepts - Case studies of mechatronics systems - Pick and place Robot - Engine Management system - Automatic car park barrier.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the interdisciplinary applications of electronics, electrical, mechanical and computer systems for the control of mechanical, electronic systems and sensor technology.

CO2 Discuss the architecture of microprocessor and microcontroller, pin diagram, addressing modes of microprocessor and microcontroller.

CO3 Discuss programmable peripheral interface, Architecture of 8255 PPI, and various device interfacing.

CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of mechatronics engineering.

CO5 Discuss various actuators and mechatronics systems using the knowledge and skills acquired through the course and also from the given case studies.

TEXT BOOKS:

1. W.Bolton, “Mechatronics”, 4th Edition,Prentice Hall, 2013.
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 6th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. David G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2018.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013.
3. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
4. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
5. A. NagoorKani “Microprocessors and Microcontrollers”. McGraw Hill Education,2nd Edition,2017.

ME 1703	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an overview of Power Plants using conventional and renewable sources of energy
- To create awareness about the economic and environmental issues of power plants

UNIT - I COAL BASED THERMAL POWER PLANTS **9**

Rankine cycle - Improvisations, Layout of modern coal power plant, Super critical boilers, FBC boilers, Turbines, Condensers, Steam & heat rate, Subsystems of thermal power plants, Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems. CO1

UNIT - II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS **9**

Otto, diesel, dual & brayton cycle - Analysis & optimisation. Components of diesel and gas turbine power plants. Combined cycle power plants. Integrated gasifier based combined cycle systems. CO2

UNIT - III NUCLEAR POWER PLANTS **9**

Basics of nuclear engineering, Layout and subsystems of nuclear power plants, Working of nuclear reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium - Uranium reactor (CANDU), breeder, gas cooled and liquid metal cooled reactors. safety measures for nuclear power plants. CO3

UNIT - IV POWER FROM RENEWABLE ENERGY **9**

Hydro electric power plants - Classification, typical layout and associated components including turbines. principle, construction and working of wind, tidal, solar photo voltaic (spv), solar thermal, geo thermal, biogas and fuel cell power systems. CO4

UNIT - V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **9**

Power tariff types, load distribution parameters, load curve, comparison of site selection criteria, relative merits & demerits, capital & operating cost of different power plants. Pollution control technologies including waste disposal options for coal and nuclear power plants. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the layout, construction and working of the components inside a thermal power plant.

CO2 Know about the layout, construction and working of the components inside a diesel, gas and combined cycle power plants

CO3 Understand the layout, construction and working of the components inside nuclear power plants.

CO4 Know about the layout, construction and working of the components inside Renewable energy power plants.

CO5 Gain knowledge about the applications of power plants while extending their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

TEXT BOOKS:

1. Arora S.C and Domkundwar S, "A Course in Power Plant Engineering", 6th Edition Dhanpat Rai, 2011
2. Nag P.K ,"Power Plant Engineering". 5th edition Tata McGraw- Hill ,2021

REFERENCE BOOKS:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw - Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw - Hill, 1998.
4. Dr.P.C.Sharma, Power Plant Engineering," S. K. Kataria & Sons, 2013
5. R.K Rajput, " Power Plant Engineering ", Scitech Publications, 2006
6. G.R.Nagpal , "Power Plant Engineering", Khanna Publishers, 1998
7. G.D.Rai, "Introduction to Power Plant technology" Khanna Publishers, 1995

ME1707 SIMULATION AND ANALYSIS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools

LIST OF EXPERIMENTS

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-functions of one variable and two variables
2. Use of MAT lab to solve simple problems in vibration
3. Mechanism simulation using multi body dynamic software

B. ANALYSIS

1. Force and stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi - symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get familiar with 1D, 2D Finite Elements(FE), modelling of structural elements with loading and boundary conditions
CO2	Understand the behaviour of structural engineering problems by 1D and 2D Finite Elements
CO3	Understand the thermal behaviour of engineering problems by using 1D and 2D Finite Elements
CO4	Understand the vibration and dynamic behaviour of 1D and 2D engineering problems
CO5	Learn and solve core mechanical engineering problems using MATLAB computational package

ME1708	MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 - Addition - Subtraction - Multiplication - Division - Sorting - Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using software.
8. Study of PLC and its applications.
9. Study of image processing techniques.

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the functioning of mechatronics system with various pneumaticsystems.
CO2	Demonstrate the functioning of mechatronics system with various hydraulicsystems.
CO3	Demonstrate the functioning of mechatronics systems with various Electrical and Electro-pneumatic systems.
CO4	Demonstrate the functioning of control systems with the help of PLC and microcontrollers.
CO5	Demonstrate the functioning of control systems with the help of microprocessors.

MG1801 INDUSTRIAL ECONOMICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT - I INTRODUCTION TO ECONOMICS		**9**
Introduction to economics- Flow in an economy, Law of supply and demand, Concept of engineering economics - Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal revenue, Sunk cost, Opportunity cost, Break-even analysis - P-V ratio, Elementary economic Analysis - Material selection for product - Design selection for a product, Process planning.	CO1	
UNIT - II VALUE ENGINEERING		**9**
Make or buy decision, Value engineering - Function, aims, Value engineering procedure. Interest formulae and their applications - Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series Present worth factor - Equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate	CO2	
UNIT - III CASH FLOW		**9**
Capital budgeting - Balance Sheet - Methods of comparison of alternatives - Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Rate of return method - Risk and decision Making - Technological change in global economy - Locating the firm in a global economy - Taxes and decision making.	CO3	
UNIT - IV REPLACEMENT AND MAINTENANCE ANALYSIS		**9**
Replacement and maintenance analysis - Types of maintenance, Types of replacement problem, Determination of economic life of an asset, Replacement of an asset with a new asset - Capital recovery with return and concept of challenger and defender - Exchange rate determination - Marketing - Product life cycle - Marketing research - Branding	CO4	
UNIT - V DEPRECIATION		**9**
Depreciation- Introduction, Straight line method of depreciation, Declining balance method of depreciation - Sum of the years digits method of depreciation, Sinking fund method of depreciation/Annuity method of depreciation, Service output method of depreciation - Evaluation of public alternatives - Introduction, Examples, Inflation adjusted decisions - Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply basic economic concepts in economic analysis

CO2 Learn time value of money and interest rates

CO3 Learn revenue based and cost based cash flow analysis

CO4 Learn replacement and maintenance based on economic life

CO5 Learn depreciation and inflation based on economic life

TEXT BOOKS:
1. Panneerselvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2001.
2. Suma Damodaran, “Managerial economics”, Oxford University press 2006.

REFERENCE BOOKS:
1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, “Principles of Engineering Economy”, Ronald Press, New York,1976.
5. Smith, G.W., “Engineering Economy”, Lowa State Press, Iowa, 1973.
6. Truett&Truett, “ Managerial economics - Analysis, problems & cases “ Wiley India 8th edition 2004.
7. Luke M Froeb / Brian T Mccann, “Managerail Economics - A Problem Solving Approach” Thomson learning 2007.E

ME1807	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS: 300

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1 Demonstrate a sound technical knowledge of their selected project topic.

CO2 Undertake problem identification, formulation and solution.

CO3 Design engineering solutions to complex problems utilising a systems approach and conduct an engineering project.

CO4 Communicate with engineers and the community at large in written and oral forms.

CO5 Demonstrate the knowledge, skills and attitudes of a professional engineer.

ME1511 DESIGN OF HEAT EXCHANGERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT - I INTRODUCTION 9

Types of heat exchangers, shell and tube heat exchangers - regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA).

UNIT - II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers - LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT - III STRESS ANALYSIS 9

Stress in tubes - header sheets and pressure vessels - thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT - IV COMPACT AND PLATE HEAT EXCHANGER 9

Types - Merits and Demerits - Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT - V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers - Cooling tower - Performance characteristics.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the classification of heat exchanger as per TEMA
CO2 Understand the design process of heat exchangers
CO3 Analyse the stress failures in the heat exchanger components
CO4 Study the performance of compact and plate heat exchanger
CO5 Study the performance of condensers and cooling tower

TEXT BOOKS:

1. Sadik Kakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.

REFERENCE BOOKS:

1. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2007
2. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
3. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001
4. Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000
5. Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients", John Wiley & Sons, 1999

ME1512 ENERGY CONSERVATION AND AUDITING

L	T	P	C
3	0	0	3

OBJECTIVES

- To conduct energy audit and suggest methodologies for energy savings
- To understand and analyse the energy data of industries
- To carryout energy accounting and balancing
- To conduct the available resources in optimal ways

UNIT - I INTRODUCTION OF ENERGY CONSERVATION 9

Energy - Power - Past & Present scenario of world; National energy consumption Data - Environmental aspects associated with energy utilization - Energy auditing: Need, Types, Methodology and Barriers. Role of energy managers. Instruments for energy auditing.

UNIT - II THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters - Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT - III ELECTRICAL SYSTEMS 9

Components of EB billing - HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination - Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT - IV ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems - Cooling Towers - D.G. sets.

UNIT - V ECONOMICS 9

Energy Economics - Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing - ESCO concept.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Learn the concept of energy scenario, energy consumption and instruments for energy auditing

CO2 Carry out energy accounting and balancing in electrical system

CO3 Carry out energy accounting and balancing in thermal system system

CO4 Suggest methodologies for energy savings in major utilities

CO5 Understand the economics in energy saving

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanagertraining.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCE BOOKS:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford,1981
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987

ME1513 EXPERIMENTAL DESIGN AND ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE)
- To demonstrate knowledge and understanding of Taguchi's approach
- To develop skills to design and conduct experiments using DOE and Taguchi's approach
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process

UNIT - I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9

Basic Principles - Guidelines for Designing Experiments- Hypothesis testing - single mean, two means, dependent/ correlated samples - confidence intervals, Experimentation - need, Simple Comparative Experiments - Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation - choice of sample size - Normal and half-normal probability plot - simple linear and multiple linear regression, testing using Analysis of variance.

UNIT - II SINGLE-FACTOR EXPERIMENTS 9

Basic Definitions - Principles of Factorial Design - The Advantage of Factorial Design - Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design - Latin Square Design- Graeco Latin Square Design - Applications.

UNIT - III FACTORIAL DESIGNS 9

Main and Interaction effects - Two and three-factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT - IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and Confounding in 2K Designs- blocking in replicated design - 2K Factorial Design in two blocks - Complete and partial confounding- Confounding 2K Design in four blocks - Two level Fractional Factorial Designs - one-half fraction of 2K Design, design resolution, Construction of one - half fraction with highest design resolution, one-quarter fraction of 2K Design.

UNIT - V ANALYSIS OF SINGLE RESPONSE AND MULTI-RESPONSE TECHNIQUES 9

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA - attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design - case studies. Introduction to Response Surface Methodology - The method of steepest ascent - Analysis of a second-order Response Surface - Experimental designs for fitting response surfaces.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the Basic principle of DOEs and ANOVA
CO2 Understand the various single factor experiments
CO3 Learn full and fraction factorial experiment design
CO4 Understand the special experimental design
CO5 Understand the single and multi-response techniques

TEXT BOOKS:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons,10th Edition 2019.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2012.

REFERENCE BOOKS:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery",2nd Edition, Wiley, 2009.
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.Third Reprint 2008.

ME1514	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic difference between incompressible and compressible flow
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
  (Use of Standard Gas Tables permitted)

UNIT - I BASIC CONCEPTS AND ISENTROPIC FLOWS 6

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable ducts - Nozzle and Diffusers.

UNIT - II FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - variation of flow properties.

UNIT - III NORMAL AND OBLIQUE SHOCKS 10

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl - Meyer relations - Applications.

UNIT - IV JET PROPULSION 10

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT - V SPACE PROPULSION 10

Types of rocket engines - Propellants-feeding systems - Ignition and combustion - Theory of rocket propulsion - Performance study - Staging - Terminal and characteristic velocity - Applications - space flights.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of compressible fluid flow in variable area ducts that follows isentropic process

CO2 Study the effects of friction and heat transfer on compressible fluid flow in constant area ducts

CO3 Acquire the knowledge of normal shock and oblique shock waves and its effects on compressible fluid properties in constant area and variable area ducts

CO4 Understand working principle and cycle analysis of jet propulsion engines

CO5 Understand theory of rocket engines and study its performance

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", 4th Edition, McGraw Hill, 2020.
2. Yahya, S.M. "Fundamentals of Compressible Flow" 6th Edition, New Age International (P) Limited, New Delhi, 2018.

REFERENCE BOOKS:

1. Hill. P. and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison - Wesley Publishing company, 2009.
2. Zucrow. N.J., "Aircraft and Missile Propulsion", Vol.1 & II, John Wiley, 2013.
3. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 2013.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2016
5. Shapiro. A.H., " Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1984
6. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2011
7. Somasundaram. PR.S.L., "Gas Dynamics and Jet Propulsions", New Age International Publishers, 1996
8. Babu. V., "Fundamentals of Gas Dynamics", ANE Books India, 2020
9. Cohen. H., G.E.C. Rogers and Saravana mutto, "Gas Turbine Theory", Longman Group Ltd., 2017

ME1515 REFRIGERATION AND AIRCONDITIONING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components
- To provide knowledge on design aspects of Refrigeration & Air conditioning system

UNIT - I INTRODUCTION TO REFRIGERATION 6

Introduction to refrigeration - Unit of refrigeration and C.O.P.- Ideal cycles - Refrigerants Desirable properties - Classification - Nomenclature - ODP & GWP.

UNIT - II VAPOUR COMPRESSION REFRIGERATION SYSTEM 10

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle - subcooling and superheating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems - problems. Equipments: Type of compressors, condensers, expansion devices, evaporators.

UNIT - III OTHER REFRIGERATION SYSTEMS 9

Working principles of vapour absorption systems and adsorption cooling systems - Steam jet refrigeration - Ejector refrigeration systems - Thermoelectric refrigeration- Air refrigeration – Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT - IV PSYCHROMETRIC PROPERTIES AND PROCESSES 10

Properties of moist Air - Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT - V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 10

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the basic concepts of refrigeration
CO2	Explain the vapor compression refrigeration systems and to solve problems
CO3	Discuss the various types of refrigeration systems
CO4	Calculate the psychrometric properties and its use in psychrometric processes
CO5	Explain the concepts of air conditioning and to solve problems

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.
2. Khurmi, R.S., "Textbook of Refrigeration and Air Conditioning" 5th edition, S Chand and Company Ltd, 2020.

REFERENCE BOOKS:

1. ASHRAE Hand book, Fundamentals, 2017.
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2020.
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 2012

ME1516 TURBOMACHINES

L	T	P	C
3	0	0	3

OBJECTIVES

- Explaining the energy transfer in rotor and stator parts of the turbo machines
- Explaining the function of various elements of centrifugal fans and blowers
- Evaluating the working and performance of centrifugal compressor
- Analyzing flow behavior and flow losses in axial flow compressor
- Explaining the types and working of axial and radial flow turbines

UNIT - I WORKING PRINCIPLES 9

Classification of Turbomachines - Energy transfer between fluid and rotor - Euler equation and its interpretation. Velocity triangles - Efficiencies in Compressor and Turbine stages. Degree of reaction. Dimensionless parameters for Turbomachines.

UNIT - II CENTRIFUGAL FANS AND BLOWERS 9

Types - components - working. Flow analysis in impeller blades - volute and diffusers. Velocity triangles - h-s diagram. Stage parameters in fans and blowers. Performance characteristic curves - various losses. Fan - bearings, drives and noise.

UNIT - III CENTRIFUGAL COMPRESSOR **9**

Components - blade types. Velocity triangles - h-s diagram, stage work. Slip factor and Degree of Reaction. Performance characteristics and various losses. Geometry and performance calculation.

UNIT - IV AXIAL FLOW COMPRESSOR **9**

Construction details. Work done factor. Velocity triangles - h-s diagram, stage work. Work done factor. Performance characteristics, efficiency and stage losses - Stalling and Surging. Free and Forced vortex flow.

UNIT - V AXIAL AND RADIAL FLOW TURBINES **9**

Axial flow turbines - Types - Elements - Stage velocity diagrams - h-s diagram, stage work - impulse and reaction stages. Compounding of turbines. Performance coefficients and losses.
Radial flow turbines: Types - Elements - Stage velocity diagrams - h-s diagram, stage work Performance coefficients and losses.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the energy transfer in rotor and stator parts of the turbo machines
CO2	Explain the function of various elements of centrifugal fans and blowers
CO3	Evaluate the working and performance of centrifugal compressor
CO4	Analyze flow behavior and flow losses in axial flow compressor
CO5	Explain the types and working of axial and radial flow turbines

TEXT BOOKS:

1. Ganesan, V., “Gas Turbines”, 3rd Edition, Tata McGraw Hill, 2011.
2. Yahya, S.M., “Turbines, Compressor and Fans”, 4th Edition, Tata McGraw Hill, 2018.

REFERENCE BOOKS:

1. Dixon, S.L., “Fluid Mechanics and Thermodynamics of Turbomachinery”, 7th Edition, Butterworth-Heinemann, 2014.
2. Gopalakrishnan .G and Prithvi Raj .D,” A Treatise on Turbomachines”, Scitech Publications (India) Pvt. Ltd., 2nd Edition, 2008.
3. Lewis, R.I., “Turbomachinery Performance Analysis” 1st Edition, Arnold Publisher, 1996
4. Saravanamutto, Rogers, Cohen, Straznicky., “Gas Turbine Theory” 6th Edition, Pearson Education Ltd, 2009.
5. Venkanna, B.K., “Fundamentals of Turbomachinery”, PHI Learning Pvt. Ltd., 2009.

ME1517 BIOENERGY CONVERSION TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- To elucidate on biomass, types, availability, and characteristics
- To study the bio-methanation process
- To impart knowledge on combustion of biofuels
- To describe on the significance of equivalence ratio on thermochemical conversion of biomass
- To provide insight to the possibilities of producing liquid fuels from biomass

UNIT – I INTRODUCTION **9**

Biomass: types – advantages and drawbacks – typical characteristics – proximate & ultimate analysis – comparison with coal - Indian scenario - carbon neutrality – biomass assessment studies – typical conversion mechanisms - densification technologies CO1

UNIT – II	**BIOMETHANATION**		**9**
Biomethenation process – influencing parameters – typical feed stocks – Biogas plants: types and design, Biogas appliances – burner, luminaries and power generation systems – Industrial effluent based biogas plants.			CO2
UNIT – III	**BIOMASS COMBUSTION**		**9**
Perfect, complete and incomplete combustion – stoichiometric air requirement for biofuels - equivalence ratio – fixed Bed and fluid Bed combustion			CO3
UNIT – IV	**GASIFICATION, PYROLYSIS AND CARBONISATION**		**9**
Chemistry of gasification - types – comparison – typical application – performance evaluation – economics. Pyrolysis - Classification - process governing parameters – Typical yield rates. Carbonization – merits of carbonized fuels – techniques adopted for carbonisation			CO4
UNIT – V	**LIQUIFIED BIOFUELS**		**9**
Straight Vegetable Oil (SVO) as fuel - Biodiesel production from oil seeds, waste oils and algae - Process and chemistry - Biodiesel Vs. Diesel – comparison on emission and performance fronts. Production of alcoholic fuels (methanol and ethanol) from biomass – engine modifications			CO5
		TOTAL PERIODS:	**45**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Estimate the surplus biomass availability of any given area.

CO2 Design a biogas plant for a variety of biofuels.

CO3 Determine and compare the cost of steam generation from biofuels with that of coal and petroleum fuels.

CO4 Analyse the influence of process governing parameters in thermochemical conversion of biomass.

CO5 Synthesize liquid biofuels for power generation from biomass.

TEXT BOOKS:

1. Biomass for Bioenergy and Biomaterials, by Nidhi Adlakha, Rakesh Bhatnagar , Syed Shams Yazdani, CRC Press; 1st edition (22 October 2021), ISBN-10 : 0367745550
2. Bioenergy and Biochemical Processing Technologies, by Augustine O. Ayeni, Samuel EshorameSanni , Solomon U. Oranusi, Springer (30 June 2022).

REFERENCE BOOKS:

1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood Chichester,1984.
2. Iyer PVR et al, Thermochemical Characterization of Biomass, M N E S
3. Khandelwal KC, Mahdi SS, Biogas Technology – A Practical Handbook, Tata McGraw Hill, 1986
4. Mahaeswari, R.C. Bio Energy for Rural Energisation, Concepts Publication,1997
5. Tom B Reed, Biomass Gasification – Principles and Technology, Noyce Data Corporation, 1981

ME1518	**ENERGY EFFICIENT BUILDINGS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To learn the climate and buildings, building efficiency rating and standards
- Developing energy efficiency in building envelopes through alternate methods
- To study the thermal comfort, passive heating and cooling techniques
- To apply various energy saving concepts in buildings.
- To incorporate Renewable energy systems in buildings

UNIT – I	**INTRODUCTION**	**9**
Climate and Building, Historical perspective, Aspects of Net Zero building design – Sustainable Site, Water, Energy, Materials and IGBC, LEED, GRIHA, IEQ, NBC and ECBC Standards		CO1
UNIT – II	**LANDSCAPE AND BUILDING ENVELOPES**	**9**
Energy efficient landscape design – Micro climates – various methods – Shading, water bodies – Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, paints, insulation, Design methods and tools		CO2
UNIT – III	**THERMAL COMFORT, PASSIVE HEATING AND COOLING**	**9**
Thermal comfort, Psychrometry, Comfort indices – ASHRAE / ISHRAE Standards on thermal Comfort – Passive heating and cooling systems - HVAC Systems for built environment – Cooling Load Calculations, Heat Pumps, Evaporative Cooling and Radiant Cooling.		CO3
UNIT – IV	**ENERGY CONSERVATION IN BUILDING UTILITIES**	**9**
Energy conservation in Hot water generator – Boiler, Heat Pumps, DG Sets, Motors , Pumps, Compressors, Illumination Systems, Electrical distribution systems, Cooling Towers, Refrigeration and Air Conditioning Systems, Cogeneration Systems, Water and Waste heat recovery systems		CO4
UNIT – V	**RENEWABLE ENERGY IN BUILDINGS**	**9**
Introduction of Renewable sources in buildings, Stand-alone PV systems, BIPV, Solar water heating, Solar Air Conditioning in Buildings, Small wind turbines, Poly-generation systems in Buildings		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Familiar with climate responsive building design and basic concepts
CO2	Explain the basic terminologies related to buildings
CO3	Discuss the energy efficient air conditioning techniques
CO4	Evaluate the performance of buildings
CO5	Gets acquainted with Renewable energy systems in buildings

TEXT BOOKS:

1. Advanced Decision Making for HVAC Engineers, by Javad Khazaii, Springer; Softcover reprint of the original 1st ed. 2016 edition (23 June 2018),ISBN-10 : 3319814869
2. Thermal Comfort and Energy-Efficient Cooling of Nonresidential Buildings, by Doreen E. Kalz, Jens Pfafferott, Springer; 2014th edition (8 April 2014), ISBN-10 : 9783319045818.

REFERENCE BOOKS:

1. ASHRAE Handbook – Fundamentals / Equipment’s/ Applications – ASHRAE 2021,2020, 2019 Editions
2. Baruch Givoni: Climate considerations in building and Urban Design, John Wiley & Sons, 1998
3. Baruch Givoni: Passive Low Energy Cooling of Buildings by, John Wiley & Sons, 15-Jul-1994
4. J A Duffie and WA Beckman: Solar Engineering of Thermal Processes, Third Edition, John Wiley & Sons, 2006.
5. Jan F. Kreider, Peter S. Curtiss, Ari Rabl, Heating and Cooling of buildings: Design for Efficiency, Revised Second Edition, CRC Press, 28-Dec-2009.

ME1519 ENERGY STORAGE TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- To study the various types of energy storage devices and technologies and them comparison.
- To learn the techniques of various energy storage devices and their performances.
- To learn the basics of batteries and hybrid systems for EVs and other mobile applications.
- To learn about the renewable energy storage systems and management systems.
- To have an insight into other energy storage devices, hydrogen, and fuel cells.

UNIT - I INTRODUCTION TO ENERGY STORAGE **9**

Need for Energy Storage – Types of Energy Storage – Various forms of Energy Storage – Mechanical– Thermal - Chemical– Electrochemical – Electrical - Other alternative energy storage technologies – Efficiency and Comparison. CO1

UNIT - II ENERGY STORAGE SYSTEMS **9**

Pumped Air Energy Storage – Compressed Air Energy Storage – Flywheel – Sensible and Latent Heat Storage – Storage Materials – Performance Evaluation - Thermochemical systems – Batteries – Types- Charging and Discharging – Battery testing and performance. CO2

UNIT - III MOBILE AND HYBRID ENERGY STORAGE SYSTEMS **9**

Batteries for electric vehicles - Battery specifications for cars, heart pacemakers, computer standby supplies – V2G and G2V technologies – HESS. CO3

UNIT - IV RENEWABLE ENERGY STORAGE AND ENERGY MANAGEMENT **9**

Storage of Renewable Energy Systems –Solar Energy – Wind Energy – Energy Storage in Micro grid– Smart Grid – Energy Conversion Efficiency - Battery Management Systems – EVBMS – Energy Audit and Management CO4

UNIT - V OTHER ENERGY DEVICES **9**

Superconducting Magnetic Energy Storage (SMES), Supercapacitors – MHD Power generation –
Hydrogen Storage Fuel Cells – Basic principle and classifications – PEMFC, AMFC, DMFC, SOFC,MCFC and Biofuel Cells – Biogas Storage. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the need and identify the suitable energy storage devices for applications.

CO2 Explain the working of various energy storage devices and their importance.

CO3 Explain the basic characteristics of batteries for mobile and hybrid systems.

CO4 Discuss the storage of renewable energies and management systems.

CO5 Explain the need for other energy devices and their scope for applications.

TEXT BOOKS:

1. Rober Huggins, “Energy Storage: Fundamentals, Materials and Applications”, 2 nd Edition, Springer, 2015.
2. Dell, Ronald M Rand, David A J, “Understanding Batteries”, Royal Society of Chemistry, 2001 .

REFERENCE BOOKS:

1. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt," Energy Storage in Power Systems" Wiley Publication, 2016.
2. Ibrahim Dincer and Mark A Rosen, "Thermal Energy Storage Systems and Applications", John Wiley & amp; Sons, 2002.
3. Lindon David, "Handbook of Batteries", McGraw Hill, 2002.
4. AuliceScibioh M. and Viswanathan B, "Fuel Cells – principles and applications', University Press(India), 2006
5. Ru-Shiliu, Leizhang, Sueliang Sun, "Electrochemical Technologies for Energy Storage and Conversion", Wiley Publications, 2012.

ME1520	RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the low and zero carbon fuels suitability and methods of use in off-road vehicles.
- To learn and understand the green energy production methodologies and its use in off-road vehicle categories.
- To learn various fuel cell types and its suitability in off-highway vehicles applications
- To illustrate the impact of in-cylinder technologies on engine out emissions control.
- To study the existing after-treatment technologies used in off-highway vehicle applications.

UNIT - I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES **9**

Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE), Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles. CO1

UNIT - II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES **9**

Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles. CO2

UNIT - III FUEL CELL POWERED OFF-HIGHWAY VEHICLES **9**

Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications. CO3

UNIT - IV IN-CYLINDER TREATMENT TECHNOLOGIES **9**

Low temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed- Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies. CO4

UNIT - V AFTER TREATMENT TECHNOLOGIES **9**

Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO2 absorption techniques, Waste Heat Recovery and Organic Rankine Cycle. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Evaluate the availability, suitability, and its role in off-road vehicle categories in reducing the carbon footprint on the environment.

CO2 Gain the knowledge on various green energy production methods and its impact on meeting energy demand of off-road vehicle applications.

CO3 Develop the working of fuel cell, various fuel cell types, and its design for off-road vehicle applications.

CO4 Gain the knowledge on various in-cylinder low temperature combustion technologies and its key role in controlling the engine-out emissions.

CO5 Develop the working of various existing aftertreatment systems in controlling the engine out emissions.

TEXT BOOKS:

1. John Twidell, and Tony Weir. Renewable Energy Sources – 3rd Edition 2015,
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines.

REFERENCE BOOKS:

1. Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,
2. W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.
3. Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011
4. Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022
5. The Political Economy of Low Carbon Transformation: Breaking the habits of capitalism (Routledge Studies in Low Carbon Development) by Harold Wilhite | 21 December 2017

ME1621 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits

UNIT - I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to fluid power - Advantages and applications - Fluid power systems - Types of fluids - Properties of fluids and selection - Basics of hydraulics - Pascal's law - Principles of flow - Friction loss - Work, Power and Torque Problems, Sources of hydraulic power : Pumping theory - Pump classification - Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of linear and rotary - Fixed and variable displacement pumps - Problems.

UNIT - II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic actuators: Cylinders - Types and construction, Application, Hydraulic cushioning - Hydraulic motors - Control components : Direction control, Flow control and pressure control valves - Types, Construction and Operation - Servo and proportional valves - Applications - Accessories : Reservoirs, Pressure switches - Applications - Fluid power ANSI symbols - Problems.

UNIT - III HYDRAULIC CIRCUITS AND SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits - Regenerative, Pump unloading, Double-Pump, Pressure intensifier, Air-over oil, Sequence, reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT - IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air - Perfect gas laws - Compressor - Filters, Regulator, Lubricator, Muffler, Air control valves, Quick exhaust valves, Pneumatic actuators, Design of pneumatic circuit - Cascade method - Electro pneumatic system - Elements - Ladder diagram - Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT - V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble shooting and Remedies in hydraulic and pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of pneumatic circuits for pick and place applications and tool handling in CNC Machine tools - Low cost Automation - Hydraulic and pneumatic power packs.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the fluid power and operation of different types of pumps
CO2	Summarize the features and functions of hydraulic motors, actuators and flow control valves
CO3	Explain the different types of hydraulic circuits and systems
CO4	Explain the working of different pneumatic circuits and systems
CO5	Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 9th Edition, 2017.
2. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw-Hill, 2017

REFERENCE BOOKS:

1. Shanmugasundaram. K, “Hydraulic and Pneumatic controls”, Chand & Co, 2014.
2. R. Srinivasan, “Hydraulic and Pneumatic controls”, Tata McGraw-Hill, 2012.
3. Majumdar S.R., “Pneumatic Systems- Principles and Maintenance”, Tata McGraw-Hill, 2017

ME1622 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design

UNIT - I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design - Function and advantages of jigs and fixtures - Basic elements - principles of location - Locating methods and devices - Redundant Location - Principles of clamping - Mechanical actuation - pneumatic and hydraulic actuation standard parts - Drill bushes and jig buttons - Tolerances and materials used.

UNIT - II JIGS AND FIXTURES 9

Design and development of jigs and fixtures for given component- Types of jigs - Post, turnover, channel, latch, box, pot, angular post jigs - Indexing jigs - General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixturing systems- Quick change fixtures.

UNIT - III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press working terminologies - operations - Types of presses - press accessories - Computation of press capacity - Strip layout - Material utilization - Shearing action - Clearances - Press work materials - Center of pressure- Design of various elements of dies - Die block - Punch holder, Die set, guide plates - Stops - Strippers - Pilots - Selection of standard parts - Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT - IV BENDING AND DRAWING DIES 9

Difference between bending and drawing - Blank development for above operations - Types of Bending dies - Press capacity - Spring back - knockouts - direct and indirect - pressure pads - Ejectors - Variables affecting Metal flow in drawing operations - draw die inserts - draw beads- ironing - Design and development of bending, forming, drawing, reverse redrawing and combination dies - Blank development for axisymmetric, rectangular and elliptic parts - Single and double action dies.

UNIT - V OTHER FORMING TECHNIQUES 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies - recent trends in tool design- computer Aids for sheet metal forming Analysis - basic introduction - tooling for numerically controlled machines- setup reduction for work holding - Single minute exchange of dies - Poka Yoke.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the locating and clamping principles
CO2	Understand the importance of Jigs and Fixture
CO3	Understand the press working terminologies and elements of cutting dies
CO4	Understand the bending and drawing dies
CO5	Understand the other forming techniques

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Third Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H “Press tools - Design and Construction”, Fourth Edition, S.Chand, 2010.

REFERENCE BOOKS:

1. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”,ANE Books India, Second Edition, 2020.
2. Donaldson, Lecain and Goold, “Tool Design”, 4rd Edition, Tata McGraw Hill, 2017.
3. Hoffman, “Jigs and Fixture Design”, Delmar Learning Drafting series, Singapore, 2011.
4. Design Data Hand Book, PSG College of Technology, Coimbatore

ME1623	FLUID POWER AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures

UNIT - I INTRODUCTION **9**

Need for Automation, Hydraulic & Pneumatic Comparison - ISO symbols for fluid power elements, Hydraulic, pneumatics - Selection criteria.

UNIT - II FLUID POWER GENERATING/UTILIZING ELEMENTS **9**

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification - Drive characteristics - Linear actuator - Types, mounting details, cushioning - power packs - construction. Reservoir capacity, heat dissipation, accumulators - standard circuit symbols, circuit (flow) analysis.

UNIT - III CONTROL AND REGULATION ELEMENTS **9**

Direction flow and pressure control valves - Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves - Different types - characteristics and performance.

UNIT - IV CIRCUIT DESIGN **9**

Typical industrial hydraulic circuits - Design methodology - Ladder diagram-cascade, method - truth table - Karnaugh map method - sequencing circuits-combinational and logic circuit.

UNIT - V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS **9**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of hydraulics and pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of hydraulics, Pneumatics and different fluid power symbols
CO2	Familiarize the different power generating elements with types and working
CO3	Acquire the knowledge pressure control and direction control element
CO4	Have a complete idea to design various circuits that suit today's industrial circuit applications
CO5	Enhance the knowledge of electro pneumatic circuits

TEXT BOOKS:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 1988.

REFERENCE BOOKS:

1. Dudbey. A. Peace, Basic Fluid Power, Prentice Hall Inc, 1967
2. E.C.Fitch and J.D.Suryaatmadja. Introduction to fluid logic, McGraw Hill, 1978
3. Herbert R. Merritt, Hydraulic control systems, John Wiley & Sons, Newyork, 1967
4. Peter Rohner, Fluid Power Logic Circuit Design, Mcmelan Prem, 1994
5. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
6. Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003

ME1624 LOW COST AUTOMATION

L	T	P	C
3	0	0	3

OBJECTIVES

- To give basic knowledge about automation
- To understand the basic hydraulics and pneumatics systems for automation
- To understand the assembly automation

UNIT - I AUTOMATION OF ASSEMBLY LINES 9

Concept of automation - mechanization and automation - concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - transfer line-monitoring system (TLMS) using Line Status - line efficiency - Buffer stock Simulation in assembly line.

UNIT - II AUTOMATION USING HYDRAULIC SYSTEMS 9

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT - III AUTOMATION USING PNEUMATIC SYSTEMS 9

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations - application - fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

UNIT - IV AUTOMATION USING ELECTRONIC SYSTEMS 9

Introduction - various sensors - transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers.

UNIT - V ASSEMBLY AUTOMATION 9

Types and configurations - parts delivery at workstations - various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - product design for automated assembly.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Know the concept of automation and its assembly lines
CO2 Gain knowledge in usage of hydraulic components in automation
CO3 Use different methods of pneumatic circuits in the automation industry
CO4 Study various sensors and programming of control systems
CO5 Study the types of assembly automation and part delivery systems

TEXT BOOKS:

1. Anthony Esposito, “Fluid Power with applications”, Prentice Hall international, 2009.
2. Mikell P Groover, “Automation, Production System and Computer Integrated Manufacturing”, Prentice Hall Publications, 2007

REFERENCE BOOKS:

1. Kuo .B.C, “Automatic control systems”, Prentice Hall India, New Delhi, 2007
2. Peter Rohner, “Industrial hydraulic control”, Wiley Edition, 1995
3. Mujumdar.S.R, “Pneumatic System”, Tata McGraw Hill 2006

ME1625 PRODUCT DESIGN ENGINEERING AND MANAGEMENT **L T P C**

3 0 0 3

OBJECTIVES

- The course aims at providing the basic concepts of innovative and evolutionary product design strategies so that students can have a basic knowledge in new product development methods and development of innovative products and processes for commercially driven markets

UNIT - I NEW PRODUCT DEVELOPMENT 9

New Product development – NPD - Design by Evolution-Design by Innovation - Product development Strategy - Integration of functional skills - Competitor and Customer - Lean Strategy. Understanding customers needs - role of customers in product development and managing requirements - Product Management Strategy - Process management and improvement -Establish product specifications-Engineering and non-engineering.

UNIT - II CONCEPT IDEALIZATION AND SELECTION 9

Goal Oriented Design - Structured approaches - Customer centric approach - Process centric approach - House of Quality - Search externally and internally - explore systematically for feasibility analysis-reflect on the outcomes – solutions - concept selection - methodology - benefits.

UNIT - III SYSTEM LEVEL PRODUCT DESIGN 9

Implications - Conceptual framework for system level design - Design standardization - product performance - manufacturability - product development strategy - product architecture - clustering - geometric layout development - fundamental and incidental interactions - procedure-pattern - framework – related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-interactive system design.

UNIT - IV INDUSTRIAL DESIGN STRATEGIES 9

Integrated product and process design - Cost management - Robust design strategy - Integrating CAE, CAD, CAM tools - Simulation based product performance and manufacturing processes - Need for industrial design - investigation for industrial design - investigation of customer needs - conceptualization - refinement - engineering change management-technology and user driven products -Qualitative index for an industrial design.

UNIT - V DESIGN FOR MANUFACTURING AND PROJECT EXECUTION 9

Definition - Product costing - Manufacturing cost - Types of manufacturing cost - Cost Minimization -Design for light weight materials - Product complexity - Prototype basics - principles of prototyping - planning for prototypes - Project plan and capital expenditure - baseline project planning - accelerating the project - project metrics and evaluation strategies.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the integrated product and process development
CO2 Develop product concepts and selection methodologies
CO3 Develop product architecture and product detailing and prototyping
CO4 Develop product development Integrated with CAD/CAM/CAE
CO5 Develop DFXs concepts with emphasis on economic decision making

TEXT BOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, ”Product Design and Development”, McGraw-Hill International Edns. 7th Edition, 2020.

REFERENCE BOOKS:

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4
3. Staurt Pugh, “Tool Design -Integrated Methods for Successful Product Engineering”, Addison Wesley Publishing, New york, NY. Digitized 2010

ME1626 VIBRATION AND NOISE CONTROL TECHNIQUES FOR MACHINES AND AUTOMOBILES

L	T	P	C
3	0	0	3

OBJECTIVES

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT – I INTRODUCTION TO VIBRATION **9**

Introduction, Types of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies , source of vibration in Automobile, source of vibration in Machines.

UNIT - II INTRODUCTION TO NOISE **9**

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement of noise in environment, equipment, frequency analysis, tracking analysis, sound quality analysis, measurement of noise in machine tool.

UNIT - III SOURCES OF NOISE IN AUTOMOBILE **9**

Noise Characteristics of engines systems, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, overall noise levels of automobile, Noise Characteristics of suspension systems , transmission noise, aerodynamic noise, tire noise, brake noise, measurement of noise in automobile.

UNIT - IV VIBRATION CONTROL TECHNIQUES **9**

Vibration isolation in suspension system, Vibration isolation in Machine tools, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT - V NOISE CONTROL TECHNIQUES **9**

Methods for control techniques of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the different types of vibrations and basics of Vibration
CO2 Study the different types of noise and basics of Noise
CO3 Understand and analyze the various sources of automotive Noise
CO4 Acquire the knowledge of control techniques for vibration in engine and suspension system
CO5 Aware about the sources and control techniques of automotive noise

TEXT BOOKS:

1. Singiresu S.Rao, “Mechanical Vibrations”, 6th Edition, Pearson Education, 2016, Latest Edition.
2. David Bies and Colin Hansen, “Engineering Noise Control - Theory and Practice”,4th E and FN Spon, Taylore & Francise e-Library, 2009.

REFERENCE BOOKS:

1. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University, 2007
3. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book”, Second Edition, SAE International, 1999
4. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 2009

ME1627	DESIGN THINKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the importance of design in today’s context of global competition.

UNIT - I DESIGN THINKING FOR NEED IDENTIFICATION 9

Introduction to New Product Development (NPD) & Design Thinking – A Framework of Design Thinking– Nine Criteria of an Inspirational Design Brief– Customer Experience Mapping– The Visualize, Empathize, and Ideate Method–Design Heuristics–Prototypes in Design Thinking – Integrating Design into the Fuzzy Front End (FFE) – Four Pillars of Innovation for Enabling Design Thinking. CO1

UNIT - II PRODUCT DEVELOPMENT PROCESS 9

The six phases of generic development–Concept Development–Opportunity Identification Process – Five step process of product planning – Process of Identifying Customer Needs – Process of Product Specifications–Concept generation method–Methods of Concept Selection & Concept Testing. CO2

UNIT - III PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN FOR ENVIRONMENT 9

Modular Architecture–Types of Modularity–Implications of the Architecture –Establishing the Architecture – Delayed Differentiation – Platform Planning: Differentiation Plan, Commonality Plan– The Industrial Design Process–Assessing the Quality of Industrial Design– Environmental Impacts –The Design for Environment Process. CO3

UNIT - IV ROBUST DESIGN FOR MANUFACTURING AND SUPPLY CHAIN 9

Robust design through the design of experiments (DOE)–Design for X (DFX)–Iteration of DFM method–Failure Mode and Effect Analysis (FMEA)–Quality Function Deployment (QFD)–Partial disassembly, folding, or compression– Delayed final packaging. CO4

UNIT - V DESIGN THINKING IN COST-CUTTING AND INTELLECTUAL PROPERTY 9

Fundamentals of Cost Calculations–Methods for Estimating Costs–Target Costing–Life Cycle costs–“Design” in Intellectual Property–Utility Patents–Design Patents–Copyrightable Designs – Trademark Rights–Legal Overlap, Trade-Offs, and Strategic Considerations. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Apply design concepts for manufacturing, assembly and environment.

CO2 Make economically sound decisions.

CO3 Design methodologies on industrial ecology.

CO4 Analyze the design for its manufacturability using modern quality control concepts and Approaches.

CO5 Learn the value of design and how it impacts society, industry, and the environment.

TEXT BOOKS:

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "Design Thinking: New Product Development Essentials from the PDMA", ISBN: 978-1-118-97180-2, November 2015, Wiley-Blackwell Publishers.
2. Karl Ulrich, Steven Eppinger, Maria C. Yang, "Product Design and Development", ISBN:9789390113231, Seventh Edition, McGraw Hill Publishers.
3. Gerhard Pahl, Wolfgang Beitz, Jörg Feldhusen, Karl-Heinrich Grote, "Engineering Design: A Systematic Approach", ISBN: 978-1-84628-319- 2, 2007, Springer Publishers.

REFERENCE BOOKS:

1. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", ISBN: 978-1-118-62012-0, August 2013,Wiley Publishers.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", ISBN: 978-1-118-08346-8, October 2012,Wiley Publishers.
3. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", ISBN: 9780062856623, March 2019, Harper Collins Publishers.

ME1628	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamental concepts of the new product development
- To develop material specifications, analysis and process.
- To Learn the Feasibility Studies & reporting of new product development.
- To study the New product qualification and Market Survey on similar products of new product development
- To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT - I FUNDAMENTALS OF NPD 9

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD. CO1

UNIT - II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS 9

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis. CO2

UNIT - III ESSENTIALS OF NPD **9**

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents. CO3

UNIT - IV CRITERIONS OF NPD **9**

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD. CO4

UNIT - V REPORTING & FORWARD-THINKING OF NPD **9**

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.) CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss fundamental concepts and customer specific requirements of the new product development
CO2	Discuss the material specification standards, analysis and fabrication, manufacturing process.
CO3	Develop feasibility studies & reporting of new product development
CO4	Analyzing the new product qualification and market survey on similar products of new product development
CO5	Develop reverse engineering, generate cloud points, convert cloud data to 3D model

TEXT BOOKS:

4. Product Development – Sten Jonsson
5. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCE BOOKS:

4. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
5. Change by Design
6. Toyota Product Development System – James Morgan & Jeffrey K. Liker
7. Winning at New Products – Robert Brands 3rd Edition
8. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

ME1629 PRODUCT LIFE CYCLE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To study about the history, concepts and terminology in PLM
- To learn the functions and features of PLM/PDM
- To develop different modules offered in commercial PLM/PDM tools
- To demonstrate PLM/PDM approaches for industrial applications
- To use PLM/PDM with legacy data bases, Coax & ERP systems

UNIT – I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM **9**

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications CO1

UNIT – II PLM/PDM FUNCTIONS AND FEATURES **9**

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration CO2

UNIT – III DETAILS OF MODULES IN A PDM/PLM SOFTWARE **9**

Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed CO3

UNIT – IV ROLE OF PLM IN INDUSTRIES **9**

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance-process compliance and process automation CO4

UNIT – V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE **9**

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Summarize the history, concepts and terminology of PLM
CO2	Develop the functions and features of PLM/PDM
CO3	Discuss different modules offered in commercial PLM/PDM tools.
CO4	Interpret the implement PLM/PDM approaches for industrial applications.
CO5	Integrate PLM/PDM with legacy data bases, CAx& ERP systems

TEXT BOOKS:

1. Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016),ISBN-10 : 3662516330
2. Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989)ISBN-10 : 0899303196

REFERENCE BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition)
2. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
3. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007 \
4. John Stark, “Product Life cycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
5. Michael Grieves, “Product Life Cycle Management”, Tata McGraw Hill, 2006.

ME1631	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

UNIT - I INTRODUCTION 9

Overview - Need - Development of Additive Manufacturing Technology - Principle - AM Process Chain- Classification - Rapid Prototyping - Rapid Tooling - Rapid Manufacturing – Applications - Benefits - Case studies.

UNIT - II DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation - Part orientation and support structure generation - Model slicing -Tool path generation- Design for Additive Manufacturing: Concepts and Objectives - AM unique capabilities - DFAM for part quality improvement- Customised design and fabrication for medical applications.

UNIT - III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Photo polymerization: SLA-Photo curable materials - Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description - powder fusion mechanism - Process Parameters- Typical Materials and Application. Electron Beam Melting.

UNIT - IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM-Introduction - Basic Principle - Materials - Applications and Limitations - Bioextrusion. Sheet Lamination Process:LOM- Gluing or Adhesive bonding - Thermal bonding.

UNIT - V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES 9

Droplet formation technologies - Continuous mode - Drop on Demand mode - Three Dimensional Printing - Advantages - Bioplotter - Beam Deposition Process: LENS- Process description - Material delivery - Process parameters - Materials - Benefits - Applications.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Know the overview of additive manufacturing
- CO2 Understand the design concept of additive manufacturing
- CO3 Understand the working principle of additive manufacturing processes
- CO4 Learn about the construction of additive Manufacturing technologies
- CO5 Understand about modern techniques and mass production in additive manufacturing process

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.
2. Ian Gibson, David W.Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” second edition, Springer , 2015.

REFERENCE BOOKS:

1. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006
3. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications :A tool box for prototype development”, CRC Press, 2007
4. Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012

ME1632	NON DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT - I OVERVIEW OF NDT **9**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT, Visual inspection - Unaided and aided.

UNIT - II SURFACE NDE METHODS **9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT - III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) **9**

Thermography - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT - IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9

Ultrasonic Testing - Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultra sound, Time of Flight Diffraction. Acoustic Emission Technique - Principle, AE parameters, Applications.

UNIT - V RADIOGRAPHY (RT) 9

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy - Xero-Radiography, Computed Radiography, Computed Tomography.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the fundamental concepts of NDT
CO2 Gain knowledge of the different methods of NDE
CO3 Explain the concept of thermography and eddy current testing
CO4 Explain the concept of ultrasonic testing and acoustic emission
CO5 Explain the concept of radiography

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCE BOOKS:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
3. Charles, J. Hellier," Handbook of Nondestructive evaluation", McGraw Hill, New York 2001
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005

ME1633 POLYMERS AND COMPOSITES

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn fundamentals of polymer composites.
- To learn the manufacturing methods of polymer composites
- To impart knowledge on testing on composite materials
- To study the need processing of ceramic matrix composites

UNIT - I INTRODUCTION TO POLYMER COMPOSITES 9

Fundamentals of composites, characteristics, applications of composites, Reinforcements - glass fibers, boron fibers, carbon fibers, organic fibers, aramid fibers, ceramic fibers, oxide and non-oxide fibers, Forms of reinforcements - Roving, Woven fabrics, Non-woven, random mats, whiskers, Rule of mixtures, Matrix materials - Polymers - Thermosetting resins, thermoplastic resins.

UNIT - II MANUFACTURING METHODS OF POLYMER COMPOSITES 9

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fiber/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems; carbon fiber/epoxy, glass fiber/polyester, etc.

UNIT - III TESTING OF COMPOSITES 9

Mechanical testing of polymer composites- tensile testing, compressive testing, intra-laminar shear testing, Impact, Flexural testing, Dynamic testing-DMA-Low velocity impact test, vibrational analysis, Thermal analysis.

UNIT - IV CERAMIC MATRIX COMPOSITES 9

Need for CMCs, Processing of CMCs - cold pressing and sintering, hot pressing, infiltration, chemical vapor deposition and chemical vapor impregnation, sol-gel and polymer pyrolysis, high temperature synthesis properties and applications of CMC.

UNIT - V METAL MATRIX COMPOSITES 9

Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC limitations of MMC Processing of MMC, liquid metal infiltration, squeeze casting, stir casting, compo casting, solid state route and diffusion bonding, powder metallurgy route slip casting.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Identify suitable reinforcement and matrix materials for different applications
CO2 Study the various manufacturing processes of Polymer Matrix Composite
CO3 Gain knowledge in testing of composites
CO4 Understand the procedure processing of CMC
CO5 Understand the procedure for processing of metal matrix composites

TEXT BOOKS:

1. B.D. Agarwal and L.J. Broutman, Analysis and Performance of Fiber Composites, John Wiley and Sons, New York, 2000.
2. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.
3. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.

REFERENCE BOOKS:

1. Sharma S.C., Composite materials, Narosa Publications, 2000
2. Sanjay.K.Majumdar, Composites Manufacturing, Kindle edition, CRC press, 2001
3. F.L.Matthews & R.D.Rawlings, Composite Materials, Engineering & Sciences, Chapman & Hall, London, 2001.
4. Graeme W.Milton , The Theory of Composites, CUP, London,2004.
5. Issac M. Daniel and Ori Ishai, Engineering Mechanics of Composite Materials, Oxford University Press-2006, First Indian Edition - 2007.

ME1634 TESTING AND CHARACTERIZATION OF MATERIALS **L T P C**

3 0 0 3

OBJECTIVES

- To understand the various destructive and non-destructive testing methods of materials and its industrial application.

UNIT - I INTRODUCTION TO MATERIALS & TESTING STANDARDS 9

Overview of materials, properties and application of advanced materials, Purpose of testing, Selection of material, Development of testing, Classification of material testing, Result Analysis, Advantages of testing, Testing organizations and its committee, Testing standards.

UNIT - II MECHANICAL TESTING FOR VARIOUS MATERIALS 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy), Drop Weight Impact test - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend (Flexural) test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT - III NON DESTRUCTIVE TESTING FOR VARIOUS MATERIALS 9

Visual inspection, Liquid Penetrate Test, Magnetic particle test, Thermography test - Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT - IV MATERIAL CHARACTERIZATION & SURFACE TOPOLOGY 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques (XRD), Spectroscopic Techniques (FTIR), Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT - V OTHER TESTING 9

Thermal Testing: Differential Scanning Calorimetry, Differential Thermal Analysis. Thermo-mechanical/Thermo Gravimetric Analysis and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma- Mass Spectrometry.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Study the basics of various materials, different types of material testing, material testing standards and organizations, characterization and techniques
CO2	Study the various mechanical testing and its procedure with application
CO3	Study the various non-destructive testing techniques
CO4	Study and analyze the surface and elemental behavior of various materials using different material characterization techniques
CO5	Study and analyze the thermal, chemical behavior of various materials by special testing techniques

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2019.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007.

REFERENCE BOOKS:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

ME1635	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.

UNIT - I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES **9**

Unconventional machining Process - Need - classification - merits, demerits and applications. Abrasive Jet Machining - Water Jet Machining - Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles - equipment used - Process parameters – MRR - Applications. CO1

UNIT - II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES **9**

Electric Discharge Machining (EDM) - Wire cut EDM - Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool - Power and control Circuits-Tool Wear - Dielectric - Flushing -- Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles - Equipment - Types - Beam control techniques - Applications. CO2

UNIT - III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **9**

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants - Maskant - techniques of applying maskants - Process Parameters - Surface finish and MRR - Applications. Principles of ECM- equipment-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications. CO3

UNIT - IV ADVANCED NANO FINISHING PROCESSES **9**

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, their working principles, equipment, effect of process parameters, applications, advantages and limitations. CO4

UNIT - V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES **9**

Recent developments in non-traditional machining processes, their working principles, equipment, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the need for unconventional machining processes and its classification
CO2	Compare various thermal energy and electrical energy based unconventional machining processes
CO3	Summarize various chemical and electro-chemical energy based unconventional machining processes
CO4	Explain various nano abrasives based on unconventional machining processes
CO5	Distinguish various recent trends based unconventional machining processes

TEXT BOOKS:

1. Anup Goel, Dr.A.Jacob Moses, "Unconventional Machining Processes", Technical Publications 1st Edition,2020.
2. Vijay.K.Jain, "Advanced Machining Processes",Allied Publishers Pvt.Ltd.,New Delhi, 2007.
3. Pandey P.C.and Shan H.S, "Modern Machining Processes", Tata Mc Graw-Hill, New Delhi, 2007.

REFERENCE BOOKS:

1. Kapil Gupta, Neelesh K. Jain, R. F. Laubscher, "Hybrid Machining Processes: Perspectives on Machining and Finishing", Springer International Publishing,2016
2. Paul De Garmo, J.T.Black, and Ronald. A. Kohser, "Materials And Processes in Manufacturing" Prentice Hall India Pvt.Ltd.,8th Edition, New Delhi, 2001
3. Benedict.G.F., "Non-traditional Manufacturing Processes",Marcel Dekker Inc., NewYork, 1987.
4. McGeough, "Advanced Methods of Machining",Chapman and Hall, London,1998.

ME1636 WELDING TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the basics of welding and to know about the various types of welding processes.

UNIT - I GAS AND ARC WELDING PROCESSES **9**

Fundamental principles - Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications. CO1

UNIT - II RESISTANCE WELDING PROCESSES **9**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications. CO2

UNIT - III SOLID STATE WELDING PROCESSES **9**

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications. CO3

UNIT - IV OTHER WELDING PROCESSES **9**

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Underwater welding, Welding automation in aerospace, nuclear and surface transport vehicles. CO4

UNIT - V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS **9**

Various weld joint designs - Welding defects - causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the construction and working principles of the gas and arc welding process
CO2 Understand the construction and working principles of the resistance welding process
CO3 Understand the construction and working principles of various solid state welding processes
CO4 Understand the construction and working principles of various special welding processes
CO5 Understand the concepts on weld joint design, weldability and testing of weldments

TEXT BOOKS:

1. Little R.L.,"Welding and welding Technology",Tata McGraw Hill Publishing Co.,Ltd., McGraw Hill Education July 2017
2. Parmer R.S.,"Welding Engineering and Technology ",1st Edition, Khanna Publishers, 2013
3. O.P.Khanna.,"Text Book Of Welding Technology", Dhanpat Rai Publications; 2011.

REFERENCE BOOKS:

1. AWS - Welding Hand HandBook.8th Edition. Vol-2. "Welding Process".
2. Christopher Davis. "LaserWelding-Practical Guide".Jaico Publishing House
3. Nadkarni S.V. "Modern Arc Welding Technology", Oxford IBH Publishers,1st Edition, 2005.
4. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993
5. Tylecote R.F., "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London.

ME1637	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concept of environmental design and industrial ecology.
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To introduce the concept of green co-rating and its need.

UNIT - I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT **9**

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology – Pollution prevention – Reduction of toxic emission – design for recycle. CO1

UNIT - II AIR POLLUTION SAMPLING AND MEASUREMENT **9**

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone. CO2

UNIT - III NOISE POLLUTION AND CONTROL		**9**
Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise- Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.	CO3	
UNIT - IV WATER DEMAND AND WATER QUALITY		**9**
Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.	CO4	
UNIT - V GREEN CO-RATING		**9**
Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage - Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green Co- Rating	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the environmental design and selection of eco-friendly materials.
CO2	Analyse manufacturing processes towards minimization or prevention of air pollution.
CO3	Analyse manufacturing processes towards minimization or prevention of noise pollution.
CO4	Analyse manufacturing processes towards minimization or prevention of water pollution.
CO5	Evaluate green co-rating and its benefits.

TEXT BOOKS:

1. Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

REFERENCE BOOKS:

1. Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
2. World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
3. Rao M.N. and Dutta A.K. "Wastewater treatment", Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
4. Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006
5. Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994.

ME1638 GREEN SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiar the various standards and legislation of modern electronic manufacturing.
- To know the conventional electronic processing and lead-free electronic manufacturing techniques.
- To recognize the steps involved in assembly process and understand the need of recycle the electronics
- To implement reliability and product life cycle estimation tools in green electronic manufacturing.
- To demonstrate the green electronic manufacturing procedure in applications.

UNIT - I INTRODUCTION TO GREEN ELECTRONICS **9**

Environmental concerns of the modern society- Overview of electronics industry and their relevant regulations in China, European Union and other key countries- global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH). CO1

UNIT - II GREEN ELECTRONICS MATERIALS AND PRODUCTS **9**

Basics of IC manufacturing and its process – Electronics with Lead (Pb) -free solder pastes, conductive adhesives, Introduction to green electronic materials and products - halogen-free substrates and components. Substitution of non-recyclable thermosetting polymer based composites with recyclable materials X-Ray Fluorescence (XRF) for identifying hazardous substances in electronic products. CO2

UNIT – III GREEN ELECTRONICS ASSEMBLY AND RECYCLING **9**

Various processes in assembling electronics components - the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology. CO3

UNIT – IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN **9**

Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry. CO4

UNIT – V CASE STUDIES **9**

Reliability of green electronics systems , Reuse and recycle of End-of-Life(EOL) electrical and electronic equipment for effective waste management – Introduction of Green Supply Chain, and Modeling green products from Supply Chain point of view - A life-cycle assessment for eco-design of Cathode Ray Tube Recycling. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get concise awareness of standards and legislation of modern electronic manufacturing for green environment.
CO2	Explain the conventional electronic processing and lead free electronic manufacturing techniques.
CO3	Realize the assembly process and the need of recycle of electronics
CO4	Use reliability and product life cycle estimation tools for electronic manufacturing.
CO5	Validate the green electronic manufacturing procedures in applications.

TEXT BOOKS:

1. Green Supply Chain Management, by CharisiosAchillas , Dionysis D. Bochtis , Dimitrios Aidonis, Routledge; 1st edition (16 November 2018), ISBN-10 : 1138644617
2. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

REFERENCE BOOKS:

1. David Austen, Green Electronic Morning, Ingleby Gallery, 2006.
2. John Hu. Mohammed Ismail, CMOS High Efficiency on – Chip Power Management, Springer Publications 4th edition, 2011.
3. Yuhang yang and Maode Ma, Green Communications and Networks, Springer Publication., 2014.
4. Sanka Ganesan, Michael Pecht, Lead free Electronics, John Wiley & Sons, 2006.
5. Charles A. Harper, Electronic Materials and Processes Hand book, McGraw-Hill, 2010.
6. Sammy G. Shina, Green Electronics Design and Manufacturing, McGraw Hill., 2008.

ME1639	INDUSTRY 4.0 FOR MECHANICAL ENGINEERING	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To introduce revolutions in the manufacturing industry
- To introduce technological advancement in modern manufacturing industries
- To introduce concepts of smart manufacturing, emphasizing Industry 4.0 in manufacturing industries

UNIT – I INTRODUCTION TO INDUSTRY 4.0 **9**

Introduction to Industry 4.0 -Need for Industry 4.0 - Framework for Industry 4.0 -Technological pillars in Industrial 4.0 -Applications, challenges and scope for Industry 4.0 - Dissemination of Industry 4.0 and the disciplines contributing to its development, Artificial intelligence, Industrial Internet of Things, Additive manufacturing, Robotization, and automation. Difference between conventional automation and Industry 4.0. CO1

UNIT – II TECHNOLOGICAL DEVELOPMENTS IN INDUSTRY 4.0 **9**

Introduction to Smart Manufacturing - Big Data, Cyber-Physical Systems, Value chains in manufacturing companies - Customization of products -Internet of Things (IoT) - Industrial Internet of Things (IIoT) -Digital Twins - Cloud Computing / Cloud Manufacturing -Artificial Intelligence and Machine Learning - Security issues within Industry 4.0 networks **CO2**

UNIT – III CYBER-PHYSICAL SYSTEMS **9**

Components of I4.0- Cyber-Physical System –Cyber world and Physical world- Concepts of embedded systems, Wireless sensor networks - Mobile networks - Satellite networks - RFID & IoT Enabled Cyber Security Systems. CO3

UNIT – IV SMART MANUFACTURING SYSTEMS **9**

Introduction to Manufacturing Processes and Systems - Industrial revolutions, Background and concept of smart manufacturing- Elements of the Smart Manufacturing Process; Sensing Elements and IoT Technologies; Data-driven models - Precision Manufacturing, Flexible Manufacturing, and Agile Manufacturing - Concept of edge, fog, and cloud computing in Manufacturing - VR, and MR (Mixed Reality) in Manufacturing - Case Studies. CO4

UNIT – V ECOSYSTEM FOR INDUSTRY 4.0 **9**

Economic aspects, opportunities, and skills required for Industry 4.0 - Effects of 4-M-Man, Machine, Material, and Method in Industry 4.0 - The Current State of Industry 4.0 in India. The Strategic Framework for Successful Implementation of Industry 4.0 and beyond. CO5

TOTAL PERIODS: 45

TEXT BOOKS

1. Leong W., (2020), Nine pillars of technologies for Industry 4.0, IET publishers.
2. Klaus Schwab, “The Fourth Industrial Revolution”.
3. Wang L, and Vincent W X, (2019), Cloud Based Cyber-Physical Systems in Manufacturing, Springer

REFERENCE BOOKS

1. V.K. Jain, Data Sciences and Analytics, Khanna Publishing House, New Delhi, 2019. 4.
2. R. Chopra, Machine Learning, Khanna Publishing House, New Delhi, 2020.
3. Jeschke S, Brecher C, Song H, and Rawat D B, (2017), Industrial Internet of Things – Cyber Manufacturing Systems, Springer
4. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things 1st ed. Edition, Kindle Edition, 2018
5. Tao F, Zhang M, and Nee A Y C, (2019), Digital Twin Driven Smart Manufacturing, Academic Press.
6. Wang L, and Vincent W X, (2019), Cloud Based Cyber-Physical Systems in Manufacturing, Springer.
7. MIT Online Course on Smart Manufacturing: https://professional.mit.edu/course catalog/smart-manufacturing-moving-static-dynamic-manufacturing-operations/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Correlate the recent manufacturing trends and technological pillars of Industry 4.0.
CO2	Understand the importance of Cloud Computing, AI, Big data,and IoT in modern industry
CO3	Understand different components of Cyber-Physical systems and their benefits
CO4	Appreciate concepts and basic framework necessary for smart manufacturing
CO5	Compare the ecosystem of the current manufacturing industry and Industry 4.0

ME1640	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basics of 6 SIGMA
- To learning about the lean manufacturing tools.
- To study about the deeper understanding methodologies of Lean manufacturing.
- To study the lean concepts and its elements.
- To learn implementation and challenges of lean manufacturing.

UNIT – I BASICS OF 6 SIGMA **9**

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality. CO1

UNIT – II INTRODUCTION TO LEAN MANUFACTURING TOOLS 9

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements. CO2

UNIT – III DEEPER UNDERSTADING METHODOLOGIES 9

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration. CO3

UNIT – IV LEAN ELEMENTS 9

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects. CO4

UNIT – V IMPLEMENTATION AND CHALLENGES 9

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the basics of 6 SIGMA

CO2 Elaborate the lean manufacturing tools.

CO3 Illustrate about the deeper understanding methodologies of Lean manufacturing.

CO4 Discuss lean concepts and its elements.

CO5 Describe the implementation and challenges of lean manufacturing.

TEXT BOOKS:

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3. The Toyota Way: 14 Management Principles
4. Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

REFERENCE BOOKS:

1. Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
3. NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

MG1003 APPLIED OPERATIONS RESEARCH

L	T	P	C
3	0	0	3

OBJECTIVES

- To provide the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Computer Applications.
- To understand , develop and solve mathematical model of linear programming problems
- To understand , develop and solve mathematical model of Transport and assignment problems
- To Understand network modeling for planning and scheduling the project activities

UNIT - I LINEAR PROGRAMMING MODELS **12**

Mathematical Formulation - Graphical Solution of linear programming models - Simplex method - Artificial variable techniques. CO1

UNIT - II TRANSPORTATION AND ASSIGNMENT MODELS **8**

Mathematical formulation of transportation problem - Methods for finding initial basic feasible solution - optimum solution - degeneracy -Mathematical formulation of assignment models - Hungarian Algorithm. CO2

UNIT - III INVENTORY MODELS **8**

Inventory Models - Economic order Quantity Models- Quantity Discount Models- Stochastic Inventory Models- Multi Product Model- Inventory Control Models in Practice. CO3

UNIT - IV SCHEDULING FOR PROJECT ACTI VITIES **7**

Network Construction - Critical Path Method - Project Evaluation and Review Technique - Resource Analysis in Network Scheduling. CO4

UNIT - V QUEUEING MODELS **10**

Characteristics of Queuing Models - Single and multi server models
Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), CO5
(M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Analyze the problems in engineering, management or business environment, focusing on important details.
CO2 Understand the transportation and assignment in logistics and job allocation scenarios.
CO3 Understand the inventory management in manufacturing context.
CO4 Understand the concept of network and project planning
CO5 Understand the applications of queuing theory in real world

TEXT BOOKS:

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

REFERENCE BOOKS:

1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley,2009
2. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern,1994
5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

ME1741 COMPUTER INTEGRATED MANUFACTURING SYSTEMS AND AUTOMATION **L T P C**

3 0 0 3

OBJECTIVES

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT - I INTRODUCTION	**9**	
Brief introduction to CAD and CAM - Manufacturing planning, Manufacturing control-Introduction to CAD/CAM - Concurrent engineering-CIM concepts - Computerised elements of CIM system - Types of production - Manufacturing models and metrics - Mathematical models of production performance - Simple problems - Manufacturing control - Simple problems - Lean production and Just-In-Time Production.	CO1	
UNIT - II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING	**9**	
Process planning - Computer Aided Process Planning (CAPP) - Logical steps in Computer Aided Process Planning - Aggregate Production Planning and the Master Production Schedule - Material Requirement planning - Capacity planning- Control Systems-Shop floor control-Inventory control-Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) , Computer Integrated Additive Manufacturing(CIAM) - Simple problems.	CO2	
UNIT - III CELLULAR MANUFACTURING	**9**	
Group Technology (GT), Part Families - Parts classification and coding - Simple Problems in Opitz part coding system - Production flow analysis - Cellular manufacturing - Composite part concept - Machine cell design and layout - Quantitative analysis in Cellular manufacturing - Rank order clustering method - Arranging machines in a GT cell - Hollier method - Simple problems.	CO3	
UNIT - IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)	**9**	
Types of Flexibility - FMS - FMS Components - FMS application & benefits - FMS planning and control - Quantitative analysis in FMS - Simple problems. Smart manufacturing - IoT, Automated Guided Vehicle System (AGVS) - AGV's application - Vehicle guidance technology - Vehicle management & safety.	CO4	
UNIT - V INDUSTRIAL AUTOMATION	**9**	
Basic Elements of an Automated System - Advanced Automation Functions Levels of Automation - Automation and Artificial Intelligence. Industrial Control Systems: Process Industries versus Discrete Manufacturing Industries - Continuous versus Discrete Control - Computer Process Control -Industry 4.0.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems
CO2	Summarize the production planning and control and computerized process planning
CO3	Differentiate the different coding systems used in group technology
CO4	Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system
CO5	Understand the basics of automation and control systems

TEXT BOOKS:

1. Mikell.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2016
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2008.

REFERENCE BOOKS:

1. Gideon Halevi and Roland Weill, "Principles of Process Planning - A Logical Approach" Chapman & Hall, London,2012
2. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.1995
3. Rao. P, N Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

ME1742	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like preventive maintenance, condition monitoring and repair of machine elements
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT - I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound Maintenance systems - Reliability and machine availability - MTBF, MTTR and MWT - Factors of availability - Maintenance organization - Maintenance economics. CO1

UNIT - II MAINTENANCE POLICIES - PREVENTIVE MAINTENANCE 9

Maintenance categories - Comparative merits of each category - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication - TPM. CO2

UNIT - III CONDITION MONITORING 9

Condition Monitoring - Cost comparison with and without CM - On-load testing and offload testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis. CO3

UNIT - IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings - Failure analysis - Failures and their development - Logical fault location methods - Sequential fault location. CO4

UNIT - V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records -Job order systems -Use of computers in maintenance. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the principles and practices of maintenance planning
CO2	Explain the maintenance policies and strategies to preventive maintenance
CO3	Summarize the different principles of condition monitoring
CO4	Summarize the repair methods for basic machine elements
CO5	Summarize the repair methods for material handling equipment

TEXT BOOKS:

1. Amiya R Mohanty, “Machinery Condition Monitoring: Principles and Practices”, CRC Press, 2015
2. Terry Wireman, “Benchmarking Best Practices for Maintenance, Reliability and Asset Management”, 3rd Edition, Industrial Press Inc. 2014.
3. Venkataraman .K “Maintenance Engineering and Management”, PHI Learning, Pvt. Ltd., 2007.
4. Heinz P. Bloch and Fred K. Geitner, “Machinery Component Maintenance and Repair”, 3rd Edition, Elsevier, 2005

REFERENCE BOOKS:

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 2010
2. Keith Mobley, Lindley Higgins, Darrin Wikoff, “Maintenance Engineering Handbook”, Seventh Edition, Mc-Graw Hill Professional, 2008.

EC1008	MEMS AND NEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of microsystems
- To know the design concepts of micro sensors and micro actuators.
- To introduce the concepts of quantum mechanics and nano systems

UNIT - I INTRODUCTION TO MEMS AND NEMS **9**

New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. CO1

UNIT - II MEMS FABRICATION TECHNOLOGIES **9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA. CO2

UNIT - III MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester. CO3

UNIT - IV MICRO ACTUATORS **9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch. CO4

UNIT - V NANO DEVICES **9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nano rods based NEMS device: Gas sensor. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and working principles of microsystems and microelectronics
CO2	Understand the both micro fabrication and manufacturing techniques
CO3	Acquire knowledge about micro system design and its various applications
CO4	Study about the basic concepts of nano electronics with various devices and also discusses with its applications
CO5	Realize the various application of NEMS and architecture of MEMS

TEXT BOOKS:

1. Marc Madou, Fundamentals of Microfabrication, CRC press 1997
2. Stephen D. Senturia, Micro system Design , Kluwer Academic Publishers,2001.

REFERENCE BOOKS:

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcraw Hill, 2002.
2. Chang Liu, Foundations of MEMS, Pearson education India limited, 2006.
3. Sergey Edward Lyshevski, MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002.

ME1743	SAFETY ENGINEERING AND DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety
- Collaborate and modify processes / procedures for safety

UNIT - I INTRODUCTION **9**

Evolution of modern safety concepts - Fire prevention - Mechanical hazards - Boilers, Pressure vessels, Electrical Exposure. CO1

UNIT - II CHEMICAL HAZARDS **9**

Chemical exposure - Toxic materials - Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene - Industrial Toxicology. CO2

UNIT - III ENVIRONMENTAL CONTROL **9**

Industrial Health Hazards - Environmental Control - Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection. CO3

UNIT - IV HAZARD ANALYSIS **9**

System Safety Analysis -Techniques - Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment. CO4

UNIT - V SAFETY REGULATIONS AND DISASTER MANAGEMENT **9**

Explosions - Disaster management - catastrophe control, hazard control, Factories Act, Safety regulations Product safety - case studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify and prevent chemical, environmental mechanical, fire hazard
CO2	Collect, analyze and interpret the accidents data based on various safety techniques. CO3: Apply proper safety techniques on safety engineering and management
CO3	Apply proper safety techniques on safety engineering and management
CO4	Perform hazard analysis
CO5	Design the system with environmental consciousness by implementing safety regulation

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003

REFERENCE BOOKS:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005.
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

ME1744	TOTAL QUALITY MANAGEMENT AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To facilitate the understanding of quality management principles and process.
- Impart knowledge in reliability concepts

UNIT - I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Supplier partnership - Partnering, Supplier selection, Supplier Rating. CO1

UNIT - II TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils, Quality Circles - Employee involvement Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - TPM - Concepts. CO2

UNIT - III TQM TOOLS AND TECHNIQUES **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, Applications to manufacturing industry - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types, Performance measures, Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function. CO3

UNIT - IV RELIABILITY CONCEPTS **9**

Reliability definition - Quality and Reliability- Reliability mathematics - Reliability functions - Hazard rate - Measures of Reliability - Design life -A priori and posteriori probabilities - Mortality of a component - Mortality curve - Useful life. CO4

UNIT - V QUALITY MANAGEMENT SYSTEM **9**

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector-Specific Standards - AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements – Implementation – Documentation – Internal Audits - Registration. CO5

ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts of quality management
CO2	Apply the principles of quality management to manufacturing and services processes
CO3	Apply the traditional tools and techniques of quality management to manufacturing and services processes
CO4	Understand the basic concepts of reliability engineering
CO5	Understand the quality management and environmental management system in manufacturing and services processes

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Charles E. Ebeling, “An introduction to Reliability and Maintainability engineering”, TMH, 2000

REFERENCE BOOKS:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2007.
5. ISO 9001-2015 standards

ME1745	DESIGN FOR MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn design consideration principles of forming in the design of extruded, stamped, and forged products.
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles of assembly in the design of assembled products.

UNIT - I INTRODUCTION AND CASTING **9**

Introduction - Economics of process selection - General design principles for manufacturability; Design considerations for: Sand cast – Die cast – Permanent mold cast parts. CO1

UNIT - II FORMING **9**

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts –Forged parts. CO2

UNIT - III MACHINING **9**

Design considerations for: Turned parts – Drilled parts – Milled, planed, shaped and slotted parts– Ground parts. CO3

UNIT - IV WELDING **9**

Arc welding – Design considerations for: Cost reduction – Minimizing distortion – Weld strength – Weldment & heat treatment. Resistance welding – Design considerations for: Spot – Seam – Projection – Flash & Upset weldment CO4

UNIT - V ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the no. of parts – Design considerations for: Rivets – Screw fasteners – Gasket & Seals – Press fits – Snap fits – Automatic assembly. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.

CO2 Explain design consideration principles of forming in the design of extruded, stamped, and forged products.

CO3 Explain design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.

CO4 Explain design consideration principles of welding in the design of welded products.

CO5 Explain design consideration principles of assembly in the design of assembled products.

TEXT BOOKS:

1. James G. Bralla, “Handbook of Product Design for Manufacture”, McGraw Hill, 1986.
2. O. M olloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

REFERENCE BOOKS:

1. Corrado Poli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Henry Peck, “Designing for Manufacture”, Sir Isaac Pitman & Sons Ltd., 1973.
5. Matousek, “Engineering Design”, Blackie & Sons, 1956.

ME1746 DIGITAL MANUFACTURING AND IoT

L	T	P	C
3	0	0	3

OBJECTIVES

- To study the various aspects of digital manufacturing.
- To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
- To formulate of smart manufacturing systems in the digital work environment.
- To interpret IoT to support the digital manufacturing.
- To elaborate the significance of digital twin.

UNIT - I INTRODUCTION **9**

Introduction – Need – Overview of Digital Manufacturing and the Past – Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management – Practical Benefits of Digital Manufacturing – The Future of Digital Manufacturing. CO1

UNIT - II	DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT	9
	Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral. Overview of Digital Supply Chain - Scope& Challenges in Digital SC - Effective Digital Transformation - Future Practices in SCM	CO2
UNIT - III	**SMART FACTORY**	**9**
	Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity	CO3
UNIT - IV	**INDUSTRY 4.0**	**9**
	Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.	CO4
UNIT - V	**STUDY OF DIGITAL TWIN**	**9**
	Basic Concepts – Features and Implementation – Digital Twin: Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins.	CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Impart knowledge to use various elements in the digital manufacturing.
CO2	Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.
CO3	Select the proper procedure of validating practical work through digital validation in Factories.
CO4	Implementation the concepts of IoT and its role in digital manufacturing.
CO5	Analyse and optimize various practical manufacturing process through digital twin.

TEXT BOOKS:

1. Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.

REFERENCE BOOKS:

1. Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.
2. Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven Smart Manufacturing”, Elsevier Science., United States, 2019.
3. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2017
4. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018.
5. Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer., Switzerland, 2018.

ME1747	PRECISION MANUFACTURING	L T P C
		3 0 0 3

OBJECTIVES

- To study the need, significance and progress of precision manufacturing and the different levels of manufacturing.
- To study the principle and working of different methods of precision machining.
- To study the special construction requirements of precision machine tools.
- To study the errors involved in precision machine tools and calculate the error budgets for a given situation.
- To study the Selecting a suitable measurement solution to measure and characterize precision machined features.

UNIT - I PRECISION ENGINEERING		**9**
Introduction to Precision Engineering, Need for precision manufacturing, Taniguchi diagram, Four Classes of Achievable Machining Accuracy – Normal, Precision, High-precision, Ultra-precision Processes and Nanotechnology.		CO1
UNIT - II PRECISION MACHINING		**9**
Overview of Micro- and Nano-machining, Conventional micro machining techniques - micro-turning, micro-milling, micro-grinding, Ultra-precision diamond turning, Non-conventional micromachining techniques – abrasive jet and water jet micromachining, Ultrasonic micromachining, micro electrical discharge machining, photochemical machining, electro chemical micromachining, laser beam micromachining, Electron beam micromachining, Focused Ion Beam micromachining, etc.		CO2
UNIT - III MACHINE DESIGN FOR PRECISION MANUFACTURING		**9**
Philosophy of precision machine design, Ultra-Precision Machine Elements: Guide- ways, Drive Systems, Friction Drive, Linear Motor Drive, Spindle Drive. Bearings: Principle, construction and application of Rolling, Hydrodynamic and Hydrostatic Bearings, Aerostatic Bearings, Magnetic bearings.		CO3
UNIT - IV MECHANICAL AND THERMAL ERRORS		**9**
Sources of error, Principles of measurement, Errors due to machine elements, bearings, spindles, Kinematic design, Structural compliance. Vibration, Thermal errors – background, thermal effects, Environmental control of precision machinery. Error mapping and error budgets.		CO4
UNIT - V MEASUREMENT AND CHARACTERISATION		**9**
Optical dimensional metrology of precision features – Machine vision, Multi-sensor coordinate metrology, Laser Tracking Systems, Laser scanners, White-Light Interference 3D Microscopes, Focus-Based Optical Metrology- Fringe projection method, Measurement of Typical Nano features. Surface metrology - 3D surface topography - Need, Measurement – Chromatic confocal Microscopy, Interferometry, Non-optical Scanning Microscopy – Scanning electron Microscopes, Scanning probe microscopes, Parameters for characterizing 3D surface topography.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the need, significance and progress of precision manufacturing and the different levels of manufacturing.
CO2	Explain the principle and working of different methods of precision machining.
CO3	Explain the special construction requirements of precision machine tools.
CO4	Explain the errors involved in precision machine tools and calculate the error budgets for a given situation.
CO5	Select a suitable measurement solution to measure and characterize precision machined features.

TEXT BOOKS:

1. Jain , V.K., Introduction to micromachining, Narosa publishers, 2018
2. Venktesh V.C., SudinIzman, Precision Engineering, Tata Mc.Graw Hill Publishing Company, New Delhi 2007.

REFERENCE BOOKS:

1. David Dornfeld, Dae-Eun Lee, Precision Manufacturing, Springer, 2008.
2. Jain, V.K., Micro manufacturing Processes, CRC Press, 2012.
3. Joseph McGeough, Micromachining of Engineered Materials, Marcel Dekker Inc., 2002.
4. Kevin Harding, "Handbook of Optical Dimensional Metrology, Series: Series in Optics and optoelectronics", Taylor & Francis, 2013.
5. Murty, R.L., Precision Engineering in Manufacturing, New Age publishers, 2005.

ME1748	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the fundamentals of surface features and different types of friction associated with metals and non-metals
- To study the different types of wear mechanism and its standard measurement.
- To study the different types of corrosion and its preventive measures
- To study the different types of surface properties and surface modification techniques
- To study the various types of materials used in the friction and wear applications

UNIT - I SURFACES AND FRICTION **9**

Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact. CO1

UNIT - II WEAR **9**

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements CO2

UNIT - III CORROSION **9**

Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors CO3

UNIT - IV SURFACE TREATMENTS **9**

Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy – Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings CO4

UNIT - V ENGINEERING MATERIALS **9**

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe the fundamentals of surface features and different types of friction associated with metals and non-metals
CO2	Analyze the different types of wear mechanism and its standard measurement.
CO3	Analyze the different types of corrosion and its preventive measures
CO4	Analyze the different types of surface properties and surface modification techniques
CO5	Analyze the various types of materials used in the friction and wear applications.

TEXT BOOKS:

1. G.W .Stachowiak and A.W.Batchelor, "Engineering Tribology", Butterworth-Heinemann, 2005.
2. S.K. Basu, S.N.Sengupta and B.B.Ahuja ,"Fundamentals of Tribology", Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Fontana G., "Corrosion Engineering", McGraw Hill, 1985.
2. Halling, J. (Editor), "Principles of Tribology ", MacMillian, 1984.
3. Rabinowicz.E., "Friction and Wear of materials", John Willey &Sons,1995.
4. Williams J.A., "Engineering Tribology", Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

ME1751 ADVANCED INTERNAL COMBUSTION ENGINES

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc

UNIT - I SPARK IGNITION ENGINES **9**

Mixture requirements - Fuel injection systems - Mono point, Multipoint & Direct injection - Stages of combustion - Normal and Abnormal combustion - Knock - Factors affecting knock - Combustion chambers. CO1

UNIT - II COMPRESSION IGNITION ENGINES **9**

Diesel Fuel Injection Systems - Stages of combustion - Knocking - Factors affecting knock - Direct and Indirect injection systems - Combustion chambers - Fuel Spray behavior - Spray structure and spray penetration - Air motion - Introduction to Turbo-charging. CO2

UNIT - III POLLUTANT FORMATION AND CONTROL **9**

Pollutant - Sources - Formation of Carbon Monoxide, Un burnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter - Methods of controlling Emissions - Catalytic converters, Selective Catalytic Reduction and Particulate Traps - Methods of measurement - Emission norms and Driving cycles. CO3

UNIT - IV ALTERNATIVE FUELS **9**

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications. CO4

UNIT - V RECENT TRENDS **9**

Air assisted Combustion, Homogeneous charge compression ignition engines - Variable Geometry turbochargers - Common Rail Direct Injection Systems - Hybrid Electric Vehicles - NOx Adsorbers - Onboard Diagnostics. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Understand the performance & characteristics a S.I Engine
- CO2 Understand about various injection systems, Fuel spray behavior, Stages of combustion, Turbo charging, Combustion chambers and Knocking in C.I Engine
- CO3 Understand various pollutants and its formations, method of controlling Emissions, Methods of measurement, Emission norms and Driving cycles
- CO4 Understand various alternative fuels, their suitability and corresponding Engine Modifications
- CO5 Understand about the recent trends in I.C. Engine’s Injection Systems, Combustion, ignition, Hybrid Vehicles and Onboard Diagnostics

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.
3. John Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Education, 2017

REFERENCE BOOKS:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

ME1752 AUTOMOBILE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT - I AUTOMOTIVE ENGINE AUXILIARY SYSTEMS **9**

Automotive engines - External combustion engines -Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines - four stroke engines - construction and working principles - IC engine components - functions and materials - valve timing - port timing diagram- Injection system -Common Rail Direct injection system - Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines - CI engines-Ignition system - Electronic ignition system - Distributor less ignition system - Transistorized ignition system, capacitive discharge ignition system. CO1

UNIT - II VEHICLE STRUCTURE AND STEERING SYSTEM **9**

Vehicle construction and different Chassis layouts -classifications of chassis- types of frames - frameless chassis construction -articulated vehicles - vehicle body - Vehicle aerodynamics - various resistances and its effects - steering system - conventional - sophisticated vehicle- and types of steering gear box-Power Steering - Steering geometry-condition for true rolling motion-Ackermann's - types of stub axle - Types of rear axles. CO2

UNIT - III TRANSMISSION SYSTEMS **9**

Clutch - types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints - Hotchkiss Drive and Torque Tube Drive - rear axle - Differential-wheels and tyres. CO3

UNIT - IV SUSPENSION AND BRAKES SYSTEMS **9**

Suspension Systems - conventional Suspension Systems - independent Suspension Systems - leaf spring - shock absorber - coil spring - taper - lite - eligo,s spring Types of brakes - Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface. CO4

UNIT - V ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles - Engine modifications required - Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell. Turbo chargers - Engine emission control by three way catalytic converter system. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the construction and working of an IC Engine and its auxiliary systems as fuel injection and ignition systems

CO2 Understand the construction and working principle of various parts of an automobile. Especially about the frame structure, layout and about the steering mechanism and components

CO3 Know about the power train, the transmission right from the flywheel, clutch and knowing further about the gear box and till the propeller shaft till the differentials and wheels

CO4 Impart knowledge on the suspension system and vehicle control systems as brake and the recent advancements in the field, the application of electronic control unit in brake and traction control

CO5 Have idea about the alternate energy sources to propel the automobile: such as natural gas, LPG, electric and also to know about hybrid vehicles and the modification needed in the existing vehicles to suit the changes. Also about the treatment on emission. Also to have practice for assembling and dismantling of engine parts and transmission system

TEXT BOOKS:

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw Hill, 2012.
2. Jain K. K. and Asthana. R. B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2020

REFERENCE BOOKS:

1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East- West Press, 2004.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart -Will Cox Company Inc, USA, 2007.
4. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 2001

ME1753 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce Governing Equations of viscous fluid flows.
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers

UNIT - I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent Flow - Turbulent-Kinetic Energy Equations - Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations. CO1

UNIT - II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations - Simple Methods - General Methods for first and second order accuracy - Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems -Parabolic equations - Explicit and Implicit schemes - Example problems on elliptic and parabolic equations - Use of Finite Difference and Finite Volume methods. CO2

UNIT - III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes properties of discretization schemes - Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes. CO3

UNIT - IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants - PISO Algorithms. CO4

UNIT - V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Ɛ) models - High and low Reynolds number models - Structured Grid generation - Unstructured Grid generation - Mesh refinement - Adaptive mesh - Software tools. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Summarize the Governing equations of fluid dynamics
CO2	Create numerical modeling in finite difference and finite volume methods for diffusion and its role in the field of fluid flow and heat transfer
CO3	Create numerical modeling in finite difference and finite volume methods for convection diffusion and its role in the field of fluid flow and heat transfer
CO4	Understand the flow field in finite volume methods
CO5	Use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCE BOOKS:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005.
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. Prodip Niyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press,2005

GE1004	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about basis of nano material science, preparation method, types and application.

UNIT - I INTRODUCTION **9**

Nano scale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nano structured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). CO1

UNIT - II GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis - Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. CO2

UNIT - III NANOMATERIALS **9**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications. CO3

UNIT - IV CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS - Nano indentation. CO4

UNIT - V APPLICATIONS **9**

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS) - Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Acquire knowledge in general methods of preparation of nano materials.
CO3	Understand the Nano forms of Carbon and methods of synthesis
CO4	Acquire knowledge in characteristic nanomaterial on various technique.
CO5	Gain knowledge on various application of nano materials.

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

ME1754 MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the fundamentals of composite material strength and its mechanical behaviour.
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber
- Thermo-mechanical behaviour and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips

UNIT - I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING **9**

Definition - Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions - Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina - Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding - Pultrusion - Filament Winding - Other Manufacturing Processes. CO1

UNIT - II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS **9**

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations - Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates. CO2

UNIT - III LAMINA STRENGTH ANALYSIS **9**

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure. CO3

UNIT - IV THERMAL ANALYSIS		**9**
Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations - Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi- Isotropic Laminates.	CO4	
UNIT - V ANALYSIS OF LAMINATED FLAT PLATES		**9**
Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations - Natural Frequencies.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the various matrices, reinforcements and their combinations in composite materials
CO2	Understanding the analysis of fiber reinforced Laminate to derive Flat plate Laminate equations
CO3	Analyze Lamina strength of individual plies on the global and local axial, bending and twisting deformation of laminate
CO4	Analyze Thermo-mechanical behaviour and study of residual stresses in Laminates during processing
CO5	Implementation of Classical Laminate Theory (CLT) to analyse Laminate flat plates

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Fourth Edition, McGraw-Hill, CRC press, 2016.
2. Hyer, M.W., "Stress Analysis of Fiber - Reinforced Composite Materials", Destech Pubns Inc, 2008.

REFERENCE BOOKS:

1. Hyer, M.W., "Stress Analysis of Fiber - Reinforced Composite Materials", Destech Pubns Inc, 2008.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1992.
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007.
4. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", CRC Press, 2007.

MG1001	**PRINCIPLES OF MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To enable the students to study the evolution of management.
- To study the functions and principles of management
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication
- To gain the knowledge of tools and techniques for an effective managerial skill

UNIT - I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS		**9**
Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations , system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management.	CO1	

UNIT - II PLANNING		**9**
Nature and purpose of planning - planning process - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.	CO2	
UNIT - III ORGANISING		**9**
Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization - delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.	CO3	
UNIT - IV DIRECTING		**9**
Foundations of individual and group behavior - motivation - motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership - communication - process of communication - barrier in communication - effective communication -communication and IT.	CO4	
UNIT - V CONTROLLING		**9**
System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance - direct and preventive control - reporting.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the various terms and definitions related to management and organization
CO2	Acquire the skill of planning and various strategies of management in an organization
CO3	Understand the various hierarchies of management and also get an insight into an HR values in an organization management
CO4	Acquire the skills of leadership and understand the importance of communication to run an organization effectively
CO5	Analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

REFERENCE BOOKS:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 6th Edition 2017.

ME1755	CARBON FOOTPRINT ESTIMATION AND REDUCTION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce climate change and carbon footprint
- To study the principle of product life cycle and Green House Gas emissions accounting
- To study the Methodology for Carbon Footprint Calculation
- To learn emission mitigation and carbon sink
- To study the case study of carbon footprint.

UNIT - I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations CO1

UNIT - II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality- Allocation and Assessing Uncertainty CO2

UNIT - III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative CO3

UNIT - IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Polcies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing. CO4

UNIT - V CASE STUDIES 9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from Municipal Wastewater Treatment and Solid waste management CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the climate change and carbon footprint
CO2 Discuss the principle of product life cycle and Green House Gas emissions accounting
CO3 Explain the Methodology for Carbon Footprint Calculation
CO4 Discuss emission mitigation and carbon sink
CO5 Explain the case study of carbon footprint.

TEXT BOOKS:

1. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, by Subramanian Senthilkannan Muthu, Springer; Softcover reprint of the original 1st ed. 2014 edition (23 August 2016), ISBN-10 : 9811011737
2. Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, by Subramanian Senthilkannan Muthu, Springer Nature; 2014th edition (30 April 2014), ISBN-10 : 9814585742

REFERENCE BOOKS:

1. Subramanian, Senthil Kannan, Muthu (2016), Carbon Foot Print Handbook, CRC Press
2. Subramanian, Senthil Kannan, Muthu (2016), Environmental Carbon Foot Print Industrial case Studies, Butterworth Heinemann Publishers
3. World Resources Institute, Green House Gas Protocol - Product Life Cycle Accounting and Reporting Standard
4. ISO 14067 -2018, Green House gases and carbon footprint, Requirements and Guidelines for Quantification, International Organisation for Standardisation.
5. IPCC (2022) –Sixth Assessment Reports – Intergovernmental Panel on Climate Change, United Framework convention on Climate Change.

ME1756	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the fundamental concept and principles of industrial safety
- To study the principles of maintenance engineering.
- To Analyzing the wear and its reduction.
- To study the faults in various tools, equipments and machines.
- To study the periodic maintenance procedures in preventive maintenance.

UNIT - I INDUSTRIAL SAFETY	**9**	
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.		CO1
UNIT - II MAINTENANCE ENGINEERING	**9**	
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.		CO2
UNIT - III WEAR AND CORROSION AND THEIR PREVENTION	**9**	
Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.		CO3
UNIT - IV FAULT TRACING	**9**	
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler,vi. Electrical motors, Types of faults in machine tools and their general causes.		CO4
UNIT - V PERIODIC AND PREVENTIVE MAINTENANCE	**9**	
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the fundamental concept and principles of industrial safety
CO2	Apply the principles of maintenance engineering.
CO3	Analyze the wear and its reduction.
CO4	Evaluate faults in various tools, equipments and machines
CO5	Apply periodic maintenance procedures in preventive maintenance.

TEXT BOOKS:

1. L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.
2. Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

REFERENCE BOOKS:

1. Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2. Garg, HP, Maintenance Engineering, S. Chand Publishing.
3. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
4. R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5. W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

ME1757	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the working principle of Li-ion batteries and battery packs.
- To learn the thermal management system in battery modules.
- To develop the different case studies in battery thermal management system.
- To learn the working principle of fuel cells cooling methods.
- To learn the inside components of thermal management systems in various famous electric and fuel cell electric vehicles.

UNIT - I ADVANCED BATTERIES **9**

Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Supercapacitors Vs batteries. Diamond battery concepts. CO1

UNIT - II THERMAL MANAGEMENT IN BATTERIES **9**

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications. Tesla Model-S Battery Module- bonding techniques, thermal management. CO2

UNIT - III BATTERY THERMAL MANAGEMENT CASE STUDIES **9**

EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modelling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multiphysics- simulation concepts. CO3

UNIT - IV THERMAL MANAGEMENT IN FUEL CELLS **9**

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications. Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions. CO4

UNIT - V CASE STUDIES ON FUEL CELL AND BATTERIES **9**

Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations and case studies - Battery EVs Vs Fuel Cell EVs. FCV- Operating principle, High pressure hydrogen tank, Boost convertor, Hydrogen refuelling, Advanced Battery Case Studies - NiMH Battery. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss the different Li-ion batteries and fuel cell performances.
CO2	Design a battery pack with appropriate PCM.
CO3	Apply cooling models using Simulation
CO4	Estimate fuel economy.
CO5	Utilize different thermal management system approaches during real world usage.

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems'', Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles'', Wiley, 2015.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design'', CRC Press, 2005.
4. John G. Hayes and G. Abas Goodarzi, "Electric Powertrain", Wiley, 2018
5. Davide Andrea, "Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.

REFERENCE BOOKS:

1. Nag.P.K, "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Education, New Delhi, 2013.
2. "Vehicle thermal Management Systems Conference Proceedings", 1st Edition; 2013, Coventry Techno centre, UK
3. Younes Shabany," Heat Transfer: Thermal Management of Electronics Hardcover" 2010, CRC Press.
4. T. Yomi Obidi, "Thermal Management in Automotive applications", 2015, SAE International.
5. Jerry Sergent, Al Krum, "Thermal Management Handbook: For Electronic Assemblies Hardcover", 1998, Mc Graw- Hill.

ME1758	VALUE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the value engineering process and able to identify its functions within the process.
- To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes.
- To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle.
- To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
- To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT - I VALUE ENGINEERING BASICS **9**

Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis. CO1

UNIT - II VALUE ENGINEERING JOB PLAN AND PROCESS **9**

Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering. CO2

UNIT - III VALUE ENGINEERING TECHNIQUES **9**

Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC) CO3

UNIT - IV WORKSHEETS AND GUIDELINES **9**

Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking - Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion. CO4

UNIT - V VERSATILITY OF VALUE ENGINEERING **9**

Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.
CO2	Discuss the product and articulate it in various phases of value engineering
CO3	Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training
CO4	Apply querying theory and FAST to prefect a value engineering project implementation.
CO5	Develop various case studies related to value engineering project implementation.

TEXT BOOKS:

1. Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009 3Ed”, 2009.
2. Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”, SAGE Publications, 1st Edition, 2003.

REFERENCE BOOKS:

1. Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.
2. Richard Park., “Value Engineering A Plan for Invention”, CRC Press, 1998.
3. Arthur E. Mudge., “Value Engineering :A systematic approach", McGraw Hill, 1989.
4. Alphonse Dell'Isola., “Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations”, R.S. Means Company, 1997.
5. Lawrence D. Miles., “Techniques of Value Analysis and Engineering”, Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

ME1861	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT - I ENTREPRENEURSHIP **9**

Entrepreneur-Meaning and Importance - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth. CO1

UNIT - II MOTIVATION **9**

Major Motives Influencing an Entrepreneur - Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test - Stress Management, Entrepreneurship Development Programs - Need, Objectives. CO2

UNIT - III BUSINESS **9**

Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies. CO3

UNIT - IV FINANCING AND ACCOUNTING **9**

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation - Income Tax, Excise Duty - Sales Tax. CO4

UNIT - V SUPPORT TO ENTREPRENEURS **9**

Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know about the importance of entrepreneurship
CO2	Know about the problems faced and to get motivated
CO3	Know about the types of business and feasibility of the business
CO4	Know about the financial need and all about the income tax and excise duty
CO5	Know about the government policies

TEXT BOOKS:

1. Donald F Kuratko, “Entrepreneurship - Theory, Process and Practice”, 9 th Edition, Cengage Learning, 2014.
2. Khanka. S.S., “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

REFERENCE BOOKS:

1. EDII “Faulty and External Experts - A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, “Entrepreneurship” 8 th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2 nd Edition, Oxford University Press, 2011.

ME1862 INDUSTRIAL TRIBOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To gain knowledge of topography of various engineering material surfaces in the aspect of friction.
- To understand the various types of wear mechanism, lubrication methods and its theory.
- To gain knowledge on surface engineering theory and bearing materials

UNIT - I SURFACES AND FRICTION **9**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding friction - Adhesion- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction. CO1

UNIT - II WEAR **9**

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements. CO2

UNIT - III LUBRICANTS AND LUBRICATION TYPES **9**

Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto-hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication- Hydrostatic Lubrication. CO3

UNIT - IV FILM LUBRICATION THEORY **9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfield diagram. CO4

UNIT - V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS		**9**
Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the topography of various engineering material surfaces in the aspect of friction
CO2	Understand the various types of wear mechanism and its measurements for various engineering material
CO3	Understand the lubricants, lubrication types and it testing methods
CO4	Understand the fluid film lubrication theory
CO5	Understand the surface engineering theory and materials used for bearings

TEXT BOOKS:

1. A.Harnoy, " Bearing Design in Machinery "Marcel Dekker Inc, NewYork,2003.

REFERENCE BOOKS:

1. M.M.Khonsari & E.R.Booser, "Applied Tribology", John Willey & Sons, New York, 2001.
2. E.P.Bowden and Tabor.D., "Friction and Lubrication", Heinemann EducationalBooks Ltd., 1974.
3. A.Cameron, "Basic Lubrication theory", Longman, U.K.., 1981.
4. M.J.Neale (Editor), "Tribology Handbook", Newnes. Butter worth, Heinemann, U.K., 1995.

GE1001 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on design, geographical indication (GI), plant variety and layout design protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

UNIT - I INTRODUCTION		**9**
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad - Genesis and Development - the way from WTO to WIPO - TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations - Important examples of IPR.		CO1
UNIT - II REGISTRATION OF IPRs		**9**
Meaning and practical aspects of registration of Copyrights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.		CO2

UNIT - III AGREEMENTS AND LEGISLATIONS **9**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act. CO3

UNIT - IV DIGITAL PRODUCTS AND LAW **9**

Digital Innovations and Developments as Knowledge Assets - IP Laws, Cyber Law and Digital Content Protection - Unfair Competition - Meaning and Relationship between Unfair Competition and IP Laws - Case Studies. CO4

UNIT - V ENFORCEMENT OF IPRs **9**

Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get an adequate knowledge on patent and copyright for their innovative research works
CO2	Get an idea about the registration process of IPR
CO3	Study various agreements and Acts regarding IPR
CO4	Inculcate the knowledge on innovations, developments and IP laws
CO5	Gain the knowledge on enforcement and current issues

TEXT BOOKS:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, Lexis Nexis, 2017

REFERENCE BOOKS:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition,2017.
2. Prabuddha Ganguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

ME1863 LEAN SIX SIGMA

L	T	P	C
3	0	0	3

OBJECTIVES

- To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT - I LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS **9**

Historical Overview - Definition of quality - What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance - Six sigma and cultural changes - six sigma capability - six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing - assessment questions. CO1

UNIT - II THE SCOPE OF TOOLS AND TECHNIQUES		**9**
Tools for definition - IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter - Tools for measurement - Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis - Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving - Tools for improvement - Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis - Tools for control - Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.	CO2	
UNIT - III SIX SIGMA METHODOLOGIES		**9**
Design For Six Sigma (DFSS), Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership - Change Acceleration Process (CAP) - Developing communication plan - Stakeholder.	CO3	
UNIT - IV SIX SIGMA IMPLEMENTATION AND CHALLENGES		**9**
Tools for implementation - Supplier Input Process Output Customer (SIPOC) - Quality Function Deployment or House of Quality (QFD) - alternative approach - implementation - leadership training, close communication system, project selection - project management and team - champion training - customer quality index - challenges - program failure, CPQ vs six sigma, structure the deployment of six sigma - cultural challenge - customer/internal metrics.	CO4	
UNIT - V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS		**9**
Evaluation strategy - the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates - continuous improvement - lean manufacturing - value, customer focus, Perfection, focus on waste, overproduction - waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people - Kaizen - 5S.	CO5	
TOTAL PERIODS:		**45**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts of lean and six sigma
CO2	Apply the tools and techniques of process improvement for manufacturing and services processes
CO3	Understand methodologies of six sigma
CO4	Understand and steps of implementing six sigma
CO5	Understand the method of evaluation and improvement process of manufacturing

TEXT BOOKS:

1. Best Practices in Lean Six Sigma Process Improvement Richard Schonberger John Wiley & Sons, Inc. 2008.
2. Lean Six Sigma Statistics Alastair K. Muir, Ph.D. McGraw-Hill 2006.

REFERENCE BOOKS:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw - Hill 2003.
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000.
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, Author House, 2004.
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma: A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 20

ME1864 PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
- To know the logistics and supply chain management

UNIT - I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control - Types of production - job - batch and continuous - Product development and design - Marketing aspect - Functional aspects - Operational aspect - Durability and dependability aspect aesthetic aspect. Profit consideration - Standardization, Simplification & specialization - Break even analysis-Economics of a new design. CO1

UNIT - II WORK STUDY **9**

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards. CO2

UNIT - III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning - Extending the original product information-Value analysis - Problems in lack of product planning - Process planning and routing- Prerequisite information needed for process planning - Steps in process planning - Quantity determination in batch production-Machine capacity, balancing - Analysis of process capabilities in a multi product system. CO3

UNIT - IV PRODUCTION SCHEDULING **9**

Production Control Systems - Loading and scheduling-Master Scheduling-Scheduling rules - Gantt charts - Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling- Batch production scheduling - Product sequencing - Production Control systems - Periodic batch control-Material requirement planning Kanban - Two bin system Dispatching - Progress reporting and expediting- Manufacturing lead time - Techniques for aligning completion times and due dates. CO4

UNIT - V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory Control - Purpose of holding stock-Effect of demand on inventories - Ordering procedures. Ordering cycle system - Determination of Economic order uantity and economic lot size - ABC analysis - Fundamentals of MRP II and ERP. Definition of Logistics and SCM: Evolution, Scope, Importance - Supply chain stages and decision phases process view of a supply chain - Supply chain flows. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand production systems and their characteristics
CO2	Evaluate MRP and JIT systems against traditional inventory control systems
CO3	Understand basics of variability and its role in the performance of a production system
CO4	Analyze aggregate planning strategies
CO5	Apply forecasting and scheduling techniques to production systems

TEXT BOOKS:

1. James. B.Dilworth, "Operations management -Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2018.
3. Sunil Chopra, Peter Meindl, "Supply Chain Management: Strategy, Planning, and operation", 5th Edition, Pearson Education Limited 2013.

REFERENCE BOOKS:

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2017.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007
5. Melynk, Denzler, " Operations management - A value driven approach" Irwin Mcgraw hill
6. Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management - Text and cases" 1st Edition, Excel books 2019
9. Martin Christopher "Logistics & Supply Chain Management: Logistics & Supply Chain Management" FT Publishing International, 5th Edition, 2016
10. Heizer, Render & Munson "Principles of Operations Management: Sustainability and Supply Chain Management", 11th Edition Pearson 2020

GE1003 PROFESSIONAL ETHICS IN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To create awareness on professional ethics and human values.
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT - I HUMAN VALUES **9**

Morals, values and Ethics - Integrity - Work ethic - Service learning - Civic virtue - Respect for others - Living peacefully - Caring - Sharing - Honesty - Courage - Valuing time - Cooperation - Commitment - Empathy - Self confidence - Character - Spirituality - Introduction to Yoga and meditation for professional excellence and stress management. CO1

UNIT - II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self-interest - Customs and Religion - Uses of Ethical Theories. CO2

UNIT - III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law. CO3

UNIT - IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination. CO4

UNIT - V GLOBAL ISSUES **9**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership -Code of Conduct - Corporate Social Responsibility. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- CO1 Define the dimensions or senses of engineering ethics and describe the various theories of moral development
- CO2 Describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies
- CO3 Understand significance of safety and risk assessment when developing engineering products
- CO4 Understand the social responsibilities and intellectual property rights of engineers
- CO5 Understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 4th edition 2017.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 12th edition, 2011.

REFERENCE BOOKS:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 3rd edition, 2008.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 6th edition, 2019.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013
6. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011

ME1865 ADVANCED VEHICLE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the basic concepts of electric vehicle and their characteristics
- To introduce different types of motors and the selection of motor for vehicle applications.
- To acquaint the student with different sensors and systems used in autonomous and connected vehicles.
- To give an overview of networking with sensors and systems.
- To introduce the modern methods of diagnosing on-board the vehicle troubles.

UNIT - I ELECTRIC VEHICLES **9**

EV architectures, advantages and disadvantages, Electrical and mechanical energy storage technologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving. CO1

UNIT - II ELECTRIC VEHICLE MOTORS **9**

Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives. CO2

UNIT - III AUTONOMOUS AND CONNECTED VEHICLES **9**

Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System. CO3

UNIT - IV AUTOMOTIVE NETWORKING **9**

Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces. CO4

UNIT - V ON-BOARD TESTING **9**

Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Acquire an overview of electric vehicles and their importance in automotive.

CO2 Discuss the characteristics and the selection of traction motor.

CO3 Comprehend the vehicle-to-vehicle and autonomous technology.

CO4 Explain the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.

CO5 Be familiar with on-board diagnostics systems.

TEXT BOOKS:

1. John G Hayes and G AbaasGoodarzi, Electric Powertrain -, 1st Edition, John Wiley & Sons Ltd., 2018
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020.

REFERENCE BOOKS:

1. Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2007.
2. Hong Cheng, ―Autonomous Intelligent Vehicles: Theory, Algorithms & Implementation‖, Springer, 2011
3. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science, Engineering and Technology: Congressional Policies, Practices and Procedures)by Andrew M Wright and Harrison R Scott | 5 September 2012
4. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002
5. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011

ME1866	DESIGN CODES AND STANDARDS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the Codes and Standards and Need for them in the Industry
- To know the different sources and the bodies that publish Codes and Standards
- To familiarize the Government Regulations and its applicability
- To familiarize with different codes used in Different Industry
- To familiarize the Codes and Standards used in Process Industry

UNIT - I INTRODUCTION **9**

Introduction to Codes and Standards. What is code? What is Standard? Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices. CO1

UNIT - II CODES **9**

Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive. HVAC. Performance Test Codes. Other Discipline codes CO2

UNIT - III STANDARDS **9**

Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes. CO3

UNIT - IV REGULATIONS **9**

Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers CO4

UNIT - V DESIGN CODES **9**

Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explain the need for codes and Standards in Industry.
CO2 Discuss the different codes and standards used in different industry.
CO3 Discuss the sources of different codes and standards and the societies that publish them and how these are evolved
CO4 Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International
CO5 Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.

TEXT BOOKS:

1. Mechanical Engg. Handbook. ASME. ASTM.API
2. Perrys Chemical Engg Handbook

REFERENCE BOOKS:

1. ASME
2. API
3. ISO, IBR, OISD
4. AWS
5. ISHRAE

ME1867 DESIGN OF PRESSURE VESSELS

L	T	P	C
3	0	0	3

OBJECTIVES

- To introduce the Mathematical knowledge to design pressure vessels and piping
- To learn the ability to carry of stress analysis in pressure vessels and piping
- To study the design of vessels and theory of reinforcement.
- To study buckling and fracture analysis in vessels.
- To learn piping layout and flow diagram.

UNIT - I INTRODUCTION **9**

Methods for determining stresses – Terminology and Ligament Efficiency – Applications CO1

UNIT - II STRESSES IN PRESSURE VESSELS **9**

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels. CO2

UNIT - III DESIGN OF VESSELS **9**

Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design. CO3

UNIT - IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS **9**

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading. CO4

UNIT - V PIPING **9**

Introduction – Flow diagram – piping layout and piping stress Analysis. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain Methods for determining stresses Terminology and Ligament Efficiency, Applications
CO2	Analyse stress in pressure vessels
CO3	Design and analysis of pressure vessels.
CO4	Analysis of buckling and fracture analysis in vessels
CO5	Design and analysis piping layout and piping.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2. Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

REFERENCE BOOKS:
1. Henry H. Bedner, “Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2. Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.
5. Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. | 1 January 2001

ME1868	POWER GENERATION EQUIPMENT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES
- To introduce the power generation equipments types layouts working cycles.
- To learn the fuels, combustion and burning methods of combustion system.
- To study the various boilers and its boilers parts of steam power plant.
- To study the basics of nuclear fuels and reactor classification.
- To study of techno economics and operating cost and safety of power plant.

UNIT - I INTRODUCTION **9**

Introduction to types, layouts and working cycles - Layouts of diesel-electric, hydro-electric, nuclear, gas turbine, steam, cogeneration, MHD and other power plants - Site selection - Reheat and regenerative steam cycles - Binary vapour cycle - Combined cycle - Topping cycle - Power plant instrumentation and control - air flow, furnace pressure, steam temperature control system - Governing system - Steam turbine. CO1

UNIT - II COMBUSTION SYSTEM **9**

Fuels, combustion and burning methods - Fuel classification - Solid, liquid and gaseous - Compositions and heating values - Classification of coal - Combustion process, atmosphere and control - ESP Furnace construction - Stokers - suspension firing - pulverised fuel firing - oil and gas burners and systems - Fuel control - Burner management system - FSSS - Ash handling system. CO2

UNIT - III STEAM POWER PLANT **9**

Steam generators - fire tube, water tube, forced circulation, once through, super charged, super critical, Lamont, Loeffler, Schmide, Hortmen and Velox boilers, Fluidised Bed & Circulated Fluidised Bed boilers - Natural, artificial, balanced and steam jet drafts - Simple problems - Functions of super heaters, economisers, air-heaters, deaerators, feed heaters, air ejectors - Feed pumps - Injectors - Feed water control- Condensers – Jet and surface type - Simple problems - Cooling towers. CO3

UNIT - IV NUCLEAR POWER PLANT **9**

Nuclear power plant - Basics of nuclear fuels - Fission and chain reaction - Reactor classification - Boiling water, pressurised water, homogeneous, gas cooled breeding and metal cooled CO4

UNIT - V TECHNO ECONOMICS OF POWER PLANT **9**

Economics and safety - Actual load curves - Fixed and operating costs - Tariff methods for electrical energy - Peak load and variable load operations - Selection of generation type and general equipment. Introduction to safety aspects in power plants - Environmental impacts - assessment for thermal power plant. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Discuss the power generation equipments types layouts working cycles.
CO2	Explain the fuels, combustion and burning methods of combustion system.
CO3	Discuss the various boilers and its boilers parts of steam power plant.
CO4	Explain the basics of nuclear fuels and reactor classification.
CO5	Discuss of techno economics and operating cost and safety of power plant.

TEXT BOOKS:

1. Power Plant Engineering - PK Nag
2. A Textbook of Power Plant Engineering - Rajput

REFERENCE BOOKS:

1. Basics of Boiler and HRSG Design - Brad Buecker
2. Steam Plant Operation-Everett B. Woodruff,Herbert B. Lammers,Thomas F. Lammers
3. Nuclear Power Plant Design and Analysis Codes Development Validation and Application 2020 Edition by Jun Wang, Xin Li, Chris Allison, Judy Hohorst , Elsevier
4. A Techno-Economic Analysis of Solar Thermal Power Plant by Malik Monu and Saini R P | 8 November 2012
5. Power Plant Engineering by Dilip Vairagkar | 1 January 2019

OEC103	BASICS OF EMBEDDED SYSTEMS AND IOT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IOT

UNIT - I INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors- Embedded system design process - Design methodologies- Design flows - Requirement Analysis - Specifications-System analysis and architecture design - Quality Assurance techniques- Distributed embedded systems - MPSoCs and shared memory multiprocessors -Design example: Model train controller. CO1

UNIT - II ARM ARCHITECTURE AND PERIPHERAL INTERFACING 9

ARM Architecture Versions - ARM Architecture - Instruction Set - Stacks and Subroutines - Features of the LPC 214X Family - Peripherals - The Timer Unit - Pulse Width Modulation Unit - UART - Block Diagram of ARM9 and ARM Cortex M3 MCU CO2

UNIT - III EMBEDDED PROGRAMMING 9

Components for embedded programs- Models of programs - Assembly, linking and loading - compilation techniques - Program level performance analysis - Software performance optimization - Program level energy and power analysis and optimization - Analysis and optimization of program size - Program validation and testing CO3

UNIT - IV INTRODUCTION TO IOT 9

Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT, Embedded Systems and M2M - Industry 4.0 concepts- Passive and active sensors - Different applications of sensors - Multi-sensors - Pre-processing - IoT front-end hardware Case Studies - Smart Parking, Air Pollution Monitoring. CO4

UNIT - V	COMMUNICATION PROTOCOLS FOR EMBEDDED AND IOT	9
Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - URIs, Communication/ Transport - Wi-Fi, Bluetooth, ZigBee, LPWAN.		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the embedded system design process

CO2 Describe the architecture and programming of ARM processor

CO3 Outline the concepts of embedded system programming

CO4 Explain the basic concepts of IOT

CO5 Model Networked systems with basic protocols

TEXT BOOKS:

1. Marilyn Wolf, Computers as Components - Principles of Embedded Computing System Design‖, Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. ArshdeepBahga, Vijay Madisetti, “Internet of Things, A Hands-on-Approach”, 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons”, Inc, USA, 2013

REFERENCE BOOKS:

1. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, 1st Edition, John Wiley & Sons Ltd, UK, 2014
2. Peter Waher, “Learning Internet of Things”, 1st Edition, Packt Publishing Ltd, UK, 2015.
3. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi”, 1st Edition, Apress Publishers, USA, 2013.
4. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017.

OCS102	PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	2	4

OBJECTIVES

- To learn the basics of C programming
- To learn the advanced features of C programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT - I	C PROGRAMMING BASICS	9
Structure of C program - Data Types - Storage classes – Variables - Constants - Keywords - Operators - Input/Output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Introduction to Arrays: Declaration, Initialization - One dimensional array - Two dimensional arrays.		CO1
UNIT - II	**FUNCTIONS, POINTERS AND STRUCTURES**	**9**
Introduction to functions: Function prototype, function definition, function call, Recursion - Pointers - Pointer operators - Pointer arithmetic - Array of pointers - Parameter passing: Pass by value, Pass by reference. Structure - Nested structures - Pointer and Structures - Array of structures - Self-referential structures - Dynamic memory allocation.		CO2

UNIT - III LINEAR DATA STRUCTURES **9**

List - Singly Linked lists - Application of List - Polynomial addition - Linked list implementation of Stacks - Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues - Application of Queue. CO3

UNIT - IV NON-LINEAR DATA STRUCTURES **9**

Trees - Binary Trees - Binary tree representation and traversals - Binary Search Trees - Applications of trees. Graph and its representations - Graph Traversals - Topological Sort - Applications of graphs. CO4

UNIT - V SEARCHING, SORTING AND HASH TABLE **9**

Linear Search - Binary Search. Bubble Sort - Insertion sort - Merge sort - Quick sort - Hashing functions - Hash tables - Introduction to Overflow handling. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Implement basics of C.
CO2 Implement advanced features of C.
CO3 Apply the different linear data structures to problem solutions.
CO4 Implement Tree and Graph data structure.
CO5 Analyse the various sorting, searching algorithms and hash table.

TEXT BOOKS:

1. Reema Thareja, Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

OEE104 ELECTRIC VEHICLE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To familiarize about the significance of EV than conventional vehicles.
- To understand the concept of hybrid electric vehicles and its types with their performance.
- To understand the EV transmission and electric propulsion using various drives.
- To understand the various converter topologies for EV vehicle.
- To understand the different strategies related to battery technology and energy storage systems.

UNIT - I INTRODUCTION TO CONVENTIONAL AND ELECTRIC VEHICLES **9**

Conventional Vehicles: Internal combustion Engines-working principle, Engine Operation Characteristics, Emission Control. EV vehicles: EV system -configurations of EVs -Components of EV - Recent EVs and HEVs - EVs advantages - EVs market - Environmental Impact. CO1

UNIT - II HYBRID ELECTRIC VEHICLES **9**

Concept of Hybrid Electric drive, Types of Hybrid, Architectures of Hybrid Electric Drive Trains, Design of HEV, Plug-in Hybrid Electric Vehicles (PHEVs), Fuel Cell Electric Vehicles (FCEVs), Comparison of Different Vehicle Specifications CO2

UNIT - III	**ELECTRIC TRAINS AND PROPULSION**		**9**
EV Transmission configurations, Transmission components, Ideal Gearbox: Steady State Model, EV Motor Sizing. Electric Propulsion: DC motor drives, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, Configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives.			CO3
UNIT - IV	**POWER ELECTRONIC CONVERTER TOPOLOGIES FOR EV/PHEV CHARGING**		**9**
Power converter topology, Grid and Photovoltaic (PV) System for EV/PHEV Charging, Design of DC/DC Converters and DC/AC Inverters for Grid/PV, Integrated converter, With and without Transformer Based Isolated Charger topology.			CO4
UNIT - V	**POWER SOURCES AND ENERGY STORAGE**		**9**
Battery Technologies - Analysis: Lead-Acid Battery, Nickel-Based Batteries, Lithium-Based Batteries - Battery parameters, Fuel cell - types and characteristics, Ultra capacitors based energy storage and its analysis, Ultra-High-Speed Flywheels based energy storage and its analysis, Hybridization of energy storage devices.			CO5
		TOTAL PERIODS:	**45**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the significance of electric vehicle compared to conventional vehicles.
CO2 Understand the concept of hybrid electric vehicles architecture with their performance.
CO3 Acquire the knowledge in EV transmission and electric propulsion using various drives train.
CO4 Design the various converter topologies for EV vehicle.
CO5 Analyse different strategies related to battery technology and energy storage systems.

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. Iqbal Husain, “Electric and Hybrid vehicles:Design fundamentals”, CRC PRESS, Boca Raton London, New York Washington, D.C,2005.

REFERENCE BOOKS:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.
4. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
5. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
6. Gregory L.Plett, “Battery Management systems”, ARTECH House,London,2016.

OCE103 ENVIRONMENTAL IMPACT ASSESSMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To impart knowledge on Environmental management and Environmental Impact Assessment.

UNIT - I INTRODUCTION 9

Impact of development projects - EIA Notifications - Urbanization – Meaning - Activities involved - Effects on environment-Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS). CO1

UNIT - II METHODOLOGIES 9

Methods of EIA – Checklists - Matrices-Networks - Cost-benefit analysis - Analysis of alternatives - Uncertainty in EIA. CO2

UNIT - III PREDICTION AND ASSESSMENT 9

Assessment of Impact on land, water, air, social & cultural activities and on flora& Fauna - Mathematical models - Public participation - SIA Judgment authorities - Rapid EIA. CO3

UNIT - IV ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on environment - Options for mitigation of impact on water, air, land and on flora & fauna - Addressing the issues related to the Project Affected People CO4

UNIT - V CASE STUDIES 9

EIA for infrastructure projects – Dams - Highways- Multi-storey Buildings - Water Supply and Drainage Projects - Waste water treatment plants, STP. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Carry out scoping and screening of developmental projects for environmental and social assessments
CO2	Explain different methodologies for environmental impact prediction and assessment
CO3	Plan environmental impact assessments and environmental management plans
CO4	Evaluate environmental impact assessment reports
CO5	Understand the Membrane Applications.

TEXT BOOKS:

1. Canter,R.L., “Environmental Impact Assessment”, McGraw-Hill Inc., New Delhi,1996.
2. Richard K. Morgan., “Environmental Impact Assessment”, Kluwer Academic Publications, London, 2002.

REFERENCE BOOKS:

1. John G. Rauand David C Hooten (Ed).,“Environmental Impact Analysis Handbook”, McGraw-Hill BookCompany,1990.
2. “Environmental Assessment Sourcebook”, Vol. I, II & III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I & II”, Blackwell Science, 1999.

OCH101 FUNDAMENTALS OF COMBUSTION

L	T	P	C
3	0	0	3

OBJECTIVES

- To make the student understand the fundamentals of combustion
- To teach them combustion in different regions like basic flame to gas turbine engines to rocket engines and finally how it is done in supersonic speed

UNIT - I INTRODUCTION TO COMBUSTION **9**

Thermo-chemical equations - Heat of formation - Activation energy - Multi-step reactions - Heat of reaction - first order, second order and third order reactions - Calculation of adiabatic flame temperature CO1

UNIT - II BASICS OF CHEMICAL KINETICS AND FLAMES **9**

Premixed flames - Diffusion flames -measurement of burning velocity - various methods - Effect of various parameters on burning velocity - flame stability - Deflagration - Detonation – Rankine - Hugoniot curve - Radiation by flames. CO2

UNIT - III COMBUSTION IN GAS TURBINE ENGINES **9**

Combustion in gas turbine combustion chambers - Recirculation - combustion efficiency, Factors affecting combustion efficiency - Fuels used for gas turbine combustion chambers - combustion stability - Flame holder types. CO3

UNIT - IV COMBUSTION IN ROCKETS **9**

Solid propellant grain types - types of solid propellant burning in rocket combustion chambers - basic mechanism of composite propellant combustion - solid propellant burn rate laws - criterion for stable combustion - combustion in liquid rocket engines - single fuel droplet combustion model - combustion in hybrid rockets. CO4

UNIT - V SUPERSONIC COMBUSTION (Qualitative Treatment only) **9**

Introduction - supersonic combustion controlled by diffusion, mixing and heat convection - Analysis of reactions and mixing processes - supersonic burning with detonation shocks . CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the detailed mechanism of combustion process
CO2	Analyse and impart the chemical kinetics and flames in combustion processes.
CO3	Understand the detailed mechanism of Aerospace Vehicles and Aircraft Engines
CO4	Analyse and impart the combustion processes that occur in Aircraft Engines and Rocket Vehicles.
CO5	Understand the supersonic combustion

TEXT BOOKS:

1. Sharma, S.P., and Chandra Mohan, “Fuels and Combustion”, Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.
2. D.P. Mishra, Fundamentals of Combustion, Prentice Hall of India, New Delhi, 2008.
3. Kuo K.K., “Principles of Combustion” John Wiley and Sons, 2005.
4. Strehlow R A., “Fundamentals of combustion”, McGraw Hill Book Company, 1984.

REFERENCE BOOKS:

1. Beer, J.M., and Chiierar, N.A. “Combustion Aerodynamics”, Applied Science Publishers Ltd., London, 1981.
2. Chowdhury, R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986.
3. Loh, W.H.T., “Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design, Springer Verlag, New York, 1982.
4. Mathur, M.L. and Sharma, R.P., “Gas Turbine, Jet and Rocket Propulsion”, Standard Publishers & Distributors, Delhi, 2nd edition 2014.
5. Sutton,G.P., Rocket Propulsion Elements, John Wiley, 1993.

OEE108 RENEWABLE ENERGY TECHNOLOGIES

L	T	P	C
3	0	0	3

OBJECTIVES

- At the end of the course, the students are expected to identify new methodologies / technologies for effective utilization of renewable energy sources.

UNIT - I ENERGY SCENARIO AND OCEAN ENERGY **9**

Conventional and non-conventional energy resources - Introduction, availability, classification, relative merits and demerits - Role of energy in economic development and social transformation: Energy &GDP, GNP and its dynamics - Energy Sources and Overall Energy demand and Availability - Energy Consumption in various sectors and its changing pattern. CO1

OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT - II BIO-ENERGY **9**

Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass - bio diesel production - Urban waste to energy conversion - Biomass energy programme in India. CO2

UNIT - III GEOTHERMAL ENERGY AND MHD **9**

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India. Thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance, and limitations. Cells: Principle of working of various types of fuel cells and their working, performance, and limitations. CO3

UNIT - IV SOLAR AND WIND ENERGY **9**

Solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc - solar PV power plant - Net metering concept

Wind energy conversion devices - classification, characteristics, applications - offshore wind energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India, horizontal and vertical axis windmills, performance characteristics, Betz criteria. CO4

UNIT - V ENERGY FORECASTING MODEL **9**

Forecasting Techniques - Regression Analysis - Double Moving Average - Double Experimental Smoothing - Triple Exponential Smoothing - ARIMA model - Validation techniques - Qualitative forecasting - Delphi technique - Concept of Neural Net Works. Applications of IoT, AI and Machine learning for energy resources assessment. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the energy scenario and ocean energy.
CO2	Acquire knowledge of biomass energy conversion techniques.
CO3	Understand geothermal energy recovery and principles of MHD, fuel cell.
CO4	Acquire knowledge of solar and wind energy conversion systems.
CO5	Carry out forecasting to predict energy demand

TEXT BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011.
2. Twidell& Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011.

REFERENCE BOOKS:

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2011.
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2010.
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2010.
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

OCS105 DATA ANALYTICS WITH R PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT - I INTRODUCTION TO DATA ANALYSIS		**9**
Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics	CO1	
UNIT - II R PROGRAMMING BASICS		**9**
Overview of R programming, Environment setup with R Studio, R Commands,Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages	CO2	
UNIT - III DATA VISUALIZATION USING R		**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Histograms, Box plots, Bar Charts, Line Graphs, Scatter plots, Pie Charts	CO3	
UNIT - IV STATISTICS WITH R		**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression	CO4	
UNIT - V PRESCRIPTIVE ANALYTICS		**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

TEXT BOOKS:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W.N.Venables, D.M.Smith and the R Development Core Team.
2. URL:https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS:

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R. L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No.1. NewYork: Springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley & Sons, 2010
7. Joseph F Hair,William C Black et al, "Multivariate Data Analysis", Pearson Education,7 th edition, 2013.
8. Mark Gardener,"Beginning R- The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

OEI104	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand general concepts of Internet of Things (IoT) (Understand)
- To Recognize various devices, sensors and applications (Knowledge)
- Analyze and Apply design concept to IoT solutions (Apply)
- Evaluate design issues in IoT applications (Evaluate)
- Create IoT solutions using sensors, actuators and Devices (Create)

UNIT - I INTRODUCTION TO IoT	**9**
Internet of Things – Physical Design – Logical Design – IoT Enabling Technologies - IoT Levels & Deployment Templates – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF-YANG - IoT Platforms Design Methodology	CO1
UNIT - II IoT ARCHITECTURE	**9**
M2M high-level ETSI architecture – IETF architecture for IoT- OGC architecture - IoT reference model – Domain model – information model – functional model - Communication model – IoT reference architecture	CO2
UNIT - III IoT PROTOCOLS	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4– BAC Net Protocol – Modbus – Zigbee Architecture – Network layer – 6 Low PAN –CoAP – Security	CO3
UNIT - IV BUILDING IoT WITH RASPBERRY PI & ARDUINO	**9**
Building IOT with RASPERRY PI – IoT Systems – Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device - Building blocks - Raspberry Pi -Board - Linux on Raspberry Pi – Raspberry Pi Interfaces – Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.	CO4

UNIT - V CASESTUDIES AND REAL WORLD APPLICATIONS		**9**
Real world design constraints – Applications – Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs–Cloud for IoT – Amazon Web Services for IoT.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze various protocols for IoT
CO2	Develop web services to access/control IoT devices.
CO3	Design a portable IoT using Rasperry Pi
CO4	Deploy an IoT application and connect to the cloud.
CO5	Analyze applications of IoT in real time scenario statistics

TEXT BOOKS:

1. Arshdeep Bahga,Vijay Madisetti,―Internet of Things – A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds),―Architecting the Internet of Things, Springer, 2011.

REFERENCE BOOKS:

1. Honbo Zhou,―The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
2. Jan Höller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi,―The Internet of Things – Key applications and Protocols, Wiley, 2012.

OCS108	INTRODUCTION TO PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of python programming.
- To learn control structures in python.
- To decompose programs in Python into functions and use Strings.
- To construct programs in Collection classes.
- To develop python programs using files and exception handling.

UNIT – I INTRODUCTION TO PYTHON PROGRAMMING		**9**
Introduction to Python, Demo of Interactive and script mode, Tokens in Python – Variables, Keywords, Comments, Literals, Data types, Indentation, Operators and its precedence, Expressions, Input and Print functions, Type Casting.	CO1	
UNIT – II CONTROL STRUCTURES		**9**
Control Structures: Selective statements – if, if-else, nested if, if – elif ladder statements; Iterative statements - while, for, range functions, nested loops, else in loops, break, continue and pass statements.	CO2	

UNIT – III FUNCTIONS AND STRINGS **9**

Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion and Lambda functions. CO3
Strings: string slices, immutability, string functions and methods, string module. Regular expression: Matching the patterns, Search and replace.

UNIT – IV COLLECTIONS **9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations. Dictionary: Create, add, and replace values, operations on dictionaries. Sets: Create and operations on set. CO4

UNIT – V FILES AND EXCEPTION HANDLING **9**

Files: Open, Read, Write, Append and Close. Tell and seek methods. Illustrative programs: word count, copy file. CO5
Command line arguments, Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, Exception Chaining, User-defined Exceptions, Defining Clean-Up actions.

TOTAL PERIODS: 45

TEXT BOOKS

1. Allen B. Downey, ―Think Python: How to Think Like a Computer Scientist , 2nd Edition, Updated for Python 3, Shroff/O‗Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr,――An Introduction to Python ―Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, **I**ntroduction to Computation and Programming Using Python‗, Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.
5. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem – Solving Focus,Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction.

COURSEOUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple console application in python.
CO2 Develop and execute simple Python programs using conditionals and loops for solving problems.
CO3 Express proficiency in the handling of strings and functions
CO4 Represent compound data using python lists, tuples and dictionaries.
CO5 Read and write data from/to files in Python.

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on the principle and design of particulate/gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT - I AIR QUALITY MONITORING		**9**
Structure and composition of Atmosphere - Definition, Scope and Scales of Air Pollution - Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility - Ambient Air Quality and Emission standards - Composition of Particulate and Gaseous Pollutants.		CO1
UNIT - II EFFECT OF ATMOSPHERIC DISPERSION		**9**
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns - Atmospheric Diffusion Theories - Dispersion models, Plume rise		CO2
UNIT - III PARTICULATE CONTAMINANTS		**9**
Gas Particle Interaction - Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators - Operational Considerations - Factors affecting Selection of Control Equipment.		CO3
UNIT - IV GASEOUS CONTAMINANTS		**9**
Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters - Process control and Monitoring - Operational Considerations - Factors affecting Selection of Control Equipment -CO2 capturing.		CO4
UNIT - V INDOOR AIR QUALITY MONITORING		**9**
Sources, types and control of indoor air pollutants, sick building syndrome types - Sources and Effects of Noise Pollution- Standards - Control and Preventive measures.		CO5
	TOTAL PERIODS:	**45**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the chemistry of the atmosphere, characterize the air pollutants, know the effects of air pollution, identify the criteria air pollutants, and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and the Gaussian plume dispersion model
CO3	Select a suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies”, Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C.Stern, "Air Pollution (Vol.I - Vol. VIII)" , Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc., 2000.

OCS104 FUNDAMENTALS OF DATABASE DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of transaction processing and concurrency
- To have an basic knowledge about the storage implementation and query processing
- To understand database security concepts and database programming

UNIT - I INTRODUCTION **10**

Purpose of Database System - Views of data - Data Models - Database System Architecture - Introduction to relational databases - Relational Model - Keys - Relational Algebra - SQL fundamentals - DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL – Static Vs Dynamic SQL CO1

UNIT - II DATABASE DESIGN **10**

Entity-Relationship model - E-R Diagrams - Enhanced-ER Model - ER-to-Relational Mapping - Functional Dependencies - Non-loss Decomposition - First, Second, Third Normal Forms, Dependency Preservation - Boyce/Codd Normal Form - Multi-valued Dependencies and Fourth Normal Form - Join Dependencies and Fifth Normal Form CO2

UNIT - III TRANSACTION CONCEPTS AND CONCURRENCY CONTROL **7**

Introduction-Properties of Transaction - Serializability- Concurrency Control - Locking Mechanisms- Two Phase Locking - Two Phase Commit Protocol - Dead lock - SQL Facilities for Concurrency and Recovery CO3

UNIT - IV IMPLEMENTATION TECHNIQUES **9**

RAID - File Organization - Organization of Records in Files - Indexing and Hashing -Ordered Indices - B+ tree Index Files - B tree Index Files - Static Hashing - Dynamic Hashing - Query Processing Overview - Query optimization using Heuristics and Cost Estimation. CO4

UNIT - V ADVANCED TOPICS AND DATABASE PROGRAMMING **9**

security issues - Discretionary access control - role based access - Encryption and public key infrastructures - challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL/Oracle. ODBC/JDBC connectivity with front end tools CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand relational data model, evolve conceptual model of a given problem and SQL

CO2 Understand relational model and normalization to perform database design effectively

CO3 Apply and relate the concept of transaction, concurrency control and recovery in database

CO4 Understand the implementation technique and query processing

CO5 Understand the concepts of database security and database programming

TEXT BOOKS:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges;
- To have knowledge on the various virtualization techniques that serve in computation. and storage services on the cloud.
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT - I INTRODUCTION **9**

Introduction to Cloud Computing - Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing - Challenges and Risks of Cloud Computing CO1

UNIT - II VIRTUALIZATION **9**

Introduction to Virtualization Technology - Load Balancing and Virtualization - Understanding Hypervisor and its types, Types of Virtualizations - Hardware, OS, Memory, Application Virtualization, Levels of Virtualization CO2

UNIT - III CLOUD ARCHITECTURE, SERVICES AND STORAGE **9**

NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges - Deployment models of cloud, Services of cloud - Cloud Storage. CO3

UNIT - IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD **9**

Inter Cloud Resource Management - Resource Provisioning Methods - Security Overview - Cloud Security Architecture-Cloud Security Challenges - Data Security - Application Security - Virtual Machine Security. CO4

UNIT - V CASE STUDIES **9**

Google App Engine (GAE) - GAE Architecture - Functional Modules of GAE - Amazon Web Services (AWS) - GAE Applications - Cloud Software Environments - Bio-data Platform & Bio Cloud CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

TEXT BOOKS:

3. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
4. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

REFERENCE BOOKS:

6. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
8. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the functions of the basic components of a Robot
- To study the use of various drive systems and types of End Effectors
- To gain knowledge on the types of sensors and machine vision
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics

UNIT - I FUNDAMENTALS OF ROBOT **9**

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Payload - Robot Parts and their Functions - Need for Robots - Different Applications CO1

UNIT - II ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - D.C. Servo Motors, Stepper Motors, A.C. Servo Motors - Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations CO2

UNIT - III SENSORS AND MACHINE VISION **9**

Requirements of a sensor, Principles and Applications of the following types of sensors - Position sensors - Piezoelectric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, CO3

Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data - Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis - Data Reduction, Segmentation, Feature Extraction, Object recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT - IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End Effector commands and simple Programs. CO4

UNIT - V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the functions of the basic components of a Robot.

CO2 Study the different types of drive system and various types of End Effectors

CO3 Understand the working of sensors and machine vision system

CO4 Familiarize with the kinematics motions of robots and to develop robotic programs for different tasks.

CO5 Examine the implementation of robots in various industrial sectors and economic analysis of Robots

TEXT BOOKS:

1. Groover M.P., Industrial Robotics -Technology, Programming and Applications‖, McGraw Hill Education, 2017.
2. Klafter R.D., Chmielewski T.A and Negin M., Robotic Engineering - An Integrated Approach‖, Prentice Hall, 2003.

REFERENCE BOOKS:

1. Deb S.R., Robotics Technology and Flexible Automation‖ Tata McGraw Hill Book Co., 2013.
2. Ray Asfahl. C., Robots and Manufacturing Automation‖, John Wiley & Sons Inc., 1985.
3. Janakiraman P.A., Robotics and Image Processing‖, Tata McGraw Hill, 1995.

OEI101 SENSORS AND TRANSDUCERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

UNIT - I INTRODUCTION **9**

Basics of Measurement - Classification of errors - Error analysis - Static and dynamic characteristics of transducers - Performance measures of sensors - Classification of sensors - Sensor calibration techniques - Sensor Output Signal Types CO1

UNIT - II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT - RVDT - Synchro - Microsyn, Accelerometer - GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). CO2

UNIT - III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors - types, principle, requirement and advantages: Magneto resistive - Hall Effect - Current sensor Heading Sensors - Compass, Gyroscope, Inclinometers. CO3

UNIT - IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors - Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC, Thermistor, RTD, Thermocouple. Acoustic Sensors - flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors. CO4

UNIT – V SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification - Filtering - Sample and Hold circuits - Data Acquisition: Single channel and multi channel data acquisition - Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Expertise in various calibration techniques and signal types for sensors.

CO2 Apply the proximity and ranging sensors in the automotive and mechatronics applications.

CO3 Understand the principles of various magnetic and heading sensors.

CO4 Understand the functioning of optical, pressure, temperature and smart sensors.

CO5 Implement the DAQ systems with different sensors for real time applications.

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems - Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawhney A K and Puneet Sawhney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

OEE107	SOLAR AND WIND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand types and applications of various form of energy sources and its environmental impacts
- To attain a broad comprehension of solar photovoltaic systems used for various applications.
- To understand and estimate performance of wind turbine

UNIT - I INTRODUCTION OF SOLAR ENERGY	**9**	
Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors - solar thermal applications - heating, cooling, desalination, drying, cooking, etc - solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells	CO1	
UNIT - II SOLAR PHOTOVOLTAIC TECHNOLOGY	**9**	
Photovoltaic basics - structure and working of solar cells - types, electrical properties and behaviour of solar cells - cell properties and design, stand alone PV systems - schematics, components, batteries, charge conditioners, grid connected PV systems - schematics, components, charge conditioners, interface components, hybrid systems - solar, biomass, wind, diesel hybrid systems, design of PV systems - radiation and load data, simple case studies.	CO2	
UNIT - III PHOTOVOLTAIC APPLICATIONS	**9**	
Battery charger, domestic lighting, street lighting, water pumping etc - Solar PV power plant - Net metering concept. National / International PV Power Programmes - Photovoltaic Power Systems - System Integration - Energy Storage - Power Electronics - Stand-Alone Systems - Grid-Connected Systems - Concentrating Photovoltaics (CPV) - Electrical Performance. Applications of IoT and Machine learning for SPV applications.	CO3	
UNIT - IV WIND ENERGY	**9**	
Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications - offshore wind energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India - Repowering concept.	CO4	
UNIT - V AERODYNAMICS AND PERFORMANCE OF WIND TURBINE	**9**	
Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Power Developed, Maximum power coefficient (Betz Limit), Thrust, Efficiency, Rotor selection Rotor design considerations, Diameter of the Rotor. Aerodynamic design principles, Blade Profile, Blade Element Theory, Choice of the number of blades, Choice of the Pitch angle, Tip speed ratio, Power speed characteristics, Torque speed characteristics, Solidity. Applications of IoT and Machine learning for wind turbines performance assessment.	CO5	

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of solar energy and its measurements applications
CO2	Understand the fundamentals of solar photovoltaic technology and design different SPV systems
CO3	Understand the application of solar photovoltaic technologies
CO4	Understand the wind resource assessment and conversion systems
CO5	Analyse wind turbine performance with regard to aerodynamics

TEXT BOOKS:

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984
2. Twidell& Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011 G.D. , “Non-Conventional Energy Sources”,

REFERENCE BOOKS:

1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011
2. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2011
3. Ramesh R & Kumar K.U , “Renewable Energy Technologies”, Narosa Publishing House, 2010
4. Mittal K M , “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2010
5. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010.

OEE102	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of drone concepts
- To learn and understand the fundaments of design, fabrication and programming of drone
- To impart the knowledge of an flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

UNIT - I INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability CO1

UNIT - II DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection. CO2

UNIT - III DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications CO3

UNIT - IV DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing CO4

UNIT - V FUTURE DRONES AND SAFETY **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know about a various type of drone technology, drone fabrication and programming.
CO2	Execute the suitable operating procedures for functioning a drone
CO3	Select appropriate sensors and actuators for Drones
CO4	Develop a drone mechanism for specific applications
CO5	Create the programs for various drones

TEXT BOOKS:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation", 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc, 2016

REFERENCE BOOKS:

1. John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
2. Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance", Springer, 2018.

OCS107	MACHINE LEARNING FOR INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce basic machine learning techniques such as regression, classification
- To learn about introduction of clustering, types and segmentation methods
- To learn about fuzzy logic, fuzzification and defuzzification
- To learn about basics of neural networks and neuro fuzzy networks.
- To learn about Recurrent neural networks and Reinforcement learning.

UNIT - I INTRODUCTION TO MACHINE LEARNING **9**

Philosophy of learning in computers, Overview of different forms of learning, Classifications vs. Regression, Evaluation metrics and loss functions in Classification, Evaluation metrics and loss functions in Regression, Applications of AI in Robotics. CO1

UNIT - II CLUSTERING AND SEGMENTATION METHODS **9**

Introduction to clustering, Types of Clustering, Agglomerative clustering, K-means clustering, Mean Shift clustering, K-means clustering application study, Introduction to recognition, K-nearest neighbor algorithm, KNN Application case study, Principal component analysis (PCA), PCA Application case study in Feature Selection for Robot Guidance. CO2

UNIT - III FUZZY LOGIC **9**

Introduction to Fuzzy Sets, Classical and Fuzzy Sets, Overview of Classical Sets, Membership Function, Fuzzy rule generation, Fuzzy rule generation, Operations on Fuzzy Sets, Numerical examples, Fuzzy Arithmetic, Numerical examples, Fuzzy Logic, Fuzzification, Fuzzy Sets, Defuzzification, Application Case Study of Fuzzy Logic for Robotics Application CO3

UNIT - IV NEURAL NETWORKS **9**

Mathematical Models of Neurons, ANN architecture, Learning rules, Multi-layer Perceptrons, Back propagation, Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks, Application Case Study of Neural Networks in Robotics CO4

UNIT - V RNN AND REINFORCEMENT LEARNING **9**

Unfolding Computational Graphs, Recurrent neural networks, Application Case Study of recurrent networks in Robotics, Reinforcement learning, Examples for reinforcement learning, Markov decision process, Major components of RL, Q-learning. Application Case Study of reinforcement learning in Robotics CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand basic machine learning techniques such as regression, classification
CO2	Understand about clustering and segmentation
CO3	Model a fuzzy logic system with fuzzification and defuzzification
CO4	Understand the concepts of neural networks and neuro fuzzy networks.
CO5	Gain knowledge on Reinforcement learning.

TEXT BOOKS:

1. Micheal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Addision Wesley, England, 2011

REFERENCE BOOKS:

1. Bruno Siciliano, Oussama Khatib, "Handbook of Robotics", 2016 2nd Edition, Springer
2. Simon Haykin, "Neural Networks and Learning Machines: A Comprehensive Foundation", Third Edition, Pearson, delhi 2016.
3. Timothy J Ross, "Fuzzy Logic with Engineering Applications", 4th Edition, Chichester, 2011, Sussex Wiley.

AD1001 CONSTITUTION OF INDIA

L	T	P	C
2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT - I INTRODUCTION **9**

History of Making of the Indian Constitution - Drafting Committee - (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features CO1

UNIT - II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies Directive Principles of State Policy - Fundamental Duties CO2

UNIT - III ORGANS OF GOVERNANCE **9**

Parliament – Composition - Qualifications and Disqualifications - Powers and Functions - Executive President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions CO3

UNIT - IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency CO4

UNIT - V LOCAL ADMINISTRATION **9**

District's Administration head - Role and Importance – Municipalities – Introduction - Mayor and role of Elected Representative - CEO of Municipal Corporation - Pachayati raj - Introduction - PRI - Zila Pachayat-Elected officials and their roles - CEO Zila Pachayat - Position and role-Block leve - lOrganizational Hierarchy (Different departments) - Village level - Role of Elected and Appointed officials - Importance of grass root democracy CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand history and philosophy of Indian Constitution.

CO2 Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

CO3 Understand powers and functions of Indian government.

CO4 Understand emergency rule.

CO5 Understand structure and functions of local administration.

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT - I INTRODUCTION TO VALUE EDUCATION **9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments CO1

UNIT - II IMPORTANCE OF VALUES **9**

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline CO2

UNIT - III INFLUENCE OF VALUE EDUCATION **9**

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth. CO3

UNIT - IV REINCARNATION THROUGH VALUE EDUCATION **9**

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence - Holy books vs Blind faith, Self-management and Good health, Science of reincarnation CO4

UNIT - V VALUE EDUCATION IN SOCIAL EMPOWERMENT **9**

Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self-destructive habits with value education
CO5	Interpret social empowerment with value education

TEXT BOOKS:

1. Chakroborty , S.K. “Values and Ethics for Organizations Theory and Practice”, Oxford University Press, New Delhi

AD1003 PEDAGOGY STUDIES

L	T	P	C
2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT - I INTRODUCTION AND METHODOLOGY **9**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and searching. CO1

UNIT - II THEMATIC OVERVIEW **9**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education. CO2

UNIT - III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **9**

Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies. CO3

UNIT - IV PROFESSIONAL DEVELOPMENT **9**

Professional development: alignment with classroom practices and follow up support - Peersupport - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes CO4

UNIT - V RESEARCH GAPS AND FUTURE DIRECTIONS **9**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the methodology of pedagogy

CO2 Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.

CO3 Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

CO4 Know the factors necessary for professional development.

CO5 Identify the Research gaps in pedagogy.

TEXT BOOKS:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do’s and Don’t’s in life through Yam
- Categorize Do’s and Don’t’s in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT - I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog.(Ashtanga) CO1

UNIT - II YAM **9**

Do`s and Don’ts in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan CO2

UNIT - III NIYAM **9**

Do `s and Don'ts in life. Ahinsa, satya, astheya, bramhacharya and aparigraha CO3

UNIT - IV ASAN **9**

Various yog poses and their benefits for mind & body CO4

UNIT - V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop healthy mind in a healthy body thus improving social health also improve efficiency

CO2 Learn Do's and Don't's in life through Yam

CO3 Learn Do's and Don't's in life through Niyam

CO4 Develop a healthy mind and body through Yog Asans

CO5 Learn breathing techniques through Pranayam

TEXT BOOKS:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT - I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses - 19,20,21,22 (wisdom) – Verses - 29,31,32 (pride & heroism) – Verses - 26,28,63,65 (virtue) CO1

UNIT - II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY – II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) CO2

UNIT - III ORGANS OF GOVERNANCE **9**

Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48 CO3

UNIT - IV EMERGENCY PROVISIONS **9**

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 CO4

UNIT - V LOCAL ADMINISTRATION **9**

Chapter 2 - Verses 17, Chapter 3 - Verses 36, 37, 42 - Chapter 4 - Verses 18, 38, 39 Chapter18 - Verses 37, 38, 63 CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop basic personality skills holistically

CO2 Develop deep personality skills holistically to achieve happy goals

CO3 Rewrite the responsibilities

CO4 Reframe a person with stable mind, pleasing personality and determination

CO5 Awaken wisdom in students

TEXTBOOKS:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringarvairagya, New Delhi, 2010
2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

AD1006 UNNAT BHARAT ABHIYAN

L	T	P	C
2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area.
Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village. CO1

UNIT - II RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market .
Assignment**:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3. CO2

UNIT - III RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. CO3

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor. CO4

UNIT - V FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools I mid-day meal centres, study academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation CO5
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings, and interview school drop outs
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learn to value the local knowledge and wisdom of the community

TEXT BOOKS:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS:

1. P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

The course will introduce the students to

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT - I INTRODUCTION TO CULTURE	**9**	
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		CO1
UNIT - II INDIAN LANGUAGES AND LITERATURE	**9**	
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2
UNIT - III RELIGION AND PHILOSOPHY	**9**	
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT - IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)	**9**	
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		CO4
UNIT - V EDUCATION SYSTEM IN INDIA	**9**	
Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand philosophy of Indian culture.

CO2 Distinguish the Indian languages and literature.

CO3 Learn the philosophy of ancient, medieval and modern India.

CO4 Acquire the information about the fine arts in India.

CO5 Know the contribution of scientists of different eras.

TEXT BOOKS:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014.

AD1008 SANGA TAMIL LITERATURE APPRECIATION

L	T	P	C
2	0	0	0

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

- Introduction to Sanga Tamil Literature.
- ‘Agathinai’ and‘Purathinai’ in Sanga Tamil Literature.
- ‘Attruppadai’ in Sanga Tamil Literature.
- ‘Puranaanuru’ in Sanga Tamil Literature.
- ‘Pathitrupaththu’ in Sanga Tamil Literature.

UNIT - I SANGA TAMIL LITERATURE – AN INTRODUCTION **9**

Introduction to Tamil Sangam - History of Tamil Three Sangams - Introduction to Tamil Sangam Literature - Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s Grammar Tamil Sangam Literature’s parables. CO1

UNIT - II ‘AGATHINAI’AND‘PURATHINAI’ **9**

Tholkappiyar’s Meaningful Verses - Three literature materials - Agathinai’s message - History of culture from Agathinai – Purathinai - Classification - Message to Society from Purathinai. CO2

UNIT - III ‘ATTRUPPADAI’ **9**

Attruppadai Literature – Attruppadaiin ‘Puranaanuru’ – Attruppadaiin ‘Pathitrupaththu’ - Attruppadaiin ‘Paththupaattu’. CO3

UNIT - IV ‘PURANAANURU’ **9**

Puranaanuru on Good Administration, Ruler and Subjects - Emotion & its Effect in Puranaanuru. CO4

UNIT - V ‘PATHITRUPATHTHU’ **9**

Pathitrupaththuin ‘Ettuthogai’ - Pathitrupaththu’s Parables - Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu. CO5

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2 Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.
CO3 Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4 Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5 Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

TEXT BOOKS:

1. Sivaraja Pillai, The Chronology of the Early Tamils, Sagwan Press, 2018.
2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books, 2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. George L. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press, 2015.
5. Xavier S. Thani Nayagam, Landscape and poetry: A Study of Nature in Classical Tamil Poetry, Asia Pub. House, 1967.

MV0001	3D PRINTING	L	T	P	C
		1	0	2	2

OBJECTIVES

- To broaden and deepen the principle methods, capabilities in analytical and experimental research methods in rapid prototyping and its applications.
- To be familiar with characteristics of different materials used in additive manufacturing.

UNIT - I INTRODUCTION 5

Need for the compression in product development, history of RP systems, survey of applications, growth of RP industry, classification of RP systems, Materials for Additive Manufacturing Technology, Data Processing for additive manufacturing technology: CAD model preparation – Part orientation and support generation – Model Slicing – Tool path Generation – Software for Additive Manufacturing Technology: MIMICS, MAGICS – Benefits.

UNIT - II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Stereolithography Apparatus, Fused deposition modeling, Laminated object manufacturing: Working principles, details of processes, products, materials, advantages, limitations and applications – Case studies

UNIT - III POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies.

UNIT - IV RAPID MANUFACTURING PROCESS OPTIMIZATION 10

Factors influencing accuracy, data preparation errors, part building errors, errors in finishing, influence of part build orientation.

UNIT - V MEDICAL AND BIO – ADDITIVE MANUFACTURING 10

Customized implants and prosthesis: Design and production, Bio-Additive Manufacturing – Computer Aided Tissue Engineering (CATE) – Case studies.

TOTAL PERIODS: 45

COURSE OUTCOME

Upon completion of the course, students will be able to

Understand the principle methods, area of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies

REFERENCE BOOKS

1. Pham D T and Dimov S S, "Rapid MANUFACTURING", Verlag, 2001.
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Lioy W. Liou, Frank W. Liou, CRC Press, 2007.
3. Rapid Prototyping: Theory and Practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006.
4. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.

MV0002	ENTREPRENEURSHIP IN SOLAR PV TECHNOLOGY	L	T	P	C
		1	0	2	2

OBJECTIVES

- Understanding the design and installation of solar PV systems for residential, industrial, commercial, and agricultural locations.
- To comprehend the design of on-grid, off-grid, and hybrid solar PV systems
- Government regulations and procedures for startups to comply with the Ministry of Corporate Affairs in the Solar PV sector.

UNIT - I SOLAR PV DESIGN AND INSTALLATION COMPONENTS 9

Renewable and Non-Renewable Energy Sources, Electricity Fundamentals, Overview of Solar Photovoltaic Cells- Building Blocks -Types-Modules- and Array Configuration-Imaging Objects-Tracking Device, Invertors-On Grid- Off Grid-Single Phase-Three Phase and Balance of Components

UNIT - II SOLAR PV SYSTEM DESIGN TECHNIQUES 9

Solar PV system Design Software for Solar system design, Irradiance, PV design and Orientation, Performance, Simulation, Tilting, Tracking, Shadow Effects, Load Calculation and Analysis. TNEB tariff calculation-Introduction to concentrated PV Cell

UNIT - III SOLAR PANEL MOUNTING STRUCTURE 9

Essential of Structures, Structure Materials- Aluminum –MS, GI, SS. Module Mounting Structures and Types for Different Roof, Ground-mounted and Vehicle-mounted PV Systems. Safety Measures, Types of Solar Batteries and Inverters, Grid Tie Connection Procedures in Tamil Nadu.

UNIT - IV APPLICATIONS OF SOLAR PV SYSTEM 9

Design and Development of Charge Controller, DC to AC converter, Solar Study Lamp, Arduino based Sun Tracking PV System, Design of Solar powered Mobile Charger, Solar Water Pumping System, Solar Street Light, Solar PV Plant Design for Industry, Simulation of Solar PV cell.

UNIT - V DESIGN OF SOLAR PV PLANT FOR INDUSTRIAL APPLICATIONS 9

Concept, Functions and Importance, Educational Impact, Entrepreneurship Schemes for Students and Startups, Startup India, How to Start a Company, Funding Schemes, Business Opportunity: Identification, Evaluation and Selection.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Design and development of fundamental solar PV components
- Design techniques for solar PV technology
- Design and development of solar panel mounting structures
- Categorical application of solar PV technology
- Design and development of solar PV technology for industrial applications

TEXT BOOKS

1. Handbook for Solar Photovoltaic (PV) Systems, "Installation, Operation & Maintenance of Solar PV Microgrid Systems", A Handbook for Trainers.
2. Photovoltaic Systems Analysis and Design", A.K. Mukherjee and Nivedita Thakur

REFERENCE BOOKS

1. Solar Photovoltaic Technology and Systems: A Manual for Technicians, Trainers and Engineers Kindle Edition by Chetan Singh Solanki
2. Design and Installation of a Grid-Connected PV System" John Christer Sivertsen Petter Soyland

MV0003 ELECTRICAL HARNESS AND ROUTING DESIGN FOR ELECTRIC VEHICLES

L	T	P	C
1	0	2	2

OBJECTIVES

- Create and modify aerodynamic surfaces
- Create electrical parts and layout design
- Proficiency in electrical harness installation and flattening.

UNIT - I 3D MODELLING FUNDAMENTAL FOR ELECTRICAL HARNESS DESIGN 9

Sketcher Mode and Orientation, Sketch workbench Tool bars are Profile, Operation, Constraint. Pad, Pocket, Shaft, Groove, Hole, Chamfer, Round, Stiffener, Shell, Mirror, Pattern, Rib, slot, Multi Section Solid, Removed Multi Section Solid, Point, Line and Plane.

UNIT - II ASSEMBLY & DRAFTING FUNDAMENTAL FOR ELEC HARNESS DESIGN 9

Insert Component, Manipulation, Snapping, checking degree of freedom, Fix Constraints, Coincidence, Contact, Offset, Angular, Fix Together, Quick Constraint, Change Constraint, Reuse Pattern, Replace Component, Fast Multi Instant, Define Multi Instant, New Part Creation and New Product Creation, Introduction to Drafting, New Sheet Creation, Sheet Properties, View Creation, Dimension creation, Dimension Properties, Text Creation, Table Creation and Balloon Creation

UNIT - III WIREFRAME AND SURFACE DESIGNFUNDAMENTALS 9

Extrude, Revolve, Sphere, Cylinder, Offset, Multi Section Surface, Sweep, Blend, Join, Healing, Untrim, Disassemble, Split, Trim, Boundary, Extract, Extrapolate, Project, intersect, Circle, and Spline.

UNIT - IV CONVERSION - MECHANICAL PARTS TO ELECTRICAL COMPONENTS 9

Electrical Device Definition Define Mounting equipment, Define Equipment, Define shell, Define Connector, Define Contact, Define Back Shell, Define Filler Plug Define Support Part, and Define protection part. Electrical Device Connection Point Definition Define Cavity, Define Termination, Define Connector Connection Point, Define Bundle Connection Point, Define Connector Connection Point, Define Back Shell Connection Point, Define Shell Connection Point and Define Cavity Connection point, Connect Electrical Device and Disconnect Electrical Device.

UNIT - V ELECTRICAL LAYOUT DESIGN (INSTALLATION & FLATTENING) 9

Geometrical Bundle, Multibranchable Document, Local Slack, and Protective Covering. Management Link, Unlink, Add Support, Remove Support, Add Branch Point, Remove Branch Point, and Delete Special—introduction to electrical harness flattening Flatten Harness Flattening Parameters, Extract and Flatten. Manipulator Arrange Junction Umbrella Like, arrange junction Equal Angle, Rotate, Bend, Quick Roll, Roll, Scale, and Straighten

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Proficiency in 3D modeling design and development for wire harness design
- Proficiency in assembly and drafting modules for wire harness design
- Proficiency in wireframe and surface modeling design for wire harness design
- Assemblage of mechanical and electrical components for wire harness design
- Design and development of electrical layout design for wire harness design

TEXT BOOKS

1. CATIA V5 for Designers by Sham Tickoo
2. Mastering Automotive Wiring Harness in CATIA V5 - Abdellatif M. Sadeq Qatar Naval Academy

REFERENCE BOOKS

1. IBM Product Lifecycle Management, “CATIA V5 Electrical Wire Harness Design and Manufacturing”, https://public.dhe.ibm.com/solutions/plm/doc/content/bin/plm_05-PLM-001610_P2_Electrical_flyer_LR.pdf
2. Wichita State University, “CATIA Electrical Harness Design” ,/Electrical-Harness-Design-R30.pdf

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

PROGRESS THROUGH KNOWLEDGE

FACULTY OF MANAGEMENT SCIENCES

MASTER OF BUSINESS ADMINISTRATION (INTEGRATED) -5 YEARS

CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To display competencies and knowledge in key business functional areas including finance, marketing, operations and human resource.
II. To prepare for a successful career with effective communication skills, teamwork skills and work with values that meet the diversified needs of industry.
III. To provide management tool to identify, analyze, and create business opportunities and also solve business problems.
IV. To develop an understanding of the diverse and rapidly changing global business environment.
V. To inspire and make them practice ethical standards in business.

PROGRAMME OUTCOMES (POs):

1. Ability to apply management theories, concepts and models to make sound and effective business decisions.
2. Ability to identify, analyse and solve complex managerial issues by using quantitative methods, statistical analyses and information technology.
3. Ability to communicate and negotiate effectively, to achieve organizational and individual goals.
4. Ability to upgrade their professional and managerial skills in their workplace.
5. Ability to develop a systematic understanding of environmental factors and its impact on business.
6. Ability to apply analytical skills to address the changing dynamics of business.
7. Ability to understand one's individual competencies to set achievable targets and complete them.
8. Ability to engage in continuing professional development and life-long learning.
9. Ability to take-up challenging assignments.
10. Ability to enhance financial literacy.
11. Ability to act with an informed awareness of social issues and contribute towards the societal benefit.
12. Ability to develop an understanding of ethical responsibility.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Ability to gain knowledge, expertise and frame of mind to become a successful manager.
2. Ability to deliver socially acceptable solutions to managerial problems with the application of

contemporary techniques for sustainable development.
3. Ability to apply the knowledge of ethical principles required to work in a team as well as to lead a team.

MAPPING OF PEOS WITH POs:

Programme Educational Objectives	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
	Programme outcomes											
I	3	3					3			3		
II			3	3							3	
III				3		3			3			
IV					3							
V		3	3					3				3

YEAR / SEM		COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR I	1	Foundation of Management	✓	✓	✓									
		Managerial Economics - I	✓	✓	✓		✓	✓						
		Principles of Accounting	✓	✓										
		Basic Psychology			✓	✓			✓	✓				
		Business Mathematics		✓										
		English				✓								
		English language laboratory			✓	✓								
	2	Cost Accounting	✓	✓										
		Business Organization	✓		✓									
		Fundamentals of Sociology				✓		✓					✓	✓
		Business Communication	✓		✓	✓								
		Fundamentals of Computers			✓	✓				✓				
		Business Statistics-I		✓										
		Computer Skills- I			✓	✓				✓				
YEAR 2	3	Managerial Economics - II	✓	✓	✓		✓	✓						
		Management Information System	✓	✓	✓	✓								
		Management Accounting	✓	✓								✓		
		Marketing Management – I	✓	✓		✓	✓							
		Business Law – I	✓		✓									
		Business Statistics-II	✓											
		Computer Skills-II			✓	✓				✓				
		Managerial Communication	✓		✓				✓	✓				
	4	Indian Economy	✓				✓	✓						
		Data Management	✓	✓	✓		✓		✓	✓	✓			
		Corporate Accounting	✓	✓								✓		

		Quality Management	✓			✓								
		Business Law – II	✓		✓									
		Applied Operations Research I		✓					✓					
		Accounting Software		✓		✓								
		Seminar I				✓								
YEAR 3	5	Applied Operations Research -II		✓					✓					
		Environmental Science and Management					✓							
		Financial Management - I	✓	✓		✓	✓		✓	✓		✓		
		Information Management	✓	✓		✓	✓		✓					✓
		Marketing Management - II	✓	✓		✓	✓		✓					
		Organizational Behavior	✓		✓	✓				✓				
		Data Analysis Laboratory - I				✓		✓			✓			
		Seminar II				✓	✓							
	6	Banking Theory and Practices	✓									✓		
		Business Policy	✓				✓							
		Enterprise Resource Planning	✓			✓	✓		✓					
		Human Resource Management	✓	✓		✓	✓		✓					
		Operations Management - I	✓	✓			✓		✓					
		Principles of Insurance	✓								✓			
		Industrial Visit*												
		Seminar III				✓			✓					
YEAR 4	7	Financial Management - II	✓	✓		✓	✓		✓	✓		✓		
		Income Tax	✓	✓								✓	✓	
		Operations Management - II	✓	✓		✓	✓		✓					
		Research Methodology		✓			✓	✓	✓					
		Retail Management	✓		✓	✓	✓							
		Strategic Management	✓	✓			✓	✓	✓	✓				
		Data Analysis Laboratory - II				✓		✓			✓			
		Seminar IV		✓				✓						
	8	Business Analytics		✓		✓				✓	✓			
		Business Ethics and Corporate Governance	✓					✓					✓	
		Creativity and Innovation	✓		✓	✓			✓	✓	✓			
		Entrepreneurship Development	✓		✓									
		Event Management	✓				✓	✓						
		International Business Management				✓	✓							
		Soft Skills Laboratory				✓		✓	✓		✓			
		Seminar V												✓
YEAR 5	9	Professional Elective - I												
		Professional Elective - II												
		Professional Elective - III												
		Professional Elective - IV												
		Professional Elective - V												

		Professional Elective - VI												
		Summer Internship	✓	✓	✓	✓	✓	✓	✓	✓	✓			
		Professional Skill Development Laboratory				✓				✓				
		Seminar VI				✓							✓	
	10	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Stream/ Specialization : Marketing Management														
	1	Brand Management	✓		✓	✓		✓		✓				
	2	Consumer Behavior	✓			✓		✓	✓	✓				
	3	Digital Marketing	✓		✓	✓		✓	✓	✓				
	4	Integrated Marketing Communication	✓		✓	✓		✓	✓	✓				
	5	Services Marketing	✓			✓	✓		✓	✓				
	6	Sales and Distribution Management	✓			✓				✓				
Stream/ Specialization : Financial Management														
	1	Banking and Financial Services	✓		✓	✓		✓		✓				
	2	Behavioral Finance	✓		✓	✓				✓				
	3	Financial Derivatives	✓		✓	✓				✓				
	4	Financial markets	✓		✓	✓		✓		✓				
	5	International Finance	✓		✓	✓	✓			✓				
	6	Security Analysis and Portfolio Management	✓		✓	✓	✓			✓				
Stream/ Specialization : Human Resource Management														
	1	Industrial Relations and Labour Legislations	✓		✓	✓	✓			✓			✓	
	2	International Human Resource Management	✓		✓	✓	✓			✓			✓	
	3	Negotiation and Conflict Management	✓		✓	✓	✓	✓		✓				
	4	Organizational, Design, Change and Development	✓		✓	✓	✓			✓				
	5	Reward and Compensation Management	✓		✓	✓	✓			✓				
	6	Strategic Human Resource Management	✓		✓	✓	✓			✓			✓	
Stream/ Specialization : Operations Management														
	1	Logistics Management	✓		✓									
	2	Materials Management	✓				✓							
	3	Project Management	✓		✓		✓							
	4	Services Operations Management	✓		✓		✓							
	5	Supply Chain Analytics		✓		✓								
	6	Supply Chain Management	✓		✓			✓						
Stream/ Specialization : Business Analytics														
	1	Cloud computing	✓	✓		✓		✓			✓			
	2	Data Mining for Business Intelligence		✓	✓	✓		✓		✓				
	3	Deep Learning and Artificial Intelligence	✓	✓		✓		✓		✓				
	4	e-business	✓			✓	✓	✓		✓				
	5	R programming	✓			✓		✓		✓	✓			
	6	Social Media and Web Analytics	✓			✓		✓		✓				

ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

REGULATIONS -2021

CHOICE BASED CREDIT SYSTEM

MASTER OF BUSINESS ADMINISTRATION (INTEGRATED) -5 YEARS

CURRICULA AND SYLLABI I TO X SEMESTERS

SEMESTER I

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1101	Foundation of Management	PCC	3	0	0	3
2	MI1102	Managerial Economics - I	PCC	3	0	0	3
3	MI1103	Principles of Accounting	PCC	3	0	0	3
4	MI1104	Basic Psychology	PCC	3	0	0	3
5	MA1172	Business Mathematics	PCC	3	0	0	3
6	HS1171	English	PCC	3	0	0	3
PRACTICALS							
7	MI1105	English Language Laboratory	EEC	0	0	4	2
		TOTAL		**18**	**0**	**4**	**20**

SEMESTER II

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1201	Cost Accounting	PCC	3	0	0	3
2	MI1202	Business Organization	PCC	3	0	0	3
3	MI1203	Fundamentals of Sociology	PCC	3	0	0	3

4	MI1204	Business Communication	PCC	3	0	0	3
5	MI1205	Fundamentals of Computers	PCC	3	0	0	3
6	MA1271	Business Statistics-I	PCC	3	0	0	3
PRACTICALS							
7	MI1206	Computer Skills- I	EEC	0	0	4	2
		TOTAL		**18**	**0**	**4**	**20**

SEMESTER III

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1301	Managerial Economics - II	PCC	3	0	0	3
2	MI1302	Management Information System	PCC	3	0	0	3
3	MI1303	Management Accounting	PCC	3	0	0	3
4	MI1304	Marketing Management - I	PCC	3	0	0	3
5	MI1305	Business Law - I	PCC	3	0	0	3
6	MA1371	Business Statistics-II	PCC	3	0	0	3
PRACTICALS							
7	MI1306	Computer Skills-II	EEC	0	0	4	2
8		Managerial Communication	VAC	0	0	2	0
		TOTAL		**18**	**0**	**6**	**20**

SEMESTER IV

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1401	Indian Economy	PCC	3	0	0	3
2	MI1402	Data Management	PCC	3	0	0	3

3	MI1403	Corporate Accounting	PCC	3	0	0	3
4	MI1404	Quality Management	PCC	3	0	0	3
5	MI1405	Business Law - II	PCC	3	0	0	3
6	MI1406	Applied Operations Research I	PCC	3	0	0	3
PRACTICALS							
7	MI1407	Accounting Software	EEC	0	0	4	2
8	MI1408	Seminar I	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**21**

SEMESTER V

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1501	Applied Operations Research -II	PCC	3	0	0	3
2	MI1502	Environmental Science and Management	PCC	3	0	0	3
3	MI1503	Financial Management - I	PCC	3	0	0	3
4	MI1504	Information Management	PCC	3	0	0	3
5	MI1505	Marketing Management - II	PCC	3	0	0	3
6	MI1506	Organizational Behavior	PCC	3	0	0	3
PRACTICALS							
7	MI1507	Data Analysis Laboratory - I	EEC	0	0	4	2
8	MI1508	Seminar II	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**21**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1601	Banking Theory and Practices	PCC	3	0	0	3
2	MI1602	Business Policy	PCC	3	0	0	3

3	MI1603	Enterprise Resource Planning	PCC	3	0	0	3
4	MI1604	Human Resource Management	PCC	3	0	0	3
5	MI1605	Operations Management - I	PCC	3	0	0	3
6	MI1606	Principles of Insurance	PCC	3	0	0	3
PRACTICALS							
7	MI1607	Industrial Visit*	EEC	0	0	4	2
8	MI1608	Seminar III	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**21**

*Students have to visit four organizations and submit individual reports

SEMESTER VII

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1701	Financial Management - II	PCC	3	0	0	3
2	MI1702	Income Tax	PCC	3	0	0	3
3	MI1703	Operations Management - II	PCC	3	0	0	3
4	MI1704	Research Methodology	PCC	3	0	0	3
5	MI1705	Retail Management	PCC	3	0	0	3
6	MI1706	Strategic Management	PCC	3	0	0	3
PRACTICALS							
7	MI1707	Data Analysis Laboratory - II	EEC	0	0	4	2
8	MI1708	Seminar IV	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**21**

SEMESTER VIII

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	MI1801	Business Analytics	PCC	3	0	0	3

2	MI1802	Business Ethics and Corporate Governance	PCC	3	0	0	3
3	MI1803	Creativity and Innovation	PCC	3	0	0	3
4	MI1804	Entrepreneurship Development	PCC	3	0	0	3
5	MI1805	Event Management	PCC	3	0	0	3
6	MI1806	International Business Management	PCC	3	0	0	3
PRACTICALS							
7	MI1807	Soft Skills Laboratory	EEC	0	0	4	2
8	MI1808	Seminar V	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**21**

Summer internship – minimum of 4 weeks of internship

The report along with the company certificate should be submitted within the two weeks of the reopening date of 9th semester. The report should be around 40 pages.

Creativity and Innovation:

Students will undergo the entire programme similar to a Seminar. It is activity based course. Students will undergo the programme with both theoretical and practical content. Each student will be required to come out with innovative products or services. This will be evaluated by the faculty member(s) handling the course and the consolidated marks can be taken as the final mark. No end semester examination is required for this course

SEMESTER IX

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1		Professional Elective - I	PEC	3	0	0	3
2		Professional Elective - II	PEC	3	0	0	3
3		Professional Elective - III	PEC	3	0	0	3
4		Professional Elective - IV	PEC	3	0	0	3
5		Professional Elective - V	PEC	3	0	0	3
6		Professional Elective - VI	PEC	3	0	0	3

PRACTICALS							
7	MI1907	Summer Internship	EEC	0	0	4	2
8	MI1908	Professional Skill Development Laboratory	EEC	0	0	4	2
9	MI1909	Seminar VI	EEC	0	0	2	1
		TOTAL		**18**	**0**	**6**	**23**

SEMESTER X

Sl. No.	Course Code	Course Title	Category	L	T	P	C
PRACTICALS							
1	MI1100	Project Work	EEC	0	0	24	12
		TOTAL		**0**	**0**	**24**	**12**

PROFESSIONAL ELECTIVES (PEC)

FUNCTIONAL SPECIALISATIONS

Students can take three elective subjects from two functional specializations

Sl. No.	Course Code	Course Title	Category	L	T	P	C
Stream/ Specialization : Marketing Management							
1	MI1M001	Brand Management	PEC	3	0	0	3
2	MI1M002	Consumer Behaviour	PEC	3	0	0	3
3	MI1M003	Digital Marketing	PEC	3	0	0	3
4	MI1M004	Integrated Marketing Communication	PEC	3	0	0	3
5	MI1M005	Sales and Distribution Management	PEC	3	0	0	3
6	MI1M006	Services Marketing	PEC	3	0	0	3
Stream/ Specialization : Financial Management							
7	MI1F001	Banking and Financial Services	PEC	3	0	0	3
8	MI1F002	Behavioral Finance	PEC	3	0	0	3
9	MI1F003	Financial Derivatives	PEC	3	0	0	3

10	MI1F004	Financial markets	PEC	3	0	0	3
11	MI1F005	International Finance	PEC	3	0	0	3
12	MI1F006	Security Analysis and Portfolio Management	PEC	3	0	0	3

Stream/ Specialization : Human Resource Management							
13	MI1H001	Industrial Relations and Labour Legislations	PEC	3	0	0	3
14	MI1H002	International Human Resource Management	PEC	3	0	0	3
15	MI1H003	Negotiation and Conflict Management	PEC	3	0	0	3
16	MI1H004	Organizational, Design, Change and Development	PEC	3	0	0	3
17	MI1H005	Reward and Compensation Management	PEC	3	0	0	3
18	MI1H006	Strategic Human Resource Management	PEC	3	0	0	3

Stream/ Specialization : Operations Management							
19	MI1O001	Logistics Management	PEC	3	0	0	3
20	MI1O002	Materials Management	PEC	3	0	0	3
21	MI1O003	Project Management	PEC	3	0	0	3
22	MI1O004	Services Operations Management	PEC	3	0	0	3
23	MI1O005	Supply Chain Analytics	PEC	3	0	0	3
24	MI1O006	Supply Chain Management	PEC	3	0	0	3
Stream/ Specialization : Business Analytics							
25	MI1B001	Cloud computing	PEC	3	0	0	3
26	MI1B002	Data Mining for Business Intelligence	PEC	3	0	0	3
27	MI1B003	Deep Learning and Artificial Intelligence	PEC	3	0	0	3
28	MI1B004	e-business	PEC	3	0	0	3
29	MI1B005	R programming	PEC	3	0	0	3
30	MI1B006	Social Media and Web Analytics	PEC	3	0	0	3

PROFESSIONAL CORE (PC)

Sl. No.	Course Code	Course Title	Category	L	T	P	C
1	MI1101	Foundation of Management	PCC	3	0	0	3
2	MI1102	Managerial Economics - I	PCC	3	0	0	3
3	MI1103	Principles of Accounting	PCC	3	0	0	3
4	MI1104	Basic Psychology	PCC	3	0	0	3
5	MA1172	Business Mathematics	PCC	3	0	0	3
6	HS1171	English	PCC	3	0	0	3
7	MI1201	Cost Accounting	PCC	3	0	0	3
8	MI1202	Business Organization	PCC	3	0	0	3
9	MI1203	Fundamentals of Sociology	PCC	3	0	0	3
10	MI1204	Business Communication	PCC	3	0	0	3
11	MI1205	Fundamentals of Computers	PCC	3	0	0	3
12	MA1271	Business Statistics-I	PCC	3	0	0	3
13	MI1301	Managerial Economics - II	PCC	3	0	0	3
14	MI1302	Management Information System	PCC	3	0	0	3
15	MI1303	Management Accounting	PCC	3	0	0	3
16	MI1304	Marketing Management - I	PCC	3	0	0	3
17	MI1305	Business Law - I	PCC	3	0	0	3
18	MA1371	Business Statistics-II	PCC	3	0	0	3
19	MI1401	Indian Economy	PCC	3	0	0	3
20	MI1402	Data Management	PCC	3	0	0	3
21	MI1403	Corporate Accounting	PCC	3	0	0	3
22	MI1404	Quality Management	PCC	3	0	0	3
23	MI1405	Business Law - II	PCC	3	0	0	3
24	MI1406	Applied Operations Research I	PCC	3	0	0	3
25	MI1501	Applied Operations Research -II	PCC	3	0	0	3
26	MI1502	Environmental Science and Management	PCC	3	0	0	3
27	MI1503	Financial Management - I	PCC	3	0	0	3

28	MI1504	Information Management	PCC	3	0	0	3
29	MI1505	Marketing Management - II	PCC	3	0	0	3
30	MI1506	Organizational Behavior	PCC	3	0	0	3
31	MI1601	Banking Theory and Practices	PCC	3	0	0	3
32	MI1602	Business Policy	PCC	3	0	0	3
33	MI1603	Enterprise Resource Planning	PCC	3	0	0	3
34	MI1604	Human Resource Management	PCC	3	0	0	3
35	MI1605	Operations Management - I	PCC	3	0	0	3
36	MI1606	Principles of Insurance	PCC	3	0	0	3
37	MI1701	Financial Management - II	PCC	3	0	0	3
38	MI1702	Income Tax	PCC	3	0	0	3
39	MI1703	Operations Management - II	PCC	3	0	0	3
40	MI1704	Research Methodology	PCC	3	0	0	3
41	MI1705	Retail Management	PCC	3	0	0	3
42	MI1706	Strategic Management	PCC	3	0	0	3
43	MI1801	Business Analytics	PCC	3	0	0	3
44	MI1802	Business Ethics and Corporate Governance	PCC	3	0	0	3
45	MI1803	Creativity and Innovation	PCC	3	0	0	3
46	MI1804	Entrepreneurship Development	PCC	3	0	0	3
47	MI1805	Event Management	PCC	3	0	0	3
48	MI1806	International Business Management	PCC	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	L	T	P	C
1	MI1105	English Language Laboratory	EEC	0	0	4	2
2	MI1206	Computer Skills- I	EEC	0	0	4	2
3	MI1306	Computer Skills-II	EEC	0	0	4	2
4	MI1407	Accounting Software	EEC	0	0	4	2
5	MI1408	Seminar I	EEC	0	0	2	1
6	MI1507	Data Analysis Laboratory - I	EEC	0	0	4	2

7	MI1508	Seminar II	EEC	0	0	2	1
8	MI1607	Industrial Visit*	EEC	0	0	4	2
9	MI1608	Seminar III	EEC	0	0	2	1
10	MI1707	Data Analysis Laboratory - II	EEC	0	0	4	2
11	MI1708	Seminar IV	EEC	0	0	2	1
12	MI1807	Soft Skills Laboratory	EEC	0	0	4	2
13	MI1808	Seminar V	EEC	0	0	2	1
14	MI1907	Summer Internship	EEC	0	0	4	2
15	MI1908	Professional Skill Development Laboratory	EEC	0	0	4	2
16	MI1909	Seminar VI	EEC	0	0	2	1
17	MI1100	Project Work	EEC	0	0	24	12

VALUE ADDED COURSE

Sl. No.		Course Title	Category	L	T	P	C
1		Managerial Communication	VAC	0	0	2	0

CATEGORY BASED CREDIT AND SPLIT-UP – SEMESTER WISE

Semester	PCC	PEC	EEC	VAC	Total credit
I	18		2		20
2	18		2		20
3	18		2	0	20
4	18		3		21
5	18		3		21
6	18		3		21
7	18		3		21
8	18		3		21
9	18		5		23
10		18	12		12
Total Credit	**162**	**18**	**38**	**0**	**200**

S.No.	Abbreviation	Detailed Description
1	PCC	Professional Core Course
2	PEC	Professional Elective Course
3	EEC	Employability Enhancement Course
4	VAC	Value added Course

SEMESTER I

MI1101	FOUNDATION OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose the students to the basic concepts of management.
- To enable the students to understand the management functions of organization.

UNIT I INTRODUCTION **9**

Nature and process of management, basic managerial roles and skills, nature of managerial work; Management vs. Administration, Management as a Science or an art, Management as a Profession, Professional Management in India; Development of Management thought: Henri Fayol, F W Taylor, Elton Mayo and Maslow; System and contingency approach. **CO1**

UNIT II PLANNING AND DECISION MAKING **9**

Planning and decision making – concept, purpose and process of planning, kinds of plans, strategies, policies and planning, premises, goal setting, MBO. Decision making – nature and process, types of managerial decisions, decision making conditions, forms of group decision making in organization. **CO2**

UNIT III ORGANIZING **9**

Organizing–Concept, Steps and elements of organizing function, basis of departmentation, distribution of authority, Types of organization structure, Delegation and Decentralization. **CO3**

UNIT IV DIRECTION **9**

Leadership – nature and significance, leading and managing, leadership styles, leadership theories. **CO4**

UNIT V CONTROL **9**

Management Control; nature, purpose and process of controlling, kinds of control system, prerequisites of effective control system, resistance to control. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Koontz & Ramachandra, Essentials of Management, Tata McGrawHill.
2. Stoner, Freeman and Gilbert, Jr. Management, Pearson Education, New Delhi

REFERENCE BOOKS

1. Weihrich, Heinz and Harold Koontz, Management: A Global Perspective, Tata Mc GrawHill
2. Dinhar Pagan, Chopra, Principles of Management.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To Understand basic terminology and concepts for Management theory.

CO2 To proficient in case study analysis and writing for Management applications.

CO3 To demonstrate the ability to apply selected Management frameworks to real world business situations for problem-solving purposes.

CO4	To demonstrate business caliber online communications and netiquette skills via proficient participation in group discussion forums.
CO5	To apply the concepts to provide business solution

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	-	-	-	-	-	-	-	-	-	2	3	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	3	3
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	3	3

MI1102	**MANAGERIAL ECONOMICS - I**	**L**	**T**	**P**	**C**
		3	0	0	3

COURSE OBJECTIVES

- To expose the basic principles of microeconomic theory.
- To illustrate how microeconomic concepts can be applied to analyze real-life situations.

UNIT I INTRODUCTION **9**

Meaning, Nature, Scope and Limitations of Business Economics – Micro & Macro Economics. – Productive efficiency Vs. economic efficiency – Economic growth & stability. **CO1**

UNIT II DEMAND AND SUPPLY **9**

Concept of Demand- Elasticity of Demand - Types and Determinants - Concepts of Supply –Elasticity of Supply - Types and Determinants. **CO2**

UNIT III PRODUCTION **9**

Introduction to production process, Short run production function: law of variable Proportions- long run production. CO3

UNIT IV COST AND REVENUE **9**

Cost Analysis: Fixed, Variable and Total Cost, Curves, Average and Marginal Costs, Long Run Cost Analysis: Economies and Diseconomies of Scale and Long Run Average and Marginal Cost Curves. Revenue Concepts – Total Revenue, Marginal Revenue, Average Revenue and their relationship. **CO4**

UNIT V MARKET STRUCTURE **9**

Price and output decisions under different market structures: Price and output decisions under perfect competition, monopoly and monopolistic competition - pricing under oligopoly – kinked demand curve, Factor Market. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. H.L. Ahuja Principles of Economics -, Sultan Chand, Nov. 2007.
2. Yogesh Maheswari, Managerial Economics, 3rd Edition, Phi Learning, NewDelhi, 2012

REFERENCE BOOKS

1. Richard Lipsey and Alec Charystal, Economics, 12th edition, Oxford, University Press, New Delhi, 2011.
2. Karl E. Case and Ray C. fair, Principles of Economics, 8th edition, Pearson, Education Asia, New Delhi, 2002.
3. Diwedi. D.N. Managerial Economics, 7th Edition, Vikas Publishing House Pvt. Ltd., 2009

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the fundamental concept of Business Economics.

CO2 To understand the concept and determinant of demand and supply.

CO3 To understand production process and to analyses the short run and long run production function

CO4 To understand cost and revenue concepts & economies and diseconomies of Scale.

CO5 To analyse the price output determination under different market structures & demand for and supply of different types of factor market.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	3	3	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	1	-	3	3	-	-	-	-	-	-	-	-	-
CO4	2	3	1	-	3	2	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	3	2	-	-	-	-	-	-	-	-	-

MI1103 PRINCIPLES OF ACCOUNTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basic accounting concepts.

UNIT I INTRODUCTION **9**

Introduction to Financial, Cost and Management Accounting- Objectives of Financial Accounting– Accounting Principles ,Concepts and Conventions–Book keeping and Accounting–Accounting System–Preparation of Journal, ledger, Cash Book and Trial Balance–Errors disclose and not disclosed by trial Balance. **CO1**

UNIT II FINAL ACCOUNTS **9**

Preparation of Final Accounts of Sole Trading Firms–with adjustments (Simple adjustments only). **CO2**

UNIT III RECTIFICATION OF ERRORS &DEPRECIATION **9**

Rectification of Errors including preparation of Suspense Account– Depreciation–Meaning and Types Methods of Charging and Providing depreciation Straight Line and Written Down Value methods (Change in method excluded). **CO3**

UNIT IV BANK RECONCILIATION STATEMENT **9**

Bank Reconciliation Statement (simple problems only)–Insurance Claim–Average Clause (Loss of profit excluded). **CO4**

UNIT V ACCOUNTING FOR NON PROFIT ORGANIZATION **9**

Non-profit organization, Income and expenditure account and balance sheet (Simple problems) - Accounting for non-profit organization – Receipts & Payments accounts. **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Reddy and Murthy, Financial Accounting by Margham Publications, 2015,
2. Gupta R.L., Gupta VK, Principles & Practice of Accounting, Sultan Chand & Sons, 2013

REFERENCE BOOKS

1. Stice & Stice, Financial Accouning Reporting and Analysis, 8th edition, Cengage Learning, 2015

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the concepts of basic financial accounting.
CO2 To understand about trading accounts, profit and loss account and balance sheet of the company.
CO3 To understand about the various depreciations methods used in accounting
CO4 To understand the reconciliation and insurance claims.
CO5 To understand about the account of nonprofit organizations.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	2	3
CO2	2	3	-	-	-	-	-	-	-	-	-	2	2	3	2
CO3	2	2	-	-	-	-	-	-	-	-	-	2	2	3	2
CO4	2	3	-	-	-	-	-	-	-	-	-	3	2	2	3
CO5	2	2	-	-	-	-	-	-	-	-	-	2	2	2	2

MI1104	BASIC PSYCHOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Develop a strong background and understanding of the scientific foundation of psychology
- Develop a knowledge base of human behavior across the broad areas of psychology.
- Aware of the applications of psychology in the professions associated withpsychology.

UNIT I INTRODUCTION **9**

Nature, scope and methods, Major perspectives of modern psychology, Subfields of psychology, Psychology and diversity, Evolutionary psychology - exportation of psychology; Biological Bases of Behavior: Neurons, nervous system – basic structure and function, The brain **CO1**

UNIT II SENSATION AND PERCEPTION **9**

Sensation: Sensory Thresholds – Role of Psychophysical Procedures, Sensory Adaptation, Vision: The Eye, Light, Basic Functions of the Visual System, Color Vision, Vision and the Brain, Hearing: The Ear, Sound, Pitch Perception, Sound and Localization, Touch and other Skin Senses, Smell and Taste: How They Operate, Some Interesting Facts, Kinesthesia and Vestibular Sense, Perception: Organising Principles, Constancies and Illusions: When Perception Succeeds and Fails, The Plasticity of Perception: Innate VS Learned, Extrasensory perception: Perception without Sensation **CO2**

UNIT III MEMORY **9**

Human memory: The Atkinson and Shiffrin Model, Neural networks models, Forgetting – Memory Distortion and memory construction – Memory in everyday life – Memory and the brain: Evidence from memory impairments **CO3**

UNIT IV COGNITION AND INTELLIGENCE **9**

Cognition: Thinking, Making decisions, Problem solving, Language; Intelligence: Unitary or Multifaceted, Measuring intelligence, Human intelligence: The Role of Heredity and the Role ofEnvironment, Grouping differences in intelligence test scores, Emotional intelligence, Creativity **CO4**

UNIT V HUMAN DEVELOPMENT **9**

Human Development: The Childhood years – Physical growth and development, Perceptual development, Cognitive development, Moral development, Social and emotional development,Gender identity and sex-category constancy; Adolescence, Adulthood and Aging: Death and bereavement **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Robert A. Baron - Psychology (5th edition), Pearson Education
2. S.K. Mangal: An Introduction to Psychology

REFERENCE BOOKS

1. Daniel L. Schacter, Daniel T. Gilbert & Daniel M. Wegner – Psychology (2nd edition)
2. James W. Kalat - Introduction to Psychology (10th edition)

3. Lahey, B. B. (1998). Psychology: An Introduction, Tata Mc Graw Hill
4. M.R. Murthy: Foundation of Psychology
5. Morgan & King - Introduction to Psychology.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the basic psychology & Biological Bases of Behavior
CO2 To understand the Concept of sense organs & Sensation
CO3 To understand the concept of Human Memory
CO4 To understand the Cognition & Intelligence
CO5 To understand the Human Development, Death & Bereavement

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO3	-	-	3	3	-	-	3	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	3	2	-	-	-	-	-	-	-
CO5	-	-	-	3		-	3	2	-	-	-	-	-	-	-

MA1172 BUSINESS MATHEMATICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- The objective of this course is to teach the mathematical concepts and principles of calculus, vector,etc. so that students will be able to apply their mathematical skills to various business problems.

UNIT I SEQUENCE AND SERIES **9**

Progressions: Arithmetic, Geometric and Harmonic progressions - Means of two positive real numbers - Relation between A.M., G.M., and H.M. - Sequences in general - Specifying a sequence by a rule and by a recursive relation - Binomial expansion - Compound interest - Normal rate and effective rate. **CO1**

UNIT II VECTORS, MATRICES AND DETERMINANTS **9**

Vectors: Operations on vectors - Matrices: Types of matrices - Matrices operations: Addition, Subtraction and Product of matrices, Multiplication of a matrix by a scalar - Determinants: Evaluation of determinants of order two and three - Properties of determinants - Singular and nonsingular matrices - Product of two determinants - Rank of the matrix. **CO2**

UNIT III SETS AND FUNCTIONS **9**

Sets: Set and sub-sets, Venn diagram and its applications - Operations on sets: Cartesian product of sets, Application - Functions: Algebraic functions (polynomial - linear, quadratic andrational), transcendental functions (exponential, log and trigonometric functions with identities) and inverse functions - The laws of logarithms and their uses. **CO3**

UNIT IV DIFFERENTIAL CALCULUS 9

Limit of functions - Continuity of functions and properties - Graphical interpretation - Differentiation: Geometrical interpretation - Differentiation using first principles - Rules of differential - Chain rule - Logarithmic differentiation of implicit function - Parametric functions -Second order derivatives - Application of derivatives: Maxima and Minima. **CO4**

UNIT V INTEGRAL CALCULUS 9

Standard Integration - Method of integrations: Integration of rational functions - Integration using algebraic substitution - Trigonometric integrals -Trigonometric substitution - Integration by parts - Definite integral - Properties of definite integrals. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. John Bird "Higher Engineering Mathematics" Newnes (An Imprint of Elsevier), 4th Edition, 2006, Indian Edition, Noida.
2. James Stewart "Calculus with Early Transcendal Functions", CENGAGE Learning 2008, Indian Edition, New Delhi.

REFERENCE BOOKS

1 H. Anton, I. Bivens and S. Davis 'Calculus', John Widely India Pvt. Ltd. 7th Edition, 2014, New Delhi.
2 B.M. Aggarwal, 'Business Mathematics and Statistics" Ane Book Pvt. Ltd., 2015, Chennai.
3 M. Raghavachari, 'A First Course in Mathematics for Management'. McGraw-Hill Education (India) Pvt. Ltd., 2015, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Students will be able to determine whether a sequence has a pattern, whether a sequence can be generalized to find a formula for the general term in the sequence. To calculate the sum of certain infinite geometric series. To determine whether or not a sequence converges to the general term as n gets infinitely large.

CO2 Students will be able to learn the basics of matrix and determinants so as to find the rank of the matrix. Characterize a linear system in terms of the number of leading entries, free variables, pivots, pivot columns, pivot positions.

CO3 Students will understand the concepts of sets and perform operations and algebra on sets. To determine properties of relations, sketch relations and identify functions and determine their properties

CO4 Students will be able to deal derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.

CO5 Students will be able to understand the concept of integration. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-

HS1171	**ENGLISH**	**L**	**T**	**P**	**C**
		3	0	0	3

COURSE OBJECTIVES

- Develop basic skills to deal with people in business situations
- Increase their knowledge of key business concepts worldwide
- Write and read basic business reports, faxes, and memos
- Expand vocabulary related to general business situations
- Evaluate their skills so that they can build their strengths and improve their weaknesses
- Be able to apply their improved problem solving and communication skills to their daily workimmediately

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY / FRIENDS &BUSINESS TALKS **9**

LISTENING: listening to pep talks to boost the confidence level. SPEAKING- Introducing oneself, the characteristics of business speaking which is needed to prosper in management. READING –Reading read short stories which can be knowledge gaining. WRITING – About oneself and prose in clear organized manner and also reading Comprehension, developing reading skills. WRITING- About oneself and prose in clear organized manner, summarizing, and Taking notes - Grammar – Parts of speech, Vocabulary – Synonyms, Antonyms, Degreesof Comparison. **CO1**

UNIT II INSTENSIVE LISTENING AND FORMAL WRITING **9**

LISTENING –listening to TED Talks, listening for information – SPEAKING- to assert one's ideas in conversation, READING – strategies, skimming and scanning; predicting, guessing, inferring; reading critically, Hints to be developed into a readable passage – WRITING – Letter writing both formal letters and informal letters, Emails, - Grammar – Tenses, Vocabulary – Prefixes, Suffixes, Single word Substitution. **CO2**

UNIT III READING AND LANGUAGE DEVELOPMENT **9**

LISTENING – Telephonic Conversations and understanding them– SPEAKING Exchanging information, Conversational Skills, Speaking about past events - READING – understanding the emoji in mails, Brochures, Emails - WRITING – Business Letters – Quotation, Complaints, Essays –analytical and argumentative, Dialogue writing, Grammar – Determiners, Relative Clauses, Vocabulary – synonyms, antonyms. **CO3**

UNIT IV SPEAKING AND LANGUAGE DEVELOPMENT **9**

LISTENING – Dialogues, Interviews, famous entrepreneur SPEAKING- Participating in informal discussions, Brief Presentations - READING –Product Review - WRITING – Jumbled sentences, Instruction writing, , Notice writing, Grammar – Expressing causes and results, Direct and indirect speech, Gerunds, Vocabulary – Sequencing Words, Linkers. **CO 4**

UNIT V EXTENDED WRITING **9**

LISTENING –Narratives, Conversations SPEAKING- Neutral and Gender-sensitive language, Interview, role plays- READING – Newspaper WRITING-Recommendations, Short Reports, Proposal writing, Grammar – Reported Speech, Idioms, Vocabulary –phrasal verbs. **CO 5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. English in Mind, Second Edition-Student's Book, Herbert Puchta and Jeff Stranks, Cambridge University Press, 2010.

REFERENCE BOOKS

1. Study Skills in English Wallace, Michael J. Cambridge University Press, Cambridge, 1980.
2. A Course in Communication Skills, P. Kiranmai Dutt, Geetha Rajeevan, and C.L.N. Prakash, Foundation Books, New Delhi, India, 2008.
3. John Eastwood et al: Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak grammatically correct sentences in English needed in business line.

CO2 Introduce the students to written skills, to define, classify, and understand the methods ofwritten language

CO3 Listen thoughtfully and respectfully to other's ideas. Prepare, organize and deliver engaging oral presentations

CO4 Write in a variety of genres as a process of intellectual inquiry, creative expression and ultimately to become more effective thinkers and communicators in the society.

CO5 Read and develop the skills of analytical and interpretive arguments and to become careful and critical readers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-

MI1105 **ENGLISH LANGUAGE LABORATORY** **L T P C**

0 0 4 2

COURSE OBJECTIVES

- To enable learners develop their communicative competence.
- To facilitate the process of acquiring and developing soft skills among the learners in a professional background.
- To enhance the employability skills of students to improve their prospects of placements.

MODULES

1 Listening to academic and professional lectures and presentations.
2 Participating in group discussions – understanding group dynamics – brainstorming - expressing opinions, initiating and turn taking. Using appropriate body language in professional contexts – gestures, facial.
3 Making presentations – introducing oneself – introducing a topic – answering questions –individual presentation practice-
4 Creating effective PPTs – presenting the visuals effectively - designing slides.
5 Reading reports in the newspaper, making a summary and presenting it.
6 Understanding graphical data – summarizing and interpreting it.
7 Writing job applications - writing covering letters and résumé - Applying for jobs online - email etiquette.
8 Writing for publications –conference papers, research reports
9 Drafting memos in business context – writing for blogs.
10 Interview skills– dress code – body language – mock interview

TOTAL: 60 PERIODS

TEXT BOOKS

1. Effective Communication. John Adair, Pan Publishing
2. Effective English Communication. Krishna Mohan and Meenakshi Raman. 3rd Edition, TataMcGraw Hill, New Delhi, 2003.
3. Professional Communication Skills. Alok Jain, Pravin S., R.Bhatia, A.M. Sheikh, 3rd Edition, SChand and Company, New Delhi, 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak confidently and professionally in business contexts
CO2 Comprehend models of business communication in real time contexts
CO3 To learn Writing for publications –conference papers, research reports
CO4 To get knowledge about Writing job applications - writing covering letters and resume
CO5 Participate in discussions and interviews in a self-assured manner.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-

CO2	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-

SEMESTER II

MI1201	**COST ACCOUNTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide the students, knowledge of the nuances involved in costing techniques followed in the corporate world

UNIT I INTRODUCTION **9**

Nature, Scope and Importance of Cost Accounting–Relationship between Cost, Financial and Management Accounting– Installation of Cost Accounting System– Cost and Profit Centers–Classification of Costs-Cost Sheets, Tenders and Quotations. **CO1**

UNIT II MATERIAL COST **9**

Material Cost-Material Control–Purchase Control– Inventory Control, Meaning and Techniques–Different methods of Pricing Material Issues. **CO2**

UNIT III LABOUR COST **9**

Labor Cost–Computation and treatment of Labor cost - Methods of Remuneration–Time and Piece Rate System –Labor Turnover and its measurement. **CO3**

UNIT IV OVER HEADS **9**

Overheads–Classification, Allocation, Apportionment–Primary and Secondary–Methods of Absorption of Overhead–Under and Over Absorption–Machine Hour Rate. **CO4**

UNIT V PROCESS COSTING **9**

Process Costing – Normal and Abnormal Loss (Equivalent Production and Inter Process Profit excluded)–Job Costing –Contract Costing. **CO5**

TOTAL : 45 PERIODS

TEXTBOOKS :

1. Cost Accounting, S.P.Jain and K.L.Narang, Kalyani Publications,2014.
2. Cost Accounting, M.Y.Khan,P.K.Jain, JBA Publishers,2015.
3. Cost and Management Accounting, Drury C. Cengage Learning India, 2013.

REFERENCES :

1. Cost Accounting, David Russel, G.J. Wilkinson-Riddle, Ashok Patel, Pearson India, 2013.
2. Cost Accounting,T.S. Reddy.Y. Hari Prasad Reddy, Margham Publications,2015.
3. Cost Accounting, M.C.Shukla, T.S.Grewal,M.P.Gupta,S.Chand,2014

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To familiarize the concept of cost accounting, relationship between cost, financial and management accounting, to find out the cost and profit centers and to analyze the classification of costs, cost sheet, tenders and quotations.

CO2 To analyze material cost, material control, purchase control, inventory control and pricing material issues.

CO3 To compute the Labor cost

CO4 To understand the methods of absorption of overhead and calculate the Machine Hour Rate.

CO5 To analyze the Process costing, Job costing and Contract costing.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO2	3	3	-	-	-	-	-	-	-	3	-	-	2	3	2
CO3	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO4	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO5	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1

MI1202	**BUSINESS ORGANIZATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- The purpose of this paper is to impart to the students an understanding of the basic conceptsin commerce, trade and industry and various forms of business organization.
- Prepare them to face emerging challenge of managing business.

UNIT I INTRODUCTION 9

Meaning and definition of business, essentials & scope of business, business as a system.

Business and profession. Classification of Business Activities, distinction between business, commerce and trade. Meaning, Definition, Characteristics and objectives of Business Organization, Evolution of Business Organization. Business and its Environment - Social Responsibility of a business firm. **CO1**

UNIT II LOCATION OF INDUSTRY **9**

Location of industry- Factors influencing location- Size and scale of operation- Optimum firms –Advantages &- Disadvantages of large scale operations - small scale operations- Industrial Estates and District Industries Centre. **CO2**

UNIT III FORMS OF BUSINESS ORGANIZATION **9**

Forms of Business Organization • Sole proprietorship - meaning, characteristics, advantages and limitations, suitability of sole proprietorship form of business organization. • Partnership - meaning, characteristics, advantages and limitations, types of partners, suitability of partnership form of business organization. • Joint Hindu family firm • Cooperative Society - meaning, characteristics, advantages and limitations, types of cooperative societies, suitability of cooperative form of business organization. **CO3**

UNIT IV JOINT STOCK COMPANY **9**

Joint Stock Company - meaning, characteristics, advantages and limitations, suitability of company form of business organization. Types of Joint Stock Company - Public Limited Companies, Private Limited Companies, Government Companies, Multinational Companies -Public Utilities and Public Enterprises. **CO4**

UNIT V BUSINESS COMBINATIONS **9**

Business Combination- Meaning, Causes, Objectives, Types and Forms. Advantages and disadvantages. Mergers, Takeovers and Acquisitions- Trade associations and chamber of commerce. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Fundamentals of Business Organisation and Management by Y.K. Bhushan, Sultan Chand & Sons, 2013.
2. Tulsian, P.C.; Business Organisation & Management, Pearson Education, New Delhi 2002.

REFERENCE BOOKS

1. R.C Bhatia, Business Organisation & Management, ANE Books 2000.
2. C.D.Balaji and G.Prasad - Business Organization, 2012, Margham Publications.
3. R.C.Bhatia,Business Organisation & Management,2012,Tax Mann Publications Pvt Ltd

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of business and the various environmental factors effectingthe business functions

CO2 To understand the location of industry and the factors to be considered during the selection ofindustry location.

CO3 To understand the different forms of business organization and its merits and demerits.

CO4 To understand the characteristics of joint stock company and the difference between private and public limited companies.

CO5 To understand the concepts of merger, acquisition and takeover

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-

MI1203	FUNDAMENTALS OF SOCIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic concepts and the major concerns of sociology.
- To understand the relationship between culture, personality, and society.
- To identify the nature and characteristics of social processes.

UNIT I INTRODUCTION **9**

Origin, Nature, Scope, and importance of Sociology; Methods of Sociology; Relationship with other social sciences **CO1**

UNIT II BASIC CONCEPTS **9**

Society, community, Institution, Social structure, Social System, Social Groups, Social organization, Relationship between Individual and Society, Societal culture. **CO2**

UNIT III SOCIALIZATION **9**

Meaning of Socialization, Socialization as a Process of Learning, Stages, and Agencies of Socialization; Social Norms: Conformity, Deviance, Needs of Social Control. **CO3**

UNIT IV SOCIAL PROCESS **9**

Social Process in Social Institution: Meaning, Causes, and Remedies; Social Stratification in Marriage, Family, Peer group- Religion and Kinship **CO4**

UNIT V APPLIED SOCIOLOGY **9**

Indian social problems- race, class, gender inequalities- Ecology and Environment: Pollution, Global warming, and the Greenhouse effect. Impact of Industrialization and Urbanization on Environment- Issues in sustainability **CO5**

TOTAL: 45 PERIODS

TEXTBOOKS

1. Sankar Rao, C.N.: Sociology, Sultan Chand and Sons, 2007
2. H.K.Rawat: Sociology basic concepts, Rawat publications, New Delhi, 2001

3. M.L. Anderrson& H.F. Taylor: Sociology: Understanding a diverse society, Wadsworth, USA, 2008, 4th edition

REFERENCE BOOKS

1 Bhusan, Vidya: Sociology, Kitab Mahal, New Delhi, 2005
2. J.Stockard: Sociology: Discovering society, Wadsworth, USA, 1996, 1st edition
3. Johnson, Harry M: Sociology, Allied Publications Pvt., Ltd. New Delhi, 2003
4. James M. Henslin: Essential of Sociology, 4th edition
5. Joan Ferrante: Sociology, the United States in a global community.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to understand the nature and scope of sociology
CO2 Ability to understand Society, community, Institution, Social structure, Social System, Social Groups, and Social organization
CO3 Acquiring knowledge about socialization, stages, and agencies of socialization
CO4 Ability to analyze and evaluate the social process and social stratification
CO5 Ability to understand the application of sociology principles in Indian society.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	2	-	2	-	-	-	-	3	1	2	3	2
CO2	-	-	-	3	-	3	-	-	-	-	1	1	3	3	3
CO3	-	-	-	2	-	2	-	-	-	-	1	1	2	3	3
CO4	-	-	-	3	-	3	-	-	-	-	1	1	3	2	2
CO5	-	-	-	2	-	2	-	-	-	-	1	1	2	1	3

MI1204	**BUSINESS COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize tertiary level grammatical usage in language
- To apply LSRW skills in a professional context
- To acquaint students with evolving trends in professional communication.

UNIT I FUNDAMENTALS OF BUSINESS COMMUNICATION 9

Formal and Informal Communication Listening to Conversations, Interviews, Introducing a Product or Service. Small Talk. SWOT Analysis - Telling a story effectively, Reading Reports, Comprehending passages in Business and Economy-related Newspapers – Basics of Business Correspondence - Formal Letters, Letters calling Quotations, Follow Up and Complaints Letters. **CO1**

UNIT II PRESENTATION AND GROUP DISCUSSION SKILLS **9**

LISTENING –SPEAKING: Seminars, Conferences, Preparing PowerPoint - READING – Profiles of Companies, Interpreting Data, Case Studies WRITING –Reports – Survey, Feasibility **CO2**

UNIT III DOCUMENTING SKILLS **9**

Press Meets SPEAKING: Group Discussion, Dynamics of a Group Culture, - READING – Critical Thinking, Problem Definition and Solving WRITING – Company Profiles, minutes of Meetings, Case Studies Job Application, Email, Cover letter Formats. **CO3**

UNIT IV NON-VERBAL COMMUNICATION **9**

Grooming, Body Language, Tone and Pitch, Intercultural and Cross-Cultural Communication SPEAKING: Presentations - READING – Meeting and their procedures WRITING – Project. **CO4**

UNIT V TELEPHONE AND EMAIL ETIQUETTE **9**

Listening to and executing formal telephone conversations, conversational tactics, seeking information LISTENING – Sales Meeting, Panel Discussion, Accents SPEAKING: Negotiation Proposals, Mini Projects, Seeking Funding , Drafting Tenders, CircularsSkills, Life Skills, Elevator Pitch, Leadership Behavior - READING –WRITING – Requisition Letters – for Reference and Recommendation, Statements of Purposes, Persuasive language Emails, Portfolios. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Business Advantage, Almut Koester, Angela Pitt, Michael Hanford and Martin Lisboa, Student's Book, Intermediate, Cambridge University Press, 2012.

REFERENCE BOOKS

1. Business Communication. Harvard Business Essentials Series, HBS
2. Excellence in Business communications, John V. Thill and Courtland L. Bovee, Pearson, 2015.
3. Business Communication, Menakshi Raman, Prakash Singh, Oxford University Press.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop good managerial communication skills
CO2 Develop good presentation skills and group discussion skills
CO3 Ability to excel in different forms of written communication required in a business context
CO4 Ability to prepare Business reports
CO5 In-depth understanding of telephone and E-mail etiquette

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1	1	-	3	3	-	-	-	-	-	-	-	-	1	-	-
CO2	1	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO3	1	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO4	1	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO5	1	-	1	1	-	-	-	-	-	-	-	-	1	-	-

MI1205	**FUNDAMENTALS OF COMPUTERS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- The course is aimed at imparting a basic level of computer knowledge and the application of computer skills for analyzing the data, creating the presentations and preparing the reports.

UNIT I INTRODUCTION TO COMPUTERS **9**

Computer and its applications: Computers in our world, Computers for individual users, Computers for organizations, Computers in society, Why are computers so important. Components of a computer system – Hardware and Software - CPU, Memory, Input and output devices, Storage devices, System software, Application software. **CO1**

Input and output devices: Input Devices - The keyboard and Mouse. Inputting data in other ways: Devices for hand, Optical input devices, Audio-visual input devices. Output Devices - Monitors, Data projectors, Sound Systems, Printers, and Plotters.

UNIT II DATA PROCESSING AND DATA STORAGE **9**

Transforming data into information: The difference between data and information, How computers represent data, How computers process data - CPU , Machine cycles, Memory, Factors effecting processing speed, The computer's internal clock, The Bus, Cache memory. **CO2**

Types of storage devices: Primary and Secondary Storage devices, How data is stored on a disk, How the operating system finds data on a disk, Removable storages, Smart cards.

UNIT III OPERATING SYSTEM **9**

Operating systems basics**:** The purpose of operating systems, Types of operating systems, Providing a user interface, Running programs, Managing hardware, Enhancing an OS utility software, Proprietary and Open source operating systems. **CO3**

Basics of popular GUI based operation system: User interface, Task Bar, Icons, Menus, Running an Application. Operating System Simple Setting – changing system Date andTime, Changing Display Properties, Changing Mouse Properties, Adding and removing printers. File and Directory Management – Creating and renaming of files and directories. Common Utilities.

UNIT IV THE INTERNET AND ITS SERVICES **9**

Introduction to internet and world wide web (www): Basics of Computer Networks, common types of networks – Local Area Network (LAN), Wide Area Network (WAN) and Internet. The Internet's history, the Internet's major services, Understanding the world wideweb, Using your browser and the world wide web, navigating the web, closing your browser, getting help with your browser, searching the web, search results and web sites. **CO4**

E-mail and other internet services**:** Overview: communicating through the Internet, Using Email, Using an E-mail program, Stomping out spam, using web-based e-mail services, more Features of the Internet.

UNIT V INTRODUCTION TO WORD PROCESSORS, SPREAD SHEETS & PRESENTATIONS **9**

Introduction to word processors: Managing document – Creating a new document, Opening pre-existing document, create/edit/insert/copy/paste text in the document, Formatting Text and Documents, Headers and Footers, Tables and Graphics - Creating a tableusing the table menu, Entering and editing text in a table, adding/inserting/deleting rows and columns, changing row heights and column width. Inserting picture in the document and formatting the picture in the document. **CO5**

Introduction to spreadsheets: Working with spreadsheets – Creating the new spreadsheet, modifying the pre-existing spreadsheet. Entering data in cell and creating data series. Formatting Cell & Rearranging worksheets- Moving cells, copying cells, sorting celldata, inserting rows, inserting columns, inserting cells. Functions & Formulas –application of popular functions like sum, average and count. Saving and Printing Spreadsheet.

Introduction to presentations: Creating Presentations - Using auto content wizard, Using blank presentation option, Using design template option, Adding slides, Deleting a slide, Importing Images from the outside world, drawing in presentation, Transition and build effects, deleting a slide, numbering a slide, saving presentation, closing presentation, printing presentation

TOTAL: 45 PERIODS

TEXT BOOKS

1. Peter Norton, Introduction to computers, 6th edition: Tata McGraw Hill , 2007.
2. Ran Mansfield, working in MIcrosoft Office: Tata McGraw Hill , 2008.

REFERENCE BOOKS

1. Reema Thareja, Fundamentals of Computers, First Edition: Oxford University Press, 2014.
2. Rajaraman V and Adabala N, Fundamentals of Computers,6th Edition :PHI, 2014.
3. Faithe Wempen, Computing Fundamentals: Introduction to Computers: Wiley, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to identify computer hardware and peripheral devices

CO2 To be familiar with software applications and Understand file management

CO3 To understand operating system concepts & the use of graphical user interface

CO4 To explore the Web and to gain experience working with email

CO5 Ability to use spreadsheets, word processors and presentations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	2	2	-	-	-	2	-	-	-	-	1	1	1
CO2	-	-	1	1	-	-	-	1	-	-	-	-	2	2	1
CO3	-	-	2	3	-	-	-	3	-	-	-	-	2	2	1

CO4	-	-	3	2	-	-	-	2	-	-	-	-	3	2	1
CO5	-	-	2	1	-	-	-	1	-	-	-	-	3	3	1

MA1271 BUSINESS STATISTICS - I

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To Provide with a working knowledge of how to apply statistics to business situation.
- To describe data and make evidence based decisions using inferential statistics thatare based on well - reasoned statistical arguments.

UNIT I FUNDAMENTALS OF STATISTICS AND GRAPHICAL DISPLAYS 9

Fundamentals of statistics: What is statistics - Need for statistics in business - Data and information - Population and sample - Sampling - Sampling methods - data types - Frequency - relative frequency - frequency tables - Cross tabulation - Graphical representation of frequency distribution: histogram, frequency polygon, ogive pie-chart. **CO1**

UNIT II DESCRIPTIVE AND INFERENTIAL STATISTICS 9

Descriptive statistics: descriptive and inferential statistics - grouped and ungrouped data - measures of central tendency, variability, dispersion: arithmetic mean, median, mode, quartiles, percentiles, deciles, interquartile, range, standard deviation, variance - Application in business scenario. **CO2**

UNIT III PROBABILITY 9

Probability : Basic concepts - axiomatic approach - classical definition - basic theorems - complements, union and intersection - venn diagrams - conditional probability, multiplicative law, independence event - total probability - Baye's theorem. **CO3**

UNIT IV PROBABILITY DISTRIBUTION FOR DISCRETE RANDOM VARIABLES 9

Discrete random variable - Probability distribution for discrete random variable - Cumulative distribution function - Moments and variation - special distributions: Binomial, Poisson and Hypergeometric distributions. **CO4**

UNIT V PROBABILITY DISTRIBUTION FOR CONTINUOUS RANDOM VARIABLES 9

Continuous random variable - Probability density function for continuous random variable - Cumulative distribution function - moments and variation - Special distribution: Exponential, uniform and normal distribution **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. S.C. Gupta and V.K. Kapoor, 'Elements of Mathematical Statistics', 3rd Edition, Sultan Chand& Sons, 2014, Chennai.
2. W. Mendenhall, R. Beaver and B.M. Beaver, 'Introduction to Probability and Statistics',Cengage Learning India Pvt. Ltd., 2016, New Delhi.
3. B.M. Aggarwal, 'Essential of Business Statistics', Ane Book Pvt. Ltd., 2016, Chennai.

REFERENCE BOOKS

1. Prem S. Mann, 'Introductory Statistics' Wiley Publications, 8th Edition, 2013, Singapore.
2. David M . Levine, 'Business Statistics - A first course' Person Publication, 7th Edition, 2015,Greater Noida.
3. Navai Bajpai, 'Business Statistics' Pearson Education, 2009, Greater Noida.
4. Sanjiv Jaggia and Alison Kelly, 'Business Statistics' - Communicating with numbers, TataMcGraw Hill, 2nd Edition, 2016, New Delhi.
5. L.J. Kazmier, Business Statistics, Schaum's Outlines, 4th edition, Tata McGraw Hill Publishing Company LiMIted, 2004, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of data and fundamentals of statistics. To know the best graphical representation for types of data. To gain data presentation skills and confidencE

CO2 Demonstrate an understanding of descriptive statistics by Designing and formulating sources ofbusiness decision making data. To evaluate and analyze methods for examining central tendencies

CO3 Compute basic probabilities as used in statistical applications by comparing the concepts of probability. To demonstrate the elementary rules of probability and uses for Bayes' Theorem

CO4 Prove an understanding of discrete probability distributions by assembling a discrete probability distribution. Also acquire skills to solve binomial, Poisson, Geometric distribution problems

CO5 Apply continuous random variables by analyzing data that require uniform distributions. Toconstruct problems requiring the application of normal distributions

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	2	-	-	-		-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	-		-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	-		-	-	-	-	-	-	-	-	-
CO4	-	1	-	-	-		-	-	-	-	-	-	-	-	-
CO5	-	1	-	-	-		-	-	-	-	-	-	-	-	-

MI1206	**COMPUTER SKILLS-I**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- The course is designed to aim at imparting a basic computer skill for Word Processing, Presentations and Spreadsheets

UNIT I MICROSOFT EXCEL **12**

Getting Started - Spreadsheet Formatting – Functions - Charts & Graphics - Pivot Table & Pivot Charts - Creating Daily and Monthly Sales Reports - Creating Cash Flow Statement - Creating Balance Sheet. **CO1**

UNIT II MICROSOFT WORD **12**

Getting Started - Formatting Text and Documents - Tables & Graphics - Creating Resume- Creating Business Letters - Creating Project Report. **CO2**

UNIT III MICROSOFT PRESENTATION **12**

Getting Started - Graphics & Visual Effects - Creating Company Profile Presentation - Creating Product Presentation - Creating Project Presentation. **CO3**

UNIT IV PRACTICALS OF INTERNET SERVICES **12**

WWW and Web Browser - Printing Web Pages. **CO4**

UNIT V EMAIL **12**

Basics of E-mail - Sorting and Searching emails - Mailbox: Inbox and Outbox. **CO5**

TOTAL :60 PERIODS

TEXT BOOKS

1. Taxali R.K., PC Software for Windows made simple

REFERENCE BOOKS

1. . MS Office 2013, Vishnu P. Singh, Computech Publications, 2012.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the concepts of Microsoft excel.
CO2 To understand the concepts of word processors and preparing reports.
CO3 To understand about the power point presentation
CO4 To understand world wide web and browser
CO5 To understand about emails and related to emails.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	3	2	-	-	-	3	-	-	-	-	2	3	2
CO2	-	-	2	3	-	-	-	2	-	-	-	-	3	2	3
CO3	-	-	2	2	-	-	-	2	-	-	-	-	3	2	2
CO4	-	-	2	3	-	-	-	3	-	-	-	-	2	2	2
CO5	-	-	2	2	-	-	-	3	-	-	-	-	3	3	2

SEMESTER III

MI1301	MANAGERIAL ECONOMICS - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the basic concepts of macroeconomics.

UNIT I NATIONAL INCOME **9**

Introduction to National Income –Circular flow of income, concept of National Income, Measurement, and determination of National Income. **CO1**

UNIT II INFLATION **9**

Inflation: meaning, types of inflation, Demand and cost push, Stagflation, effects of inflation in economy and Philip's Curve. Unemployment, Okun's Law, Business cycle. **CO2**

UNIT III THEORY OF INVESTMENT **9**

Meaning of investment, Types of investment, Determinants of investment. Multiplier: investment multiplier; static and dynamic, tax multiplier, foreign trade multiplier, balanced budget multiplier, leakages from multiplier, importance, and limitations. **CO3**

UNIT IV MONEY **9**

Definition of money, Functions of money, Concepts of money supply and money Demand. Money market equilibrium, monetary policy. **CO4**

UNIT V INTERNATIONAL TRADE **9**

International Trade -Importance, Advantages and Disadvantages – Trade Balance. Fiscal Policy. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Maheshwari Y, Managerial Economics, Third Edition, Prentice Hall India Learning, New Delhi, 2012.
2. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri, Anindya Sen, Economics, McGraw-Hill, Twentieth Edition, 2019.

REFERENCE BOOKS

1. Richard Lipsey and Alec Charystal, Economics, 12th edition, Oxford, University Press, New Delhi, 2011.
2. Karl E. Case and Ray C. fair, Principles of Economics, 8th edition, Pearson, Education Asia, New Delhi, 2002.
3. Diwedi. D.N. Managerial Economics, 7th Edition, Vikas Publishing House Pvt. Ltd., 2009.
4. L. Peterson and Jain,Managerial Economics, 4th edition, Pearson Education.
5. Keat Paul, K Young Philip), Erfle Steve, College Dickinson, Banerjee Sreejatha, Managerial Economics, Pearson Education, Seventh Edition, 2017.
6. Karl E. Case, Ray C. Fair, Sharon E. Oster, Principles of Macroeconomics, Pearson Education, Twelfth Edition, 2019.
7. Froyen, Macroeconomics: Theories and Policies, Pearson Education India, 10th Edition, 2013.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	To understand the fundamental concept of Macro Economics and the concept of national income with the circular flow of income.

CO2	To understand the concept of inflation and unemployment.
CO3	To know the concept of investment and multiplier effects.
CO4	To understand the concept of money and monetary policies created by RBI
CO5	To explain the concept of international trade and fiscal policy.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	3	3	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	3	2	-	-	-	-	-	-	-	-	-
CO3	3	3	1	-	3	3	-	-	-	-	-	-	-	-	-
CO4	2	3	1	-	3	2	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	3	2	-	-	-	-	-	-	-	-	-

MI1302 MANAGEMENT INFORMATION SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental concepts of system, information.
- To study the importance of decision making
- To impart the knowledge of development of MIS
- To know the security issues of MIS

UNIT I CONCEPTUAL FOUNDATIONS 9

Introduction to Systems and Basic Systems Concepts, Elements of System, Characteristics of System, Types of Systems, System Approach to Problem Solving.
Information Systems: Definition & Characteristics, Types of Information, Role of Information in Decision Making. **CO1**

UNIT II MANAGEMENT DECISION MAKING 9

Simon's Model of Decision Making. Concepts of Management Organization and Hierarchy of Management Activity, Structured Vs. Unstructured Decisions, Formal Vs. Informal Systems, Levels of Management.
Introduction to different kinds of Information Systems and Concept, Characteristics and Components: ESS, EIS, DSS, MIS, KWS, TPS, OAS and EDP- GDSS **CO2**

UNIT III AN OVERVIEW OF MANAGEMENT INFORMATION SYSTEM 9

Definition & Characteristics, History of MIS Components of MIS, Frame Work for Understanding MIS, Types of Computers Used by Organizations in Setting up MIS, Hardware support for MIS, The Structure of Management Information System. **CO3**

UNIT IV DEVELOPING INFORMATION SYSTEMS **9**

Analysis & Design of Information Systems: Implementation & Evaluation. Pitfalls in MIS Development. Functional MIS: A Study of Marketing, Personnel, Financial and Production MIS. **CO4**

UNIT V SECURITY AND ETHICAL ISSUES **9**

Introduction, Control Issues in Management Information Systems, Security Hazards, Ethical Issues, Technical solutions for Privacy Protection. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Management Information system, Bidgoli, Chattopadhyay, Cengage learning original edition 2012 reprint 2016.
2. "Management Information Systems", Davis, Gordan B. & Olson, M.H, Second Edition, 2008.

REFERENCE BOOKS

1. Management Information Systems: Managing the Digital Firm (14th Edition) by Kenneth C. Laudon and Jane P. Laudon 2015.
2. Management Information Systems, Goyal, D.P., Fourth Edition, Macmillan. 2014
3. "Management Information Systems", Kanter, J.,Third Edition, PHI.
4. Information Systems for Modern Management, Murdick, Robert G., & Ross, Joel E., & Claggett, James R., Third Edition, PHI. 1985.
5. Analysis, Design & Implementation of Information System, Lucas, Fourth Edition,1992.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Understand the systems basics and information systems, role of information in decision making.
CO2 Know different types of decisions and information systems.
CO3 Understand well about the requirements and implementation of MIS
CO4 Analyze and design the IS, Different types of functional information systems.
CO5 Understand the security and ethical issues in MIS.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	1	-	-	-	-	-	-	-	-	2	3	1
CO2	3	2	2	3	-	-	-	-	-	-	-	-	3	2	2
CO3	2	3	3	2	-	-	-	-	-	-	-	-	1	3	2
CO4	3	3	3	3	-	-	-	-	-	-	-	-	2	3	1
CO5	1	1	-	3	-	-	-	-	-	-	-	-	-	1	3

MI1303 MANAGEMENT ACCOUNTING

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES

- Acquire fundamental knowledge in Management Accounting.

UNIT I INTRODUCTION **9**

Management Accounting – Meaning, Scope, Importance and Limitations – Management Accounting Vs. Financial Accounting – Analysis of Financial Statements – Meaning, Tools and Methods – Comparative, Common Size Statements, Trend Analysis. **CO1**

UNIT II RATIO ANALYSIS **9**

Ratio Analysis – Meaning, Merits and Demerits – Classification of Ratios –Liquidity, Profitability, Turnover, Capital structure and Leverage ratios (simple problems only). **CO2**

UNIT III FUND FLOW AND CASH FLOW STATEMENTS **9**

Preparation of Fund Flow and Cash Flow (as per AS3) Statements (simple problems only). **CO3**

UNIT IV BUDGETARY CONTROL **9**

Budgetary Control – Meaning, steps involved – Merits and Demerits – Types of Budgets – Production, Sales, Cash – Fixed and Flexible Budgets. **CO4**

UNIT V MARGINAL COSTING **9**

Marginal Costing (excluding decision making) – BEP, Break Even Charts, Limiting Factors. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reddy and Hari Prasad Reddy, Management Accounting by Margham Publications, 2015, Chennai.
2. S.N.Maheswari, Management Accounting, Sultan Chand & Sons, 2014, New Delhi
3. Sharma and Shashi Gupta, Management Accounting, Kalyani Publishers, 2014, New Delhi.

REFERENCE BOOKS :

1. Horngren, Surdem, Stratton, Burgstahler, Schatzberg, Introduction to Management Accounting, PHI Learning, 2015
2. Charles T. Horngren and Gary N. Sundem, Introduction to Management Accounting, Prentice Hall.
3. Chadwick, Essence of Management Accounting, 2014, Prentice Hall of India, Pvt. Ltd.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	To understand the basics of management accounting and work out problems is basic financial analysis tools

CO2	To analyse the relationship between various items in the financial statement and measure the solvency, profitability, activity and leverage.
CO3	To analyse the actual flow of fund and cash from the financial statements.
CO4	To understand concept of budgeting and budgeting control and create the various type of Budgets.
CO5	To evaluate the marginal costing involved in the production process.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO2	3	3	-	-	-	-	-	-	-	3	-	-	2	3	2
CO3	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO4	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1
CO5	3	3	-	-	-	-	-	-	-	3	-	-	2	3	1

MI1304	MARKETING MANAGEMENT - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- The objective of this course is to provide basic knowledge of concepts, principles, tools and techniques of marketing.
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give the man understanding of the basic philosophies and tools of marketing management.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT **9**

Introduction-Market and Marketing-the Exchange Process -Core Concepts of Marketing-Functions of Marketing-Importance of Marketing-Marketing Orientations-Marketing Mix-The Traditional 4Ps-The Modern Components of the Mix- The Additional 3Ps – Developing an Effective Marketing Mix. **CO1**

UNIT II MARKETING ENVIRONMENT **9**

Introduction-Environmental Scanning-Analyzing the Organization's Micro Environment-Company's Macro Environment, Differences between Micro and Macro Environment-Techniques of Environment Scanning-Marketing organization-Marketing Research and the Marketing Information System, Types and Components. **CO2**

UNIT III CONSUMER AND BUSINESS BUYER BEHAVIOR **9**

Introduction —Characteristics-Types of Buying Decision Behavior-ConsumerBuyingDecision Process—Buying Motives-Buyer Behavior Models-Characteristics of Business Markets-Differences between Consumer and Business Buyer Behavior-Buying Situations in Industrial/Business Market-Buying Roles in Industrial Marketing-Factors that Influence Business Buyers-Steps in Business Buying Process.	**CO3**
UNIT IV SEGMENTATION, TARGETING AND POSITIONING	**9**
Introduction-Concept of Market Segmentation- Benefits of Market Segmentation-Requisites of Effective Market Segmentation-The Process of Market Segmentation —Bases for Segmenting Consumer Markets – Targeting (T)-Market Positioning (P).	**CO4**
UNIT V INTERNATIONAL MARKETING MANAGEMENT	**9**
Introduction-Nature of International Marketing-International Marketing Concept–International Market Entry Strategies- Approaches to International Marketing- International Product Policy	**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Sherlekar S.A, Marketing Management, Himalaya PublishingHouse,2016.
2. Philip Kortler and Kevin Lane Keller,MarketingManagement,PHI15thEdition,2015

REFERENCE BOOKS

1. V.S.Ramaswamy S.Namakumari, Marketing Management Global Perspective, Indian Context, Macmillan PublishersIndia,5thedition,2015
2. S.H.H. Kazmi,Marketing Management,2013,Excel BooksIndia.
3. Dr.C.B.Gupta&Dr.N.RajanNair,MarketingManagement-textandCases,17thedition2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To gain Knowledge of basic understanding in solving marketing related problems.
CO2 To understand marketing management process, and the marketing mix elements.
CO3 To analyze the nature of Consumer and Industrial buying behavior.
CO4 To understand Segmenting, Targeting and Positioning
CO5 To understand the basic concepts of International marketing, entry strategies and international policy.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	P O2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	2	2	-	-	-	-	-	-	-	3	1	2
CO2	3	2	-	2	2	-	-	-	-	-	-	-	2	2	2
CO3	3	3	-	1	2	-	-	-	-	-	-	-	3	2	1
CO4	3	3	-	2	3	-	-	-	-	-	-	-	3	1	2
CO5	3	3	-	2	2	-	-	-	-	-	-	-	3	1	2

MI1305	BUSINESS LAW-I	L	P	T	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic legal terms and concepts used in law pertaining to business

UNIT I THE INDIAN CONTRACT ACT 1872 **9**

Definition of contract, essential elements, types, and characteristics of a contract, Formation of a contract, performance of contracts, breach of contract and its remedies, Quasi-contracts - Contract of Agency: Nature of agency, Creation, and types of agents, Authority and liability of Agent and principal: Rights and duties of principal and agents, termination of agency. **CO1**

UNIT II SALE OF GOODS ACT, 1930 **9**

Definition of Sales, essentials for the contract of sale, Documents of title, risk of loss, Guarantees and Warranties, the performance sale of contracts, conditional sales, and rights of an unpaid seller **CO2**

UNIT III NEGOTIABLE INSTRUMENTS ACT, 1881 **9**

Negotiable Instruments Act 1881: Definitions, Nature, and requisites of negotiable instruments. Types of negotiable instruments, the liability of parties, holder in due course, special rules for Cheque and drafts, discharge of negotiable instruments. **CO3**

UNIT IV COMPANY LAW **9**

Definitions - Nature of a company, characteristics of a company, Types of companies, Formation of Company – Memorandum and articles of association, Prospectus, Power, duties and liabilities of Directors, winding up of companies, Corporate Governance **CO4**

UNIT V THE COMPETITION ACT, 2002 **9**

Objectives of Competition Act, the features of Competition Act, components of Competition Act, Competition Commission of India, Appellate Tribunal, offenses and penalties under the Act. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Maheshwari, S.N. and S.K. Maheshwari; *A Manual of Business Law*, 6th Edition, Himalaya Publishing House, 2015.
2. Kuchhal M.C., Modern Indian Company Law, 20th edition 2015,Shree Mahavir Book Depot.
3. Kapoor, N. D.; *Elements of Mercantile Law*, 30th edition, Sultan Chand & Sons, New Delhi, 2015

REFERENCE BOOKS

1. Gulshan S.S. and Kapoor G.K., “Business Law including Company Law”,2013, New Age International Private Limited Publishers.
2. Dr. & Agnihotri, Dr. Dagar, “Business Law, 2nd edition, 2014”,Galgotia Publishing Company.
3. Chawla, Garg, and Sareen: Mercantile Law 7th Ed. Kalyani publishers
4. Dr. Singh, Avtar; Company Law, Eastern Book Co. Lucknow, Bharat Law House, Delhi, 2016

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To familiarize the concept of legal provisions. To understand the objectives of various Acts related to business transactions. To understand the provisions related to Contract & Agency.
CO2	To understand the provisions related to Commercial Law. To understand the provisions related to the sale of goods.
CO3	To familiarize the concept of legal provisions. To understand the provisions related to the Negotiable instruments Act.
CO4	To familiarize the concept of legal provisions related to Company Law. To understand the provisions related to the memorandum and articles of associations, prospects, and winding up of the company.
CO5	To familiarize the concept of legal provisions related to the Competition Act and the penalties therein.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	1	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	-	2	-	-	-	-	-	-	-	-	-	1	1	1
CO3	2	-	2	-	-	-	-	-	-	-	-	-	2	1	2
CO4	3	-	3	-	-	-	-	-	-	-	-	-	2	2	3
CO5	2	-	1	-	-	-	-	-	-	-	-	-	2	1	3

MA1371 BUSINESS STATISTICS - II **L T P C**
3 0 0 3

CAREER OBJECTIVES

- To introduce some of the ideas of statistics, emphasizing the applications of these methods inthe business scenario
- To provide basic knowledge to do estimation of population, test hypothesis
- To provide knowledge about the various parametric and non-parametric tests

UNIT I SAMPLING DISTRIBUTION AND ESTIMATION **9**

Sampling- sampling methods - sampling distribution - sampling and non-sampling errors - mean and standard deviation of sampling distribution-Estimation- Introduction- Estimators and properties - Point and Interval estimate - introduction to t-distribution- interval estimation of population mean: large and small samples- Interval estimation of population mean - finite and infinite population- Interval estimation for population proportion- large and small samples. **CO1**

UNIT II HYPOTHESIS TESTS I **9**

Introduction to hypotheses and testing hypotheses - significance level- one tail and two tail tests - region of rejection - hypothesis test about mean: large and small samples - hypothesis test about mean: known and unknown population standard deviation - Hypothesis test about mean : finite and infinite population - Hypothesis test about proportions; large and small samples. **CO2**

UNIT III HYPOTHESIS TESTS II **9**

Hypothesis tests about difference between two sample means : large and small case- hypothesis tests about difference between two sample means for paired samples - hypothesis tests about difference between two sample proportions -large and small case- F-test for two sample standard deviations. ANOVA one and two way. **CO 3**

UNIT IV PARAMETRIC TESTS **9**

Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data- Rank sum test- Kolmogorov-Smirnov : test for goodness of fit, comparing two populations- Mann – Whitney U test and Kruskal Wallis test- One sample run test. **CO4**

UNIT V CORRELATION AND REGRESSION **9**

Correlation – Coefficient of Determination – Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate **CO5**

TEXT BOOKS

1. Statistics for Management, Richard I. Levin, David S. Rubin, Sanjay Rastogi Masood Husain Siddiqui, Pearson Education, 7th Edition, 2016.
2. Introductory Statistics Prem.S.Mann, , 7th Edition, Wiley India, 2016.

REFERENCE BOOKS

1. Complete Business Statistics, Aczel A.D. and Sounderpandian J 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2012.
2. Business Statistics using Excel - Glyn Davis and Branko Pecar, Oxford University Press.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To apply the different sampling methods for designing and selecting a sample from a population. To understand the basic principles underlying survey design and estimation

CO2 To formulate null and alternative hypothesis and apply small, large sample in real life problems. To obtain confidence interval of a parameter and its relation with testing of hypothesis problem.

CO3 To explore small and large datasets to create testable hypotheses and identify appropriate Statistical tests. ANOVA statistical significance result is independent of constant bias and scaling errors as well as the units used in expressing observations.

CO4 To learn the types of parametric and non-parametric tests for testing the hypothesis and make decisions.

CO5 To calculate and interpret the correlation between two variables. To calculate the simple linear regression equation for a set of data. To employee the principles of linear regression and correlation, including least square method, predicting a particular value

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	P O2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	1	-

MI1306	**COMPUTER SKILLS - II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

EXPERIMENTS:

Practicals on Spreadsheet:

Exercise 1: Look up and Reference
- VLOOKUP
- HLOOKUP
- INDEX
- MATCH
- OFFSET
- TRANSPOSE

Exercise 2: Conditional statements
- If-else statement
- AND
- OR
- NOT
- TRUE
- Nested If-else

Exercise 3: Conditional formatting
- Conditional formatting with multiple cell rules
- Color scales and icon sets in conditional formatting
- New rules and managing existing rules

Practicals on Word Processors:

Exercise 1: Tools for editing a document
- Auto-text
- Autocorrect
- Spelling & Grammar tool
- Document Dictionary
- Page formatting

- Bookmark

Exercise 2: Mail Merge
Exercise 3: Macros
Exercise 4: Styles
Exercise 5: Linking and embedding objects
Exercise 6: Templates

Practicals on Presentations:
Exercise 1: Create a presentation with animation effects
Exercise 2: Create a looping introduction
Exercise 3: Loop a motion path animation
Exercise 4: Master slide
Exercise 5: Sound effects
Exercise 6: Videos
Exercise 7: Macros

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Taxali R.K., PC Software for Windows made simple,2nd edition , McGraw Hill Education,2001
2. Microsoft Excel 2016 Step by Step, Frye Curtis, PHI, 2016.
3. MS Office 2013, Vishnu P. Singh, Computech Publications, 2012.

COURSE OUTCOMES:
Upon completion of the course, students will be able to

CO1 To understand the advanced concepts of spread sheets and it applications
CO2 To understand the purpose and functions of logical conditioning functions in spread sheets
CO3 To understand the conditional formatting in spreadsheets
CO4 To understand the formatting conditions in word processors
CO5 To understand the purpose and importance of presentation tools in management concepts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	2	3	-	-	-	3	-	-	-	-	1	1	1
CO2	-	-	2	3	-	-	-	3	-	-	-	-	2	2	1
CO3	-	-	2	3	-	-	-	3	-	-	-	-	2	1	1
CO4	-	-	2	3	-	-	-	3	-	-	-	-	1	1	1
CO5	-	-	3	3	-	-	-	3	-	-	-	-	3	2	1

SEMESTER IV

MI1401	INDIAN ECONOMY	L T P C
		3 0 0 3

COURSE OBJECTIVES

1. To understand the various aspects of Indian Economy.
2. To develop a perspective on the different problems and approaches to economic planning and development in India.

UNIT I MEANING AND CHARACTERISTICS **9**

Economy – definition - Classification of economy – developing and developed economy. Indian economy – structure of the economy – agricultural, industrial and service sectors. Sectoral contribution to the national income of Indian economy. Characteristics of Indian economy in terms of demographic, economic and social indicators. Major development issues in India. **CO1**

UNIT II INDIAN DEMOGRAPHY **9**

Population – size and growth of population. Features of Indian population –sex ratio, rural and urban distribution, age distribution, density of population, occupational distribution. Causes for population growth – natural growth rate of population. Problems of higher population – poverty: definitions of poverty – measures to eradicate poverty. **CO2**

UNIT III ECONOMIC PLANNING AND AGRICULTURAL SECTOR **9**

Planning in India – five year planning. Evolution of Indian planning. Major achievements and failures of Indian planning since first five year planning. Objectives of 12th five year plan. Allocation of resources for agricultural, industrial and service sectors of the economy. Agricultural growth during the post reform period- achievements and failures **CO3**

UNIT IV INDUSTRIAL SECTOR **9**

Industrial policy, 1991 - Liberalization, privatization and globalization of Industrial sector - Industrial growth since economic reform. Growth and problems of SMEs. **CO4**

UNIT V FOREIGN TRADE **9**

India's balance of trade and payment since 2007. Exports and Imports – pattern of trade. Trade policy of India, 1991. BOT and exchange rate. Government of India's measures to manage exchange rate fluctuations. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Datt Ruddar and KPM Sundaram, Indian Economy, 67th Edition S. Chand & Company Ltd., New Delhi, 2013.
2. Gaurav Datta Ashwani Mahajan, Indian Economy. 68 th Edition S. Chand & Company Ltd., New Delhi, 2013.

REFERENCE BOOKS

1. Misra S.K. & V. K. Puri, Indian Economy, 32nd Edition, Himalaya Publication house, Mumbai.2014.
2. Gopal Ji,Suman Bhakri & Anisha Bhakri, Indian Economy -Performance and Policies, 2 nd Edition, Vikas Publishing, New Delhi,2015.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the economic issues in range of economic activities in the Indian Economy.
CO2 To apply the demographic features of Indian Economy to solve economic issues.
CO3 To understand the features of Indian economy and known the five year plan.
CO4 To identify the economic factors contributing to industrial growth.

CO5 To analyze the role of Indian Economy in global context and how different factors affect them.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	P O2	PO 3	P O4	PO 5	P O6	P O7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	2	3	-	-	-	-	-	-	2	3	1
CO2	3	-	-	-	2	2	-	-	-	-	-	-	2	3	2
CO3	3	-	-	-	3	3	-	-	-	-	-	-	2	3	1
CO4	3	-	-	-	3	3	-	-	-	-	-	-	2	3	1
CO5	3	-	-	-	3	2	-	-	-	-	-	-	2	3	1

MI1402 DATA MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the fundamentals of database systems
- To learn widely used Relational Database Management Systems (RDBMS) and its related concepts
- To understand emerging database technologies like NoSQL

UNIT I DATABASE MANAGEMENT SYSTEMS **9**

Data, Database, Database Management Systems, Types of Database Management Systems – Relational, Hierarchical, Network, and Object oriented database management systems, Entity Relationship Model (E-R Model) **CO1**

UNIT II RELATIONAL DATABASE MANAGEMENT SYSTEMS (RDBMS) **9**

Relational Model -Relations, Tuples, domains and type of keys, Boyce–Codd Normal Form, normalization of databases– The first and second normal form of databases. **CO2**

UNIT III INTRODUCTION TO SQL **9**

Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language, Cartesian Product and Joins, Use of Union, Intersection, Minus, SQL operators and functions, SQL select statement and type of queries, In, Exists, Group by Having and Like clause in SQL. **CO3**

UNIT IV XML **9**

Structure of XML Data, XML Document Schema, Querying and Transformation, Storage ofXML Data, XML Data and World Wide Web. **CO4**

UNIT V EMERGING DATABASE TECHNOLOGIES - NOSQL **9**

Why NoSQL? Overview of NoSQL, Brief Introduction to various NoSQL Data Models– Key-Value, Document, Column-Family Stores and Graph and Limitations of NoSQL **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts,

SixthEdition, Tata McGraw-Hill,2013
2. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson,Seventh Edition, Global Edition,2010

REFERENCE BOOKS

1. C. J. Date, "An Introduction to Database Systems", Eighth Edition, Pearson Education,2004.
2. Pramod J. Sadalage and Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1st Edition, Addison-Wesley Professional,2012.
3. Guy Harrison, Next Generation Databases: NoSQL, NewSQL, and Big Data, Apress,2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the importance of database and the different types used in Organizations.

CO2 To understand the importance of Relational Database Management Systems and the steps indesigning it for the organization.

CO3 To understand the importance of SQL and its functions in accessing he data from an database.

CO4 To understand the use of XML in analyzing, designing and implementing data access on awireless networks.

CO5 To understand the recent developments in database technologies and its impact in businessprocess.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	1	-	-	-	2	2	-	-	-	1	1	2
CO2	1	-	3	2	-	-	-	1	1	-	-	-	3	1	2
CO3	2	-	2	1	-	-	-	3	2	-	-	-	3	2	2
CO4	1	-	1	3	-	-	-	2	3	-	-	-	3	1	3
CO5	2	-	2	2	-	-	-	1	1	-	-	-	1	1	2

MI1403	CORPORATE ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the nuances involved in accounting procedures and standards followed in Corporate Houses

UNIT I SHARES 9

Shares – Definition – Types of shares – Accounting treatment for various modes of issue of Shares – Full consideration, instalment, Bonus shares, Rights issue, Employee Stock Option, Sweat Equity, Private Placement, Buy Back of Shares – Forfeiture and Re-issue of Shares. **CO1**

UNIT II DEBENTURES **9**

Definition – Classification - Accounting treatment for issue of Debentures – for cash and non-cash consideration - Accounting treatment for Redemption of Debentures – in lump sum, in instalments,by conversion, Insurance Policy and Sinking Fund methods. **CO2**

UNIT III PREFERENCE SHARES **9**

Redemption of Preference Shares – Meaning and relevant provisions of Companies Act – Accounting treatment for redemption of Preference Shares – out of profit, fresh issue of shares, by conversion – Minimum fresh issue of shares – Profit Prior to Incorporation – Meaning – Method and procedure for ascertaining and accounting treatment of Profit or Loss Prior to Incorporation. **CO3**

UNIT IV UNDERWRITING **9**

Underwriting of Shares and Debentures – Meaning, need and importance – Types of underwriting – Factors affecting valuation of Goodwill and Shares – Methods of valuing Goodwill– Average Profit, Super Profit, Capitalization methods – Methods of valuation of shares – NetAsset, Yield and Fair Value methods. **CO4**

UNIT V FINAL ACCOUNTS **9**

Form of Statement of Profit and Loss and Account and Balance Sheet - Preparation of Company Final Accounts with adjustments - Basics (theory only) of Human Resource Accounting, Inflation Accounting, Accounting Standards, Social Responsibility Accounting **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS:

1.Corporate Accounting, S.N.Maheswari and S.K.Maheswari, Vikas Publishing, 2015
2.Corporate Accounting, V.K.Goyal, Printice Hall India Learning Pvt. Ltd.2012

REFERENCE BOOKS:

1. Corporate Accounting ,V.Rajasekaran, R.Lalitha, Pearson India, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To familiarize the concept of Shares
CO2 To understand the concept of Debentures,
CO3 To familiarize the concept of Redemption of preference shares & Profit prior to incorporation.
CO4 To familiarize the concept of Underwriting of shares & Debentures and valuing Good will.
CO5 To familiarize the concept of statement of Profit & Loss Account & Balancesheet.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	P O4	P O5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	3	-	-	3	3	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-	3	2	-

CO3	3	3	-	-	-	-	-	-	-	3	-	-	3	3	-
CO4	3	3	-	-	-	-	-	-	-	3	-	-	3	2	-
CO5	3	3	-	-	-	-	-	-	-	3	-	-	3	2	-

MI1404	**QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:

- To learn the various principles and practices of Quality Management

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality – different perspectives. Introduction to total Quality - Concept of total Quality - Design, inputs, process and output - Cost of quality - Attitude and involvement of top management - TQM culture, TQM framework, benefits, awareness and obstacles. **CO1**

UNIT II QUALITY GURUS 9

Contributions of Crosby, Deming, Masaaki Imai, Feigenbaum, Ishikawa, Juran, Oakland, Shigeo Shingo, and Taguchi. **CO2**

UNIT III QUALITY PRINCIPLES 9

Leadership – Strategic quality planning, - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating. **CO3**

UNIT IV QUALITY TOOLS 9

Overview of Quality Tools - The seven traditional tools of quality – New management tools – Six- sigma– Benchmarking – FMEA – Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM. **CO4**

UNIT V QUALITY MANAGEMENT SYSTEMS 9

Introduction Quality management systems – IS/ISO 9004:2000 – Quality System – Elements, Documentation guidelines for performance improvements. Quality Audits - QS 9000 – ISO 14000 – Concepts. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2010
2. Poornima M. Charantimath, Total Quality Management, Pearson Education, Second Edition, 2011.

REFERENCE BOOKS

1. Suganthi, L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd. (2006)
2. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To Understand the evolution of Quality management
CO2 To Understand quality philosophies and practices
CO3 To Apply statistical process control to enhance quality
CO4 To Apply quality tools to enhance organization's quality performance
CO5 To Bring awareness of quality management systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	1	-	-	-	-	-	-	-		1	1	1
CO2	2	-	-	3	-	-	-	-	-	-	-		2	1	2
CO3	3	-	-	3	-	-	-	-	-	-	-		3	2	2
CO4	2	-	-	2	-	-	-	-	-	-	-		3	2	2
CO5	2	-	-	3	-	-	-	-	-	-	-		2	1	2

MI1405 BUSINESS LAW – II

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide the student with knowledge of the legal environment in which a consumer and businesses operates.
- To acquire problem solving techniques and to be able to present coherent, concise legal argument.

UNIT I TAXATION 9

Constitutional frame work of taxation, direct and indirect tax. Elementary knowledge of central sales tax. Goods and Service Tax – Concepts, Scope, Methods of GST Calculation, Practical Implications of GST. **CO1**

UNIT II THE CONSUMER PROTECTION ACT, 1986 9

Definition – consumer – complainant – goods – service – complaint – unfair trade practices – restrictive trade practices – rights and remedies for consumers - consumer protection council – consumer disputes redressal agencies. **CO2**

UNIT III THE INFORMATION TECHNOLOGY ACT, 2000 9

Definitions, Cyber Laws in India, Rationale and need of information technology act-Objectives of Information Technology ACT- Changes in Information Technology Act. Electronic records and governance. Cybercrimes – offences and penalties under IT Act, 2000. **CO3**

UNIT IV DIGITAL SIGNATURE 9

Definitions, Legal recognition of Digital signature, Regulation of certifying authorities, Appointment of certifying authorities to issue digital signature certificates, Procedure, Duties of subscribers, Cyber regulations appellate tribunal, Computer crimes. **CO4**

UNIT V INTELLECTUAL PROPERTY RIGHTS 9

Meaning of IPR, objectives and types of IPR. Copy rights: Meaning and purpose of copyright, procedure for Registration of Copyrights, Right of owner of copyrights. Patent Act: Meaning and Advantages of patent, Procedure for Registration of patents **CO 5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Maheshwari, S.N. and S.K. Maheshwari; A Manual of Business Law, 6th Edition, Himalaya Publishing House, 2015.
2. Rama Gopal, C., Business Legislation, New Age International Publisher, New Delhi, 1st edition 2008

REFERENCE BOOKS

1. Kapoor, N. D.; Elements of Mercanlite Law, 30th edition, Sultan Chand & Sons, New Delhi,2015
2. Kuchhal, M. C.; Business Law, Vikas Publishing House, New Delhi, 6th edition, 2013.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	To familiarize the concept of Taxations.
CO2	To understand the provisions under Consumer protection act.
CO3	To familiarize the concept of IT act 2000.
CO4	To know the concept Digital signature and to understand nature and duty of Certifying Authority.
CO5	To familiarize the concept of intellectual property and procedures for registration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	-	-	-	-	-	-	-	-	-	2	3	1
CO2	2	-	3	-	-	-	-	-	-	-	-	-	2	3	2
CO3	3	-	2	-	-	-	-	-	-	-	-	-	2	3	1
CO4	3	-	3	-	-	-	-	-	-	-	-	-	2	3	1
CO5	3	-	3	-	-	-	-	-	-	-	-	-	2	3	1

MI1406	**APPLIED OPERATIONS RESEARCH - I**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To learn the fundamentals of operations research applied in business decision making.
- To apply the techniques constructively to make effective business decisions

UNIT I INTRODUCTION TO LINEAR PROGRAMMING	**9**
Introduction to applications of operations research in functional areas of management. Linear Programming-formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase)	**CO1**
UNIT II TRANSPORTATION MODELS	**9**
Transportation Models (Minimising and Maximising Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI / Stepping Stone method. Case of Degeneracy. Transhipment Models.	**CO2**
UNIT III ASSIGNMENT PROBLEMS	**9**
Assignment Models (Minimising and Maximising Problems) – Balanced and Unbalanced Problems. Solution by Hungarian and Branch and Bound Algorithms. Travelling Salesman problem. Crew Assignment Models.	**CO3**
UNIT IV INVENTORY MODELS	**9**

Inventory Models – EOQ and EBQ Models (With and without shortages), Quantity Discount Models. **CO4**

UNIT V GAME THEORY **9**

Game Theory-Two person Zero sum games-Saddle point, Dominance Rule, Methods of matrices, graphical and LP solutions. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gupta P.K, Hira D.S, Problem in Operations Research, S. Chand and Co, 2007.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.

REFERENCE BOOKS

1. Hamdy A Taha, Introduction to Operations Research, Prentice Hall India, Seventh Edition, Third Indian Reprint 2004.
2. Frederick & Mark Hillier, Introduction to Management Science – A Modeling and case studies approach with spreadsheets, Tata Mcgraw Hill, 2005.
3. G. Srinivasan, Operations Research – Principles and Applications, PHI, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to understand and analyse managerial problems in industry so that resources are used more effectively.
CO2 To solve specialized linear programming problems like transportation models.
CO3 To solve specialized linear programming problems like assignment models.
CO4 To understand the concepts of inventory control for better decision making.
CO5 Understand the concepts of game theory and analysing in an interactive situation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO2	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO3	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO4	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO5	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1

MI1407 **ACCOUNTING SOFTWARE**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

- Understand the techniques of using accounting software package for recording accounts.

Details of Experiments

S. No	Exp. No.	Name	Duration
1	1	Company creation and management	4
2	2	Accounting Groups and Ledger creation and management	4
3	3	Cash and Bank transactions	4
4	4	Accounting Voucher creation – Sales, Purchase, Receipt and Payment vouchers	4
5	5	Contra, Journal vouchers, Debit Notes, Credit Notes	4
6	-	Extended experiment - 1	4
7	6	Trial Balance, Final Accounts without adjustments	4
8	7	Final Accounts with adjustments,	4
9	8	Report generation	4
10	-	Extended experiment - 2	4
11	9	Inventory management –Creating Stock Groups, Stock Categories, Godown/Location, Unit of Measure, Stock items, Inventory Masters	4
12	10	Inventory Voucher creation – Purchase Order, Sales Order, Rejections, Stock Journal, Delivery Notes, Receipt Voucher	4
13	11	Preparation of Bank Reconciliation Statement	4
14	12	Export and Import of Data, Data Security, Printing of Reports	4
15	-	Extended experiment - 3	4

TOTAL : 60 PERIODS

REFERENCE BOOKS:

1. Mastering Tally ERP 9, Ashok K. Nadhani, BPB Publications, 2016.
2. Accounting with Tally 9, Dinesh Maidasani, Laxmi Publications, 2014.
3. Tally ERP 9, Kogent Learning Solutions Inc., Dreamtech Press, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basics of Computer based accounting procedures.
CO2 To understand the concepts and steps involved in Computer based accounting process.
CO3 To understand the procedures of data entry and access of data.
CO4 To understand the retrieval of data and generating different types of reports.
CO5 To understand the concepts of data transfer to different users.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)	PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	2	-	-	-	-	-	-	-	-	3	1	1
CO2	-	3	-	2	-	-	-	-	-	-	-	-	3	1	1
CO3	-	3	-	2	-	-	-	-	-	-	-	-	3	1	1
CO4	-	3	-	2	-	-	-	-	-	-	-	-	3	1	1
CO5	-	3	-	2	-	-	-	-	-	-	-	-	3	1	1

		L	T	P	C
MI1408	**SEMINAR I**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVE

- To expose the students to the basics of business etiquette.

Students are expected to prepare and present on topics suggested below:

1. Business Communication Etiquette
2. Professional Image
3. Body language and Gestures
4. Impression management
5. Networking
6. Restaurant Etiquette
7. Business travel planning
8. Hosting and attending Events
9. Business meetings
10. Time Management

TOTAL : 30 PERIODS

REFERENCE BOOKS:

1. Barbara Pachter , The Essentials of Business Etiquette: How to Greet, Eat, and Tweet Your Way to Success, McGraw - Hill Professional, 2013
2. Shital Kakkar Mehra Business Etiquette: A Guide for The Indian Professional Paperback, HarperCollins, 2012
3. Cyrus M. Gonda, Master of Business Etiquette Paperback, Embassy Books; First Edition, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the importance of Business Communication Etiquette and Professional Image.
CO2 To understand various Body language and Gestures and Impression management.
CO3 To Learn and apply networking and restaurant Etiquette..
CO4 To Learn Business travel planning and hosting and attending Events.
CO5 To Learn the importance of Business meetings and Time Management.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	3	-	-		-	-	-	-	-	2	3	1

CO2	-	-	-	2	-	-		-	-	-	-	-	2	3	2
CO3	-	-	-	3	-	-		-	-	-	-	-	2	3	1
CO4	-	-	-	3	-	-		-	-	-	-	-	2	3	1
CO5	-	-	-	3	-	-		-	-	-	-	-	2	3	1

SEMESTER V

MI1501 APPLIED OPERATIONS RESEARCH - II **L T P C**

3 3 0 0

COURSE OBJECTIVES

- To impart knowledge in concepts and models used in Operations Research
- To apply the techniques constructively to make effective business decisions.

UNIT I ADVANCED LINEAR PROGRAMMING - I **9**

Introduction to principles of Duality, Solution by Dual Simplex method and Revised Simplex method. Sensitivity of optimal LP solutions. **CO1**

UNIT II ADVANCED LINEAR PROGRAMMING - II **9**

Integer Programming – Branch and Bound (Graphical method), Gomory's cutting plane method - Pure and Mixed IPP. **CO2**

UNIT III DECISION THEORY **9**

Decision making under uncertainty – Criterion of optimism – Criterion of pessimism – Savage criterion – Criterion of realism – Criterion of rationality, Decision making under risk – Expected Monetary value – Expected Opportunity Loss – Expected Value of Perfect Information, Decision tree analysis. **CO3**

UNIT IV QUEUING MODELS **9**

Queuing Models - Single (M/M/1): (α/FIFO), (M/M/1): (N/FIFO) and multi-Channel Models (M/M/C): (α/FIFO). **CO4**

UNIT V REPLACEMENT MODELS **9**

Replacement of items that deteriorate gradually, Replacement of items that fail suddenly - Individual and group replacement of items. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gupta P.K, Hira D.S, Problem in Operations Research, S. Chand and Co, 2007.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.

REFERENCE BOOKS

1. Hamdy A Taha, Introduction to Operations Research, Prentice Hall India, Seventh Edition, Third Indian Reprint 2004.
2. Frederick & Mark Hillier, Introduction to Management Science – A Modeling and case studies approach with spreadsheets, Tata Mcgraw Hill, 2005.
3. G. Srinivasan, Operations Research – Principles and Applications, PHI, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the alternative courses of action and their effect on values of the objective function.

CO2 To construct linear integer programming models and discuss the solution techniques

CO3 To propose the best strategy using decision making methods under risk and uncertainty

CO4 To understand different queuing situations and find the optimal solutions using models for different situations.

CO5 To understand and formulate a replacement policy to determine the time at which replacement of equipment is economical

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO2	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO3	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO4	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1
CO5	-	3	-	-	-	2	-	-	-	-	-	-	3	1	1

MI1502 ENVIRONMENTAL SCIENCE AND MANAGEMENT

L	T	P	C
3	3	0	0

COURSE OBJECTIVES

- To study the nature and facts about environment.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT AND ECOSYSTEMS 9

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids. **CO1**

UNIT II BIODIVERSITY 9

Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity. **CO2**

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes, climate change, acid rain, disaster management: floods, earthquake, cyclone and landslides. **CO3**

UNIT IV NATURAL RESOURCES 9

Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, equitable use of resources, resource conservation, Sustainable development. **CO4**

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT 9

Urban problems related to energy –water conservation, rain water harvesting, watershed management– resettlement and rehabilitation of people, Environment protection act – Air(Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Christopher Sheldon and Mark Yoxon, "Installing Environmental management Systems – a step by step guide" Earthscan Publications Ltd, London, 1999.

REFERENCE BOOKS

1. ISO 19011: 2002, "Guidelines for quality and/or Environmental Management System auditing, Bureau of Indian Standards, New Delhi, 2002
2. Paul L Bishop „Pollution Prevention: Fundamentals and Practice‟, McGraw- Hill International, Boston, 2000.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of IndiaPvt,New Delhi,2009

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Will become aware of the ecosystem, bio system, the natural resources and the environment.

CO2	Will work towards protecting the environment as well as be aware of the Acts.
CO3	Resource conservation will help individuals to appreciate the utility value of the resources.
CO4	Will understand the various resources available across the globe.
CO5	Will learn the environmental issues and to protect the natural resources.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	3	-	-	-	-	-	3	3	3	2	1
CO2	-	-	-	-	3	-	-	-	-	-	3	3	3	2	1
CO3	-	-	-	-	3	-	-	-	-	-	3	3	2	2	1
CO4	-	-	-	-	3	-	-	-	-	-	3	3	2	2	2
CO5	-	-	-	-	3	-	-	-	-	-	3	3	2	2	2

MI1503	FINANCIAL MANAGEMENT - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Acquaint the students with the basic concepts of Financial Management and its pivotal role in the corporate world.
- Encourage students to think critically about issues in corporate financial management.
- Understand some of the approaches used by a Finance Manager with respect to financial analysis, profit planning, control and management of current resources.

UNIT I OVERVIEW OF FINANCIAL MANAGEMENT **9**

Financial Management – Meaning, Scope and Functions – Objectives of Financial Management – Profit maximization Vs. wealth maximization-Agency Problems-Managers Vs. Shareholders. Role of finance manager-current issues of finance manager-financial ethics and corporate social Responsibility. **CO1**

UNIT II SOURCES OF FINANCE **9**

Long term finance- Shares, Debentures, Preference stock and term loans- Features, Rights, Advantages and Disadvantages- Short Term Sources-Trade credit, Commercial paper, Certificate of deposit and Bank Finance. **CO2**

UNIT III FINANCING DECISION **9**

Leverages- Operating, Financial and Combined Leverages – Measurement of leverages. EBIT-EPS Analysis- Indifference point. Capital structure - Factors influencing Capital structure - Optimal capital structure. **CO3**

UNIT IV DIVIDEND DECISION **9**

Objectives of Dividend Policies-Types- Determinants of dividend policy - forms of dividend- Bonus shares- Share split- Reverse Split-Buy back of shares. **CO4**

UNIT V WORKING CAPITAL MANAGEMENT **9**

Meaning, Types and Sources of Working Capital – Factors affecting Working Capital – Computation of Working Capital - Management of Cash, Receivables and Inventory – Concept, Need and Techniques. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. M.Y.Khan and P.K.Jain, Financial Management: Text, Problems and Cases, 7th Edition, McGraw-Hill Education (INDIA) Pvt. Ltd., New Delhi. Year 2017.
2. Prasanna Chandra, Financial Management: theory and practice, 9th Edition, McGraw-Hill Education (INDIA) Pvt. Ltd. Company Ltd., New Delhi. Year 2015.

REFERENCE BOOKS

1. I.M.Pandey, Financial Management, 11th Edition, Vikas Publishing House Pvt. Ltd., New Delhi. Year 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts related to financial management.

CO2 To understand the various source of long-term and short-term sources of funds.

CO3 To analyze and evaluate the financial decisions of an organization.

CO4 To analyze and evaluate the dividend decisions of an organization.

CO5 To understand various aspects of working capital.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	3	3	-	2	3	-	3	-	-	2	3	3
CO2	3	3	-	2	3	-	2	3	-	3	-	-	2	3	2
CO3	2	3	-	3	3	-	3	3	-	3	-	-	2	3	2
CO4	2	3	-	3	3	-	3	3	-	3	-	-	2	3	2
CO5	3	3	-	3	3	-	3	3	-	3	-	-	2	3	1

MI1504 **INFORMATION MANAGEMENT**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the importance of information in business.
- To know the technologies and methods used for effective decision making in an organization

UNIT I INTRODUCTION **10**

Data, Information, information as resource, Intelligence, decision making with MIS- tactical, operational and strategic decisions, ethical and social issues. **CO1**

UNIT II ENTERPRISE INFORMATION SYSTEM **10**

Business process integration, Motivation for Enterprise systems-ERP system-Finance and accounting module, HR management Module, Manufacturing and operations Module, Sales and Marketing module, CRM. **CO2**

UNIT III MANAGING DATA RESOURCES **8**

Need for data management, Challenge for data management-data independence, consistency, data access, data administration, concurrency, security, recovery, data base design, data warehouses - uses. **CO3**

UNIT IV DATA MINING AND BUSINESS INTELLIGENCE **8**

Data Mining-virtuous cycle of data mining, data mining application for effecting decision making, Business Intelligence-framework of business intelligence, BI implementation and integration. **CO4**

UNIT V RECENT TRENDS IN INFORMATION SYSTEMS **9**

Introduction to E-commerce/E-business-B2B, B2C, C2C, portal E-governance; Cloud computing, Internet of Things (IoT). **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Robert Schultheis and Mary Summer, Management Information Systems – The Managers View, Tata McGraw Hill, 2008.
2. Kenneth C. Laudon and Jane Price Laudon, Management Information Systems – Managing the digital firm, PHI Learning / Pearson Education, PHI, Asia, 2012.
3. Gordon Davis, Management Information System: Conceptual Foundations, Structure and Development, Tata McGraw Hill, 21st Reprint 2008.

REFERENCE BOOKS

1. Rahul de, Managing Information systems in business government and society, Wiley, 2016.
2. EfraimTurban,Ramesh Shardam,DursunDelen and David King ,Business Intelligence- A managerial Approach , second edition, Pearson 2012
3. Michael J.A.Berry and Gordon S.Linoff, Data mining Techniques, Second edition, Wiley 2004.

4. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005. 9th edition, 2013.

5. Raplh Stair and George Reynolds, Information Systems, Cengage Learning, 10th Edition, 2012.

6. Frederick Gallegor, Sandra Senft, Daniel P. Manson and Carol Gonzales, Information Technology Control and Audit, Auerbach Publications, 4th Edition, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concept of MIS and how in helps in decision making.
CO2 To understand the importance and uses of different applications / Modules.
CO3 To handle the data efficiently and effectively.
CO4 To learn data mining for better decision making and learn to frame business intelligence.
CO5 To know the recent trends in Information Systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	1	2	-	2	-	-	-	-	-	1	2	-
CO2	3	2	-	3	3	-	1	-	-	-	-	-	2	1	1
CO3	2	3	-	3	-	-	3	-	-	-	-	-	3	3	3
CO4	2	3	-	3	3	-	1	-	-	-	-	-	3	2	1
CO5	1	3	-	3	2	-	3	-	-	-	-	-	2	2	2

MI1505	MARKETING MANAGEMENT - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the changing business environment.
- To identify the indicators of marketing management principles and practices.
- To understand fundamental premise underlying market driven strategies.

UNIT I PRODUCT MANAGEMENT 9

Product- Meaning, Classification of Products, Levels of Products - Product Hierarchy - New Product Development Strategies and Product Life Cycle (PLC) - Product Line Strategies - Product Mix Strategies - Packaging –Labeling- Branding **CO1**

UNIT II PRICING 9

Introduction - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Product Mix Pricing Strategies - Adjusting the Price of the Product - Initiating and Responding to the Price Changes - Global and International Pricing. **CO2**

UNIT III DISTRIBUTION MANAGEMENT 9

Introduction - Need for Marketing Channels - Decisions Involved in Setting up the Channel - Channel Management Strategies - Introduction to Logistics Management - Reverse Logistics - Backward and Forward Integration - Introduction to Retailing and Wholesaling.	**CO3**

UNIT IV PROMOTION MANAGEMENT **9**

Non-personal and personal communication channels: Introduction - Integrated Marketing Communications (IMC) - Communication Development Process - Budget Allocation Decisions in Marketing Communications - Introduction to Advertising, Fundamentals of Sales Promotion - Basics of Public Relations and Publicity- Personal Selling - Direct Marketing.	**CO4**

UNIT V CUSTOMER RELATIONSHIP MANAGEMENT **9**

Introduction - Relationship Marketing Vs. Relationship Management - Definitions of Customer Relationship Management (CRM) - Types of CRM - Significance of Customer Relationship Management - Managing Customer Loyalty and Development - Reasons Behind Losing Customers by Organizations - Social Actions Affecting Buyer-Seller Relationships.	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Marketing Management- An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
2. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India,5th edition, 2015.

REFERENCE BOOKS

1. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.
2. Marketing Management- text and Cases, Dr. C.B.Gupta & Dr. N.Rajan Nair, 17th edition, 2016.
3. Marketing Management, Sherlekar S.A, Himalaya Publishing House, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand product, new product development and product line strategies and branding.
CO2	To understand the various pricing strategies and about the global and international pricing.
CO3	To understand the various marketing channels and strategies and Retailing & Wholesaling.
CO4	To understand the concept communication channels, Advertising, Sales promotion, PR and Sales management process.
CO5	To examine the fundamentals of Customer Relationship Management and customer loyalty.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	-	1	3	-	1	-	-	-	-	-	2	1	2
CO2	3	1	-	1	3	-	3	-	-	-	-	-	3	1	1

CO3	1	1	-	1	3	-	1	-	-	-	-	-	2	1	2
CO4	1	1	-	1	3	-	3	-	-	-	-	-	2	1	1
CO5	1	2	-	1	3	-	3	-	-	-	-	-	3	1	2

MI1506 ORGANIZATIONAL BEHAVIOUR L T P C

3 0 0 3

COURSE OBJECTIVES

- Understand the implications of individual and group behavior in organizational context.
- Understand the concept of organizational behavior, the social organization and the diverse environment alongside with the management of groups and teams.

UNIT I INTRODUCTION TO ORGANIZATIONAL BEHAVIOUR - I 9

Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models- Diversity in work place- Organization structure – Formation - Types. **CO1**

UNIT II INDIVIDUAL PROCESSES I 9

Personality – Types – Factors Affecting Personality –Theories– Emotional Intelligence- Learning – Types of learners – The learning process –- Types of Learning Styles . **CO2**

UNIT III INDIVIDUAL PROCESSES II 9

Perceptions – Importance – Factors influencing perception. Attitudes – Characteristics – Components – Motivation – Importance – Types – Theories - Effects on work behavior- Work Stress - Causes-Managing stress. **CO3**

UNIT IV GROUP DYNAMICS 9

Groups in organizations – types- Group dynamics –Team and team building – Developing high performance teams - Communication in teams and organizations – Control. Leader Vs Managers- Power and influence in work place- Organizational Politics. **CO4**

UNIT V ORGANIZATIONAL PROCESSES 9

Organizational culture and climate – Factors affecting organizational climate – Organizational change – Importance – the change process – Resistance to change – Managing change- Conflict-Conflict resolution. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. L.M.Prasad, -Organisational Behaviour,-Sultan Chand & Sons
2. Fred Luthans-Organisational Behaviour- McGraw Hill Book Co

REFERENCE BOOKS

1.Bhattacharya-Organization Behavior-Oxford University Press, 2013.
2.Mc Shane, Steven L, Mary Von Glinow and Radha R. Sharma, - Organizational Behavior, Tata McGraw Hill, New Delhi

COURSE OUTCOMES:
Upon completion of the course, students will be able to

CO1 To understand the fundamentals of organizational behavior.

CO2 To understand the different types of personality.

CO3 To understand the fundamentals of motivation.

CO4 To understand group dynamics, various ways to resolve conflicts.

CO5 To study the different styles of leadership, power and politics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	2	-	-	-	2	-	-	-	-	2	2	3
CO2	2	-	2	1	-	-	-	1	-	-	-	-	3	3	3
CO3	3	-	3	2	-	-	-	3	-	-	-	-	3	3	3
CO4	3	-	3	1	-	-	-	3	-	-	-	-	2	3	2
CO5	3	-	3	3	-	-	-	3	-	-	-	-	3	2	2

MI1507 DATA ANALYSIS LABORATORY - I

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- The objective is to provide a hands-on knowledge of how to apply statistics to business situation using spreadsheets.

Exercise 1 : Random number generation
Exercise 2 : Rank and percentile
Exercise 3 : Simple Random sampling and Systematic Random sampling
CO1

Exercise 4 : Descriptive Statistics
CO2

Exercise 5 : t-test
Exercise 6 : z-test
Exercise 7 : F-Test
Exercise 8: ANOVA
Exercise 9: Chi-square test
CO3

Exercise 10: Mann- Whitney U test
Exercise 11 : Kruskal-Wallis test **CO4**
Exercise 12: Correlation and Regression
Exercise 13: One sample Run test
Exercise 14: Moving average and Exponential Smoothing **CO5**
Exercise 15: Trend analysis

TOTAL : 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	To understand the sampling techniques
CO2	To apply the Descriptive Statistics
CO3	To apply the Parametric analysis
CO4	To apply the Nonparametric analysis
CO5	To make forecast

REFERENCES

1. David R. Anderson, et al, "An Introduction to Management Sciences: Quantitative approaches to Decision Making", (13th edition) South-Western College Pub, 2011.
2. William J. Stevenson, Ceyhun Ozgur, "Introduction to Management Science with Spreadsheet", Tata McGraw Hill, 2009
3. Hansa Lysander Manohar, "Data Analysis and Business Modelling using Microsoft Excel" PHI, 2017.
4. David M. Levine et al, “Statistics for Managers using MS Excel" (6th Edition) Pearson, 2010.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	1	-			-	-	1	-	-	-	-	-	-	-
CO2	-	1	-			-	-	1	-	-	-	-	-	-	-
CO3	-	1	-			-	-	1	-	-	-	-	-	-	-
CO4	-	1	-			-	-	1	-	-	-	-	-	-	-
CO5	-	1	-			-	-	1	-	-	-	-	-	-	-

MI1508	SEMINAR II	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To enable the learners in understanding of the basic concept economics.
- To enable the learners to have exposure on international monetary fund, world trade organisation and the Nobel Memorial Prize in Economic Sciences

UNIT I CAPITALISM AND COMMUNISM **6**

Capitalism – Varieties, History, Pros & Cons, Socialism; Industrial Revolution; Communism- History, Theory, concepts, and types. **CO1**

UNIT II PROTECTIONISM AND GLOBALIZATION **6**

Protectionism- Policies, history, and growth and current world trend. Globalization- Cultural, political, dimensions, and criticism. **CO2**

UNIT III ECONOMICS AND POVERTY **6**

Economic growth, development of research, global indicators, impact evaluation, elements, inequality, and Poverty. **CO3**

UNIT IV IMF and WTO **6**

International Monetary fund – Functions, history, member countries, voting power; criticism. **CO4**
World Trade Organization-Functions, Principles, Organizational structure, decision making, membership, disputes, agreements, budget, and criticism.

UNIT V BEHAVIORAL ECONOMICS AND THE NOBEL MEMORIAL PRIZE IN ECONOMIC SCIENCES **6**

Behavioral Economics-History, Prospect Theory, Concept, honors, awards, and The Nobel Memorial Prize in Economic Sciences. **CO5**

TOTAL : 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 The learners are able to apply the basic concepts of capitalism and communism.
CO2 The learners can learn about Protectionism and Globalization.
CO3 The learner can understand the economics and reason for poverty.
CO4 The learner get familiar with IMF and WTO.
CO5 The learner is provided exposure on the behavioral Economics and The Nobel Memorial Prize in Economic Sciences

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	3	3	-	-	-	-	-	-	-	3	1	-
CO2	-	-	-	3	3	-	-	-	-	-	-	-	3	2	-
CO3	-	-	-	3	3	-	-	-	-	-	-	-	3	1	-
CO4	-	-	-	3	3	-	-	-	-	-	-	-	3	1	-
CO5	-	-	-	3	3	-	-	-	-	-	-	-	3	1	-

SEMESTER - VI

MI1601	BANKING THEORY AND PRACTICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The course aims at imparting knowledge about the Banking Operations among the students

- Students will get exposure for banking operations
- Students will be exposed to various dimensions of day to day operations.

UNIT I BANKING AN OVERVIEW **9**

Origin and development of banking in India- Functions of Banks-Credit creation-Techniques of Credit creation and its limitations –Commercial banks – role in the Indian money market -Reserve bank of India- Functions-Monetary policy-Instrument of Credit control operation–relation to cooperative banks and credit institutions. **CO1**

UNIT II OPERATIONS OF BANK ACCOUNTS **9**

Types of Bank Accounts – fixed deposits – Fixed deposit receipts and its implications, savings deposit accounts – current Accounts – recurring deposit Accounts – new deposit savings schemes introduced by banks – super savings package – cash certificate, annuity deposit – reinvestment plans – perennial premium plan – Non-resident (external) accounts scheme-Demat account. **CO2**

UNIT III BANKER AND CUSTOMER RELATIONSHIP **9**

Definition of Banker-Customer-General relationship-Bankers lien-Secrecy of customer Account, banker as borrowers-Opening, conducting and closing of accounts of special types of customer-Minor- Lunatic-Drunkard-Married Woman-Trustee-Partnership-Joint stock companies. **CO3**

UNIT IV METHODS OF PAYMENT AND COLLECTION **9**

Cheque - Requisites of cheque - crossing of cheque- types of crossing-Different kinds of crossing and their significance. -Duties and responsibilities of the paying banker-Endorsement-Kinds of endorsement-Statutory protection to the banker and paying banker-Payment in due course. Collection of cheque- Duties and responsibilities of collecting banker- precautions, statutory protection to the collecting banker-Pass book- Effect of entries in the pass book. Loans and advances- Forms of advance, Cash credit-Over draft- Principles of lending-Modes of creating charge, Lien, Pledge, Hypothecation, Mortgage. **CO4**

UNIT V ELECTRONIC BANKING AND ELECTRONIC FUND TRANSFER **9**

E-banking-internet banking services-mobile banking-ATM-Credit cards and debit cards- MICR cheques- Features, benefits and challenges. Electronic fund transfer-RBI guidelines-Benefits of electronic clearing systems-Interbank transfer- Real time gross settlement (RTGS)-National Electronic fund transfer (NEFT)-Immediate payment service (IMPS). **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Banking Theory, Law & Practice – Sundaram and Varshney, Sultan Chand Company, New Delhi.
2. Banking Law, Theory and Practice- S.N. Maheswari, Kalyani Publications, 2009.

REFERENCE BOOKS

1. Banking Law and Practice, (Fourth Revised Edition) K.P. Kandasami, R.Parameswaran, S. Natarajan, Sultan Chand Company, New Delhi, 2013.
2. Banking Theory and Practice, 21/e, K C Shekhar & Lekshmy Shekhar, Vikas Publishing

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To help them gather knowledge on banking and financial system in India

CO2	To provide knowledge about commercial banks and its products
CO3	To enable them to understand better customer relationship
CO4	To make them understand various methods of payment and collection
CO5	To create awareness about modern banking services like e-banking, m-banking and internet banking

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	3	-	-	3	1	-
CO2	3	-	-	-	-	-	-	-	-	3	-	-	3	1	-
CO3	2	-	-	-	-	-	-	-	-	3	-	-	3	1	-
CO4	2	-	-	-	-	-	-	-	-	3	-	-	3	1	-
CO5	2	-	-	-	-	-	-	-	-	3	-	-	3	1	-

MI1602 **BUSINESS POLICY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- The objective of this course is to help students develop the skills for formulating business policy. It provides an understanding of a firm's operative environment and how to sustain competitive advantage

UNIT I BUSINESS ENVIRONMENT **9**

Business- Definition- Business as a social System / Economic System: Objective of Business; Business Environment - The industry Environment - The International Environment **CO1**

UNIT II ENVIRONMENTAL ANALYSIS **9**

External Environment analysis (PEST) - Internal Environment analysis (SWOT) – analysis of specific environment (Michael E Porter's 5 S Model) **CO2**

UNIT III SOCIETY AND BUSINESS **9**

Society and Business: Business ethics, Social responsibility of Business - Business obligations - Corporate Governance - Social Audit - Business Policy in Various Economic Systems **CO3**

UNIT IV BUSINESS POLICY **9**

Business policy – Characteristics – objectives- importance - Elements of business policy - Classification of policies - Parameter of policy - Development of business policy - Implementation of policy. **CO4**

UNIT V MAJOR & MINOR POLICIES **9**

Supporting policies - Composite policies & Contingency Policies - HR Policies - Marketing Policies- Production Policies - Purchase Policies - Financial Policies - Distribution Policy. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mamoria and Mamoria – Business planning and Policy, Himalaya Publishing house – Revised Edition 2017

2. Cheryl Van Deusen, Steven Wiiamson, Harold C Babson, Business policy and strategy: the art of competition, & 7th edition, Auerbach Publications, 2007. Forida

REFERENCE BOOKS

1. Strategic Management and Business Policy: Text and Cases" by Appa C. Rao and Parvathiswara B. Rao
2. WIlliam H. Tomlinson, Robert G. Murdick Business Policy and Strategy: An Action Guide, Sixth Edition

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the business and environmental factors affecting business activities

CO2 To understand the social responsibilities of businessmen and ethics to be followed by them.

CO3 To know basic concepts of business policies and its development & implementation.

CO4 To understand various major & minor policies

CO5 To make acquaint with the basic concepts of strategies and its development & implementation

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-		3	-	-	-	-	-	-	-	1	-	-
CO2	2	-	-		3	-	-	-	-	-	-	-	1	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

MI1603	**ENTERPRISE RESOURCE PLANNING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the various enterprise business process.
- To understand the emerging trends in ERP developments.
- To obtain knowledge on the various ERP software products available in Market.
- Role of ERP in business transformation.

UNIT I ERP - INTRODUCTION **9**

Enterprise – An Overview, Business Process, Introduction to ERP, Basic ERP Concepts, Justifying ERP Investments, Risks of ERP, Benefits of ERP. **CO1**

UNIT II ERP AND TECHNOLOGY **9**

ERP and Related Technologies, Business Intelligence (BI) and Business Analytics (BA), E-Commerce and E-Business, Business Process Reengineering (BPR), Data Warehousing and Data Mining, On-line Analytical Processing (OLAP), Product Life Cycle Management (PLM), Supply Chain Management (SCM), Customer Relationship Management (CRM), Geographic Information System (GIS), Advanced Technology and ERP Security. **CO2**

UNIT III ERP IMPLEMENTATION **9**

Implementation Challenges, ERP Implementation Strategies, ERP Implementation Life Cycle, Pre-Implementation Tasks, Implementation Methodologies, ERP Deployment Methods, ERP Project Teams, Vendors and Consultants, Employees and Employee Resistance, Contracts with Vendors, Consultants and Employees, Training and Education, Data Migration, Project Management and Monitoring, Post-Implementation Activities, Success and Failure Factors of an ERP Implementation.	**CO3**
UNIT IV BUSINESS MODULES	**9**
Business Modules of an ERP Package, Financials, Manufacturing, Human Resource Management, Plant Maintenance, Materials Management, Quality Management, Marketing, Sales, Distribution and Service.	**CO4**
UNIT V ERP - PRESENT AND FUTURE	**9**
Turbo Charge the ERP System, Enterprise Application Integration (EAI), ERP and E-Business, ERP and Total Quality Management, Future Directions and Trends in ERP.	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Alexis Leon, ERP demystified, Third Edition Tata McGraw-Hill, 2014.
2. Enterprise Resource Planning Concepts And Practices By Vinod Kumar Garg & N Venkatakrishna, 2nd Edition, PHI, 2012.

REFERENCE BOOKS

1. Enterprise Resource Planning by Ashim Raj Singla, 2nd edition, Cengage Learning (I) P.Ltd.2016.
2. Ellen Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", 4th Edition, Cengage Learning India Pvt.Ltd., New Delhi, 2012.
3. Enterprise Resource Planning – A Managerial Perspective by D P Goyal, Tata McGraw Hill Education, 2011.
4. Enterprise Resource Planning - Murthy CSV, Himalaya Publishing House Pvt. Ltd., 2012.
5.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Knowledge of ERP implementation cycle.
CO2 Awareness of core and extended modules of ERP.
CO3 Various ERP products available in Market.
CO4 Challenges in implementing ERP for an organization
CO5 Knowledge about present and Future of ERP

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	3	1	-	2	-	-	-	-	-	2	2	2
CO2	2	-	-	2	3	-	2	-	-	-	-	-	3	1	1
CO3	1	-	-	1	2	-	1	-	-	-	-	-	2	2	3
CO4	2	-	-	3	3	-	3	-	-	-	-	-	2	1	1
CO5	1	-	-	2	1	-	2	-	-	-	-	-	3	1	1

MI1604 HUMAN RESOURCE MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide knowledge about management issues related to staffing, training, performance, compensation, human factors consideration, and compliance with human resource requirements.

UNIT I PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT **9**

Evolution of human resource management – The importance of the human capital – Role of human resource manager –Challenges for human resource managers - trends in Human resource policies – Computer applications in human resource management – Human resource accounting and audit. **CO1**

UNIT II HUMAN RESOURCE PLANNING AND RECRUITMENT **9**

Importance of Human Resource Planning – Forecasting human resource requirements – matching supply and demand - Internal and External sources. Recruitment - Selection – induction and Socialization. **CO2**

UNIT III TRAINING AND DEVELOPMENT **9**

Training- purpose- methods - benefits- resistance. Executive development programmes – Common practices - Benefits – Self-development – Knowledge management. **CO3**

UNIT IV EMPLOYEE ENGAGEMENT **9**

Compensation plan – Reward – Motivation – Application of theories of motivation – Career management – Mentoring - Development of mentor – Protégé relationships. **CO4**

UNIT V PERFORMANCE EVALUATION AND CONTROL **9**

Performance evaluation – Methods- Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance – Methods – Requirement of effective control systems grievances – Causes – Implications – Redressal methods. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14th Edition, Pearson Education Limited, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014.

REFERENCE BOOKS

1. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
2. Bernadin , Human Resource Management ,Tata Mc Graw Hill ,8th edition 2012.
3. Wayne Cascio, Managing Human Resource, McGraw Hill, 2007.
4. Ivancevich, Human Resource Management, McGraw Hill 2012.
5. 5. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the various aspects of HRM
CO2 To analyse the demand and supply of HR and forecast human resource requirements
CO3 To understand the methods of training and executive development programs
CO4 To understand motivation techniques career management and mentor protégé relationship
CO5 To familiarize the process of performance evaluation and grievance redressal systems of the employees.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	3	3	-	3	-	-	-	-	-	2	1	2
CO2	3	3	-	3	1	-	3	-	-	-	-	-	3	1	1
CO3	2	3	-	2	3	-	3	-	-	-	-	-	2	1	2
CO4	3	3	-	3	3	-	3	-	-	-	-	-	2	1	1
CO5	2	3	-	1	3	-	3	-	-	-	-	-	3	1	2

MI1605	OPERATIONS MANAGEMENT – I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make learners understand about the basic concepts related to operations management.
- To apply statistical and mathematical tools and techniques to issues in operations management.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT **9**

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit and framework. **CO1**

UNIT II FORECASTING AND CAPACITY PLANNING **9**

Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning – Long range, Types, Developing capacity alternatives. **CO2**

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS **9**

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work and Method Study **CO3**

UNIT IV MATERIALS MANAGEMENT **9**

Materials Management – Objectives, Planning, Budgeting and Control. Purchasing – Objectives, Functions, Policies, Vendor Management Inventory, Vendor rating and Value Analysis. **CO4**

UNIT V SCHEDULING AND PROJECT MANAGEMENT

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, Shop floor control. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12th Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 2002.

REFERENCE BOOKS

1. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009.
2. Russel and Taylor, Operations Management, Wiley, Fifth Edition, 2006.
3. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2004.
4. Chary S. N, Production and Operations Management, Tata McGraw Hill, Third Edition, 2008.
5. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.
6. Mahadevan B, Operations Management Theory and practice, Pearson Education, 2007.
7. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basic concepts of operation, its evolution and the challenges faced by the modern operations management.
CO2	To analyze the forecasting of demand using quantitative and qualitative techniques and evaluate the capacity planning and facility Design of an Organization.
CO3	To understand and create product, process and work system design.
CO4	To evaluate the need and requirement of material and create the materials budget.
CO5	To evaluate and create schedule for the project under various conditions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	1	1	-	-	3	-	-	-	2	-	-
CO2	3	3	-	-	2	3	-	-	3	-	-	-	2	-	-
CO3	3	3	-	-	1	3	-	-	3	-	-	-	2	-	-
CO4	2	2	-	-	2	2	-	-	3	-	-	-	2	-	-
CO5	3	3	-	-	1	3	-	-	3	-	-	-	2	-	-

MI1606	PRINCIPLES OF INSURANCE	L	T	P	C
		3	3	3	0

COURSE OBJECTIVES

- To understand about the principles of insurance and the essential of a valid insurance contract.
- To understand the relationship between insurers and their customers and the importance of insurance contracts.

UNIT I THE CONCEPT OF INSURANCE AND ITS EVOLUTION AND SCOPE OF INSURANCE **9**

The basics insurance – Introduction to Insurance - evolution of insurance - Nature and Scope of Insurance, how insurance operates today – importance of insurance – Common terms used in Life and nonlife insurance. History of Insurance in India. **CO 1**

UNIT II DIFFERENT TYPES OF INSURANCE **9**

Health Insurance - Auto Insurance - Group Insurance – Unit linked insurance Accident or Sickness Insurance - Property Insurance - Liability Insurance- Other Types of Insurance. Insurance Customers: Understanding insurance customers – different customer needs - importance of customers – customer mindsets - customer satisfaction - customer behavior at purchase point - customer behavior when claim occurs - importance of ethical behavior. **CO 2**

UNIT III THE BUSINESS OF INSURANCE **9**

Management of risk by individuals – management of risk by insurers – role of insurance in economic development and social security. Premium Payment, Lapse and Renewal: Premium, Surrender Values, Non- Forfeiture Options, Revival; Assignment, Nomination, Loan and Surrenders, Foreclosure. Policy Claims: Maturity Claims Survival Benefits, Death Claims, Claim Concession Presumption of Death, Accident Benefit Options, Settlement Options, Valuation and Surplus. **CO 3**

UNIT IV THE INSURANCE CONTRACT **9**

Terms of an insurance contract - principles which form the foundation of insurance - significance of the principle of insurable interest – the principle of indemnity - the principle of subrogation - the principle of contribution – disclosure of all relevant information - principle of utmost good faith - the relevance of proximate cause - the insurance contract. Reinsurance: What is reinsurance - Need for reinsurance - Functions of reinsurance - Types of reinsurance – Reinsurance. **CO 4**

UNIT V DISPUTE RESOLUTION MECHANISM **9**

Settlement of Claims, Insurance Laws and Regulations - Insurance Act 1938, Life Insurance Corporation Act 1956, IRDA Act 1999, Ombudsman Scheme Tax Benefits under Life Insurance Policies. **CO 5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Mishra M.N. - Insurance Principle & Practice, (Sultan Chand & Company Ltd., NewDelhi) Rev. Edn. 2007
2. Tripathy N.P - Insurance: Theory and Practice (Prentice Hall India Learning Private Limited (2005)
3. George E. Rejda & Michael McNamara - Principles of Risk Management and Insurance, 12th Edition (Pearson Series in Finance) 2013

REFERENCE BOOKS

1. P. Periasami- Principles and Practice of Insurance (Himalaya Publications, 2012)
2. Jones H & Long D-Principles of insurance: life, health and annuities; LOMA, 1997.
3. S. Arunajatesan and T.R. Vishwanathan: Risk Management and Insurance: Macmillan publications 2009, New Delhi.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand basics of insurance and its evolution in India.
CO2 To remember the various types of insurance and the customer associated with those types.
CO3 To understand and evaluate the risk associated with insurance.
CO4 To understand the legal procedures related to the insurance contract and its practical issues.

CO5 To understand the post insurance activity and the governing and monitoring body related to Insurance.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	1	-	-	-	2	-	-
CO2	3	-	-	-	-	-	-	-	1	-	-	-	2	-	-
CO3	3	-	-	-	-	-	-	-	3	-	-	-	2	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	1	-	-	-	1	-	-

MI1607	**INDUSTRIAL VISIT**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVE:

- To introduce the students to industries and their working style.

TOTAL: 60 PERIODS

Students are expected to go on industrial visit to at least 4 firms and submit a diary of events - of things learned at the industries.

COURSE OUTCOME:

Upon completion of the course, students will be able to

CO1 The students will be able to understand the functioning of the organizations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-

MI1608 **SEMINAR III**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To introduce the students to the Self Development topics.

Students are expected to prepare and present on Topics suggested below:

1. Pygmalion Effect
2. Transaction analysis
3. Strokes
4. Life Positions
5. Self-efficacy/ Confidence
6. Positive Psychology
7. Psychological Capital
8. Happiness/ Subjective well-being
9. Emotional Labour
10. Creating Rapport

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the Pygmalion effect and transaction analysis.
CO2 To understand stroke and importance of life positions.
CO3 To understand self-efficacy/ confidence and positive psychology
CO4 To understand psychological capital and happiness/ subjective well-being
CO5 To understand emotional labour and creating rapport

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

SEMESTER – VII

MI1701 **FINANCIAL MANAGEMENT-II**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To Understand the operational nuances of a Finance Manager.
- To Comprehend the technique of making decisions related to finance functions.

UNIT I FUNDAMENTAL VALUATION CONCEPTS 9

Time value of money – compounding and discounting techniques-valuation of Annuity – Multi period compounding – Valuation of securities – valuation of shares and bonds - Concept of risk and return – single asset and portfolio.	**CO1**
UNIT II INVESTMENT DECISIONS – CAPITAL BUDGETING	**9**
Capital budgeting: Principles and techniques – Nature of capital budgeting – identifying relevant cash flows – Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index – Comparison of DCF techniques.	**CO2**
UNIT III INVESTMET DCISIONS – COST OF CAPITAL	**9**
Cost of Capital – Meaning, Features and Importance – Classification of Cost of Capital – Computation of Cost of Capital – Debt, Preference and Equity Shares and Retained Earnings – Weighted Average Cost of Capital.	**CO3**
UNIT IV CAPITAL STRUCTURE AND DIVIDEND THEORIES	**9**
Capital Structure Theories – Definition and Assumptions – NI, NOI, MM and Traditional Approaches – Capital structure planning in practice – Dividend Theory and Policy – Meaning – Water, Gordan, MM Models – Rights evaluation and Effect of Bonus issue.	**CO4**
UNIT V FINANCIAL MARKETS	**9**
Financial Markets – Capital Market – New Issues market – Secondary Market, Money Market and Government Securities Market – Asset based financing – Lease, Hire Purchase, Venture Capital Financing.	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. I M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018
2. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8th edition, 2017

REFERENCE BOOKS

1. Srivatsava, Mishra, Financial Management, Oxford University Press, 2012.
2. Prasanna Chandra, Financial Management, 9th edition, Tata McGraw Hill, 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basic concepts related to the time value of money and to evaluate risk and return.
CO2	To analyze the cash inflow and outflow and evaluate the capital budgeting decision.
CO3	To understand the concepts related to the cost of capital and analyze the various source of capital.
CO4	To understand the theories of capital structure and to create the capital structure for an organization.
CO5	To understand various aspects of the Financial Market.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	-	2	2	-	3	2	-	2	-	-	3	2	3
CO2	2	2	-	2	3	-	2	2	-	2	-	-	2	3	2
CO3	2	3	-	2	2	-	2	3	-	2	-	-	3	2	3

CO4	3	2	-	2	2	-	3	2	-	2	-	-	2	2	2
CO5	2	2	-	2	2	-	2	2	-	2	-	-	2	2	2

MI1702 **INCOME TAX** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To prepare students for a professional qualification in taxation

UNIT I CONCEPTS AND DEFINITION **9**

Basic concepts – Income Tax Act, 1961 – definition – previous year – assessment year – person – assesse, income, total income – casual income, capital and revenue – residential status and incidence of tax, incomes exempt under section 10 – Heads of Income. **CO1**

UNIT II INCOME FROM SALARY AND HOUSE PROPERTY **9**

Salary Income – basis of charge – different forms of salary, allowances, perquisites and their valuation –deduction from salary – computation of taxable salary. House Property – basis of charge – determination of annual value – GAV, NAV – Income from let – out – property – self occupied property – deductions – computation of taxable income. (Simple problems only) **CO2**

UNIT III INCOME FROM BUSINESS/ PROFESSION **9**

Profits and gains from business and profession – basis of charge – methods of accounting – deductions – disallowances, computation of taxable income. **CO3**

UNIT IV INCOME FROM CAPITAL GAINS **9**

Capital gains – basis of charge – short term and long-term capital gains – indexed cost of acquisition and improvement – exemptions – chargeability of short and long term capital gains – deduction under section 80C – introduction to direct taxes code. **CO4**

UNIT V COMPUTATION OF INCOME FOR INDIVIDUALS AND FILING RETURNS **9**

Preparation of return of income for individuals – PAN – Signing and Filing of Returns – Online Filings – Tax Planning – Relevant case problems. Income tax administration-penalties-when an assessee becomes liable for penalty and prosecution-Appeals-Appellate authorities-revisionary powers of commission- appeals to high court and supreme court – income tax authorities. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1.Gaur & Narang, "Income Tax Law & Practice', DP Kalyani Publishers, Latest Edition, New Delhi.

REFERENCE BOOKS

1.Bhagavati Prasad, ' Income Tax', Wishwa Prakashan, New Delhi.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	Describe about basic concepts, terminologies and residential status of an assessee
CO2	Compute income from salary and house property by applying the provisions of income tax Act.
CO3	To analyse the income from business and Profession
CO4	Make use of Income tax act to assess the taxable income from capital gain
CO5	Explain the powers and responsibility of income tax authorities and assess the role of PAN and importance of assessment procedures and methods of filling of return.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	3	3	-	3	1	3
CO2	3	3	-	-	-	-	-	-	-	3	3	-	3	1	3
CO3	3	3	-	-	-	-	-	-	-	3	3	-	3	1	3
CO4	3	3	-	-	-	-	-	-	-	3	3	-	3	1	3
CO5	3	2	-	-	-	-	-	-	-	3	2	-	3	1	3

MI1703 OPERATIONS MANAGEMENT - II L T P C

3 0 0 3

COURSE OBJECTIVES

- To explain the concepts, strategies , tools and techniques for managing the critical decision areas in operations management.

UNIT I PROCESS STRATEGY 9

Process Structure - manufacturing, services; Process strategy decisions - customer involvement, resource flexibility, capital intensity; Strategic fit; strategies for changes - reengineering, improvement, process analysis and documentation. **CO1**

UNIT II CONSTRAINT MANAGEMENT 9

Theory of constraints - managing bottlenecks and capacity constrained resources - Drum- buffer-rope systems - Line balancing - synchronous manufacturing. **CO2**

UNIT III OPERATIONS PLANNING 9

Operations planning - Framework - Aggregate Planning – Approaches, costs, relationship to Master Production schedule. Materials requirement planning - MRP, MRP II and ERP. **CO3**

UNIT IV INVENTORY MANAGEMENT 9

Inventory – objectives, costs and control techniques - Fixed order quantity and fixed time period models; Just-in-time and lean systems; Stores Management. **CO4**

UNIT V FACILTY LOCATION AND LAYOUT 9

Location decisions – Need - Nature, factors affecting, Theories, Steps in Selection, Location Models ; Facility Layout – Principles, Types, Planning tools and techniques. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1.K.Aswathappa, K.Shridhara Bhat, Production and Operations Management, Himalayas Publishing House.

REFERENCE BOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Operations and Supply Chain Management, McGraw Hill Education (India) Pvt. Ltd, 14th Edition, 2014.
2. Krajewski, Lee J., Larry P. Ritzman, and Manoj K. Malhotra. Operations management: processes and supply chains. Upper Saddle River, NewJersey: Pearson, 2010.
3. Mahadevan B, Operations management: Theory and practice. Pearson Education India; 2015.

4. William J Stevenson, Operations Management, Tata McGrawHill, 9th Edition, 2009.
5. Heizer, Jay H., and Barry Render. Operations management. Vol. 1. Pearson Education India, 2008.
6. Cecil C. Bozarth, Robert B. Handfield, Introduction to Operations and Supply Chain Management, Pearson, 4th Edition, 2016.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	To understand the process strategy decision, the strategic fit and strategies for changes.
CO2	To understand theory of constraints and line balancing.
CO3	To understand medium term operations planning.
CO4	To understand and evaluate the different inventory control techniques. To understand stores management.
CO5	To evaluate and apply plant location and layout decisions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	3	3	-	3	-	-	-	-	-	2	1	2
CO2	3	3	-	3	3	-	3	-	-	-	-	-	3	1	1
CO3	3	3	-	3	3	-	3	-	-	-	-	-	2	1	2
CO4	3	3	-	3	3	-	3	-	-	-	-	-	2	1	1
CO5	3	3	-	3	3	-	3	-	-	-	-	-	3	1	2

MI1704	**RESEARCH METHODOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize students with basic of research and the research process.
- To help students in conducting research work and making research reports.

UNIT I INTRODUCTION **9**

Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research. **CO1**

UNIT II RESEARCH DESIGN AND MEASUREMENT **9**

Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design –Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument. **CO2**

UNIT III DATA COLLECTION **9**

Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of questionnaire and instrument – Sampling plan – Sample size – determinants optimal sample size – sampling techniques – Sampling methods.	**CO3**
UNIT IV DATA PREPARATION AND ANALYSIS	**9**
Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative Vs Quantitative data analyses – Applications of Bivariate and Multivariate statistical techniques, Factor analysis, Discriminant analysis, Cluster analysis, Multiple regression and Correlation – Application of statistical software for data analysis.	**CO4**
UNIT V REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH	**9**
Research report –Types – Contents of report – need for executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension – tone – final proof – report format – title of the report – ethics in research – Ethics in research – Subjectivity and Objectivity in research.	**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods, 12th Edition, Tata Mc Graw Hill, New Delhi, 2018.
2. Alan Bryman and Emma Bell, Business Research methods, 5th Edition, Oxford University Press, New Delhi, 2018.

REFERENCE BOOKS

1. William G Zikmund, Barry J Babin, Jon C. Carr, Atanu Adhikari, Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi,2016.
2. V K Ahuja, Law Relating to Intellectual Property Rights 3rd edition 2017, Publisher: LexisNexis, Universal bookstores, India.
3. Anil Kumar H S, Ramakrishna B, Fundamentals of Intellectual Property Rights, 2017 Notion press

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concept of research methods and apply in problem solving.
CO2 To apply the research design.
CO3 To understand the guidelines for sampling design.
CO4 To understand and acquire the knowledge on data analysis and report writing.
CO5 To understand and acquire the knowledge on Intellectual Property Rights.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	2	3	3	-	-	-	-	-	3	2	3
CO2	-	2	-	-	2	2	1	-	-	-	-	-	2	1	2
CO3	-	3	-	-	2	3	3	-	-	-	-	-	3	3	3

CO4	-	3	-	-	3	2	3	-	-	-	-	-	2	3	2
CO5	-	3	-	-	3	3	2	-	-	-	-	-	2	2	2

MI1705 **RETAIL MANAGEMENT** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To understand the concepts of effective retailing

UNIT I INTRODUCTION **9**

An overview of Global Retailing – Challenges and opportunities – Retail trends in India – Socio economic and technological Influences on retail management – Government of India policy implications on retails. **CO1**

UNIT II RETAIL FORMATS **9**

Organized and unorganized formats – Different organized retail formats – Characteristics of each format – Emerging trends in retail formats – MNC's role in organized retail formats. **CO2**

UNIT III RETAILING DECISIONS **9**

Choice of retail locations - internal and external atmospherics – Positioning of retail shops – Building retail store Image - Retail service quality management – Retail Supply Chain Management – Retail Pricing Decisions. Merchandizing and category management – buying. **CO3**

UNIT IV RETAIL SHOP MANAGEMENT **9**

Visual Merchandise Management – Space Management – Retail Inventory Management – Retail accounting and audits - Retail store brands – Retail advertising and promotions – Retail Management Information Systems - Online retail – Emerging trends . **CO4**

UNIT V RETAIL SHOPPER BEHAVIOR **9**

Understanding of Retail shopper behavior – Shopper Profile Analysis – Shopping Decision Process - Factors influencing retail shopper behavior – Complaints Management - Retail sales force Management – Challenges in Retailing in India. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Michael Havy ,Baston, Aweitz and Ajay Pandit, Retail Management, Tata Mcgraw Hill, Sixth Edition, 2007
2. Ogden, Integrated Retail Management, Biztantra, India, 2008.
3. Patrick M. Dunne and Robert F Lusch, Retailing, Thomson Learning, 4th Edition 2008.
4. Chetan Bajaj, Rajnish Tow and Nidhi V. Srivatsava, Retail Management, Oxford University Press, 2007.
5. Swapna Pradhan, Retail Management -Text and Cases, Tata McGraw Hill, 3rd Edition, 2009.
6. Dunne, Retailing, Cengage Learning, 2nd Edition, 2008
7. Ramkrishnan and Y.R.Srinivasan, Indian Retailing Text and Cases, Oxford University Press, 2008
8. Dr.JaspreetKaur , Customer Relationship Management, Kogent solution.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To provide insights on retail operation
CO2 To understand effective methods and strategies required for retail management.
CO3 To understand how to utilize resources and techniques used in retail management.
CO4 To understand analysis of store location, merchandising, products and pricing.
CO5 To gain knowledge about shopping behavior.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	1	3	-	-	-	-	-	-	-	2	1	1
CO2	2	-	3	2	3	-	-	-	-	-	-	-	2	1	2
CO3	1	-	2	3	2	-	-	-	-	-	-	-	1	2	2
CO4	1	-	2	2	2	-	-	-	-	-	-	-	2	1	1
CO5	2	-	1	2	1	-	-	-	-	-	-	-	1	1	1

MI1706	STRATEGIC MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the major initiatives taken by a company' stop management on behalf of corporate, involving resources and performance in external environments. It entails specifying the organization's mission, vision and objectives, and to equip with skills required to manage business and non-business organizations at senior levels.
- The course adopts functional approach to management developing policies and plan to understand the analysis and implementation of strategic management in strategic business units.

UNIT I STRATEGY AND PROCESS **9**

Conceptual framework for strategic management, the Concept of Strategy and the Strategy Formation Process – Stakeholders in business – Vision, Mission and Purpose – Business definition, Objectives and Goals - Corporate Governance and Social responsibility-case study. **CO1**

UNIT II COMPETITIVE ADVANTAGE **9**

External Environment - Porter's Five Forces Model-Strategic Groups Competitive Changes during Industry Evolution- Globalisation and Industry Structure - National Context and Competitive advantage Resources- Capabilities and competencies–core competencies-Low cost and differentiation Generic Building Blocks of Competitive Advantage- Distinctive Competencies- Resources and Capabilities durability of competitive Advantage- Avoiding failures and sustaining competitive advantage-Case study. **CO2**

UNIT III STRATEGIES **10**

The generic strategic alternatives – Stability, Expansion, Retrenchment and Combination strategies - Business level strategy- Strategy in the Global Environment-Corporate Strategy- Vertical Integration-Diversification and Strategic Alliances- Building and Restructuring the corporation- Strategic analysis and choice - Environmental Threat and Opportunity Profile (ETOP) - Organizational Capability Profile - Strategic Advantage Profile - Corporate Portfolio Analysis - SWOT Analysis - GAP Analysis - Mc Kinsey's 7s Framework - GE 9 Cell Model - Distinctive competitiveness - Selection of matrix - Balance Score Card-case study. **CO3**

UNIT IV STRATEGY IMPLEMENTATION & EVALUATION **9**

The implementation process, Resource allocation, Designing organizational structure-Designing Strategic Control Systems- Matching structure and control to strategy-Implementing Strategic change-Politics-Power and Conflict-Techniques of strategic evaluation & control-case study	**CO4**

UNIT V OTHER STRATEGIC ISSUES **8**

Managing Technology and Innovation-Strategic issues for Non Profit organizations. New Business Models and strategies for Internet Economy-case study	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Azhar Kazmi, Strategic Management and Business Policy, 3rd Edition, Tata McGraw Hill, 2008.
2. Hill. Strategic Management: An Integrated approach, 2009 Edition Wiley (2012).

REFERENCE BOOKS

1. Gupta, Gollakota and Srinivasan, Business Policy and Strategic Management – Concepts and Application, Prentice Hall of India, 2005.
2. John Pearce, Richard Robinson and Amitha Mittal, Strategic Management, McGraw Hill, 12th Edition, 2012

COURSE OUTCOMES: Upon completion of the course, students will be able to

CO1	Ability to understand and analyse the concept of strategic Management process and formulations to gain knowledge about corporate governance and social Responsibility.
CO2	To Evaluate the external environment using tools like differentiation with distinctive advantage to avoid failures and sustaining competitive advantage.
CO3	To analyse internal business environment and create organizational level strategies
CO4	To apply strategies in practice. To evaluate and control strategies.
CO5	To create innovative technology and to analyze the issues of profit and nonprofit organizations.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	3	3	3	3	-	-	-	-	3	3	2
CO2	3	3	-	-	3	3	3	3	-	-	-	-	3	3	2
CO3	3	3	-	-	3	3	3	3	-	-	-	-	3	3	2
CO4	3	3	-	-	3	3	3	3	-	-	-	-	3	3	2
CO5	3	3	-	-	3	3	3	3	-	-	-	-	2	2	2

MI1707	DATA ANALYSIS LABORATORY - II	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- The objective is to provide a hands-on knowledge of how to apply statistics to business situation in management functional areas using spreadsheets.

EXERCISES

Exercise 1: Portfolio selection
Exercise 2: Exercise1 - Extension
Exercise 3: Risk Analysis

Exercise 4: Sensitivity Analysis using Monte Carlo simulation
Exercise 5: Exercise4 - Extension
Exercise 6: Financial performance Analysis Using What if Analysis
Exercise 7: Transportation problem
Exercise 8: Exercise7 - Extension
Exercise 9: Assignment problem
Exercise 10: Exercise9 - Extension
Exercise 11: Shortest path Problem
Exercise 12: Maximum Flow Problem
Exercise 13: Critical path Method
Exercise 14: Queuing Model
Exercise 15: Economic Ordering Quantity(EOQ)

TOTAL : 60 PERIODS

REFERENCES

1. David R. Anderson, et al, "An Introduction to Management Sciences: Quantitative approaches to Decision Making", (13th edition) South-Western College Pub, 2011.
2. William J. Stevenson, Ceyhun Ozgur, "Introduction to Management Science with Spreadsheet", Tata McGraw Hill, 2009.
3. Hansa Lysander Manohar, "Data Analysis and Business Modelling using Microsoft Excel" PHI, 2017.
4. David M. Levine et al, “Statistics for Managers using MS Excel" (6th Edition) Pearson, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand forecasting in real time business world using analytical tools.
CO2	To understand and Ability to conduct Risk and sensitivity analysis and portfolio selection based on business data.
CO3	To understand and ability to conduct financial performance analysis using what-if analysis.
CO4	To have enhanced knowledge about networking concept and its model using software.
CO5	To understand inventory models and queuing theory using data analytical tools.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	3	-	2	-	-	3	-	-	-	3	3	1
CO2	-	-	-	3	-	2	-	-	2	-	-	-	3	3	1
CO3	-	-	-	2	-	1	-	-	2	-	-	-	3	3	1
CO4	-	-	-	1	-	1	-	-	1	-	-	-	3	3	1
CO5	-	-	-	3	-	2	-	-	2	-	-	-	3	3	1

MI1708 **SEMINAR IV** **L T P C**
0 0 2 1

COURSE OBJECTIVES

- To introduce the students to research practices and tools in Management.

Students are expected to prepare and present on Topics suggested below:

1. Types of Data collection and challenges
2. Exploratory research
3. Regression analysis
4. Sampling techniques and its limitations
5. Cross sectional vs longitudinal research
6. Experimental design
7. Validation techniques
8. Design of questionnaire
9. Visualization techniques
10. Descriptive statistics

TOTAL : 30 PERIODS

REFERENCE BOOKS:

1. Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods, 12th Edition, Tata Mc Graw Hill, New Delhi, 2018.
2. Alan Bryman and Emma Bell, Business Research methods, 5th Edition, Oxford University Press, New Delhi, 2018.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 To understand the importance of Data collection and challenges.
CO2 To understand Regression analysis and Sampling techniques.
CO3 To Learn and apply various Research Design.
CO4 To Learn about the ddesign of questionnaire.
CO5 To Learn the importance of Descriptive statistics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	-	-	2		-	-	-	-	-	3	3	2
CO2	-	2	-	-	-	3		-	-	-	-	-	2	3	2
CO3	-	3	-	-	-	3		-	-	-	-	-	3	3	1
CO4	-	3	-	-	-	2		-	-	-	-	-	2	3	2
CO5	-	3	-	-	-	3		-	-	-	-	-	3	3	1

SEMESTER – VIII

MI1801	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Use business analytics for decision making
- To apply the appropriate analytics and generate solutions
- Model and analyse the business situation using analytics.

UNIT I INTRODUCTION TO BUSINESS ANALYTICS (BA)	**9**
Business Analytics - Terminologies, Process, Importance, Relationship with Organizational Decision Making, BA for Competitive Advantage.	**CO1**
UNIT II MANAGING RESOURCES FOR BUSINESS ANALYTICS	**9**
Managing BA Personnel, Data and Technology. Organizational Structures aligning BA. Managing Information policy, data quality and change in BA.	**CO2**
UNIT III DESCRIPTIVE ANALYTICS	**9**
Introduction to Descriptive analytics - Visualising and Exploring Data - Descriptive Statistics - Sampling and Estimation - Probability Distribution for Descriptive Analytics - Analysis of Descriptive analytics	**CO3**
UNIT IV PREDICTIVE ANALYTICS	**9**
Introduction to Predictive analytics - Logic and Data Driven Models - Predictive Analysis Modeling and procedure - Data Mining for Predictive analytics, Analysis of Predictive analytics.	**CO4**
UNIT V PRESCRIPTIVE ANALYTICS	**9**
Introduction to Prescriptive analytics - Prescriptive Modeling - Non Linear Optimisation - Demonstrating Business Performance Improvement.	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Robert Schultheis and Mary Summer, Management Information Systems – The Managers View, Tata McGraw Hill, 2008.
2. Kenneth C. Laudon and Jane Price Laudon, Management Information Systems – Managing the digital firm, PHI Learning / Pearson Education, PHI, Asia, 2012.

REFERENCE BOOKS

1. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, " Business Analytics
2. Principles, Concepts, and Applications - What, Why, and How" , Pearson Ed, 2014
   Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", Fifth edition, Cengage Learning, 2015.
3. James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Ed, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to understand the role of Business Analytics in decision making
CO2 Ability to identify the appropriate tool for the analytics scenario
CO3 Ability to apply the descriptive analytics tools and generate solutions
CO4 Understanding of Predictive Analytics and applications
CO5 Knowledge of Prescriptive Analytics and demonstrating business process improvement

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	1	-	3	-	-	-	1	1	-	-	-	1	1	1
CO2	-	2	-	3	-	-	-	1	1	-	-	-	1	1	3
CO3	-	3	-	3	-	-	-	1	3	-	-	-	2	3	1
CO4	-	3	-	3	-	-	-	1	3	-	-	-	3	3	1
CO5	-	3	-	3	-	-	-	1	3	-	-	-	3	3	1

MI1802 BUSINESS ETHICS AND CORPORATE GOVERNANCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To provide an understanding on ethical practices in business.
- To study the business ethical behavior of an individual in the organization.
- To learn the corporate governance in the business.

UNIT I INTRODUCTION **9**

Definition & nature Business ethics, Characteristics, Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good. **CO1**

UNIT II ETHICS THEORY AND BEYOND **9**

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers- Code of ethics; Business and ecological / environmental issues in the Indian context and case studies. **CO2**

UNIT III LEGAL ASPECTS OF ETHICS **9**

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP &FERA. Social – cultural environment and their impact on business operations, **CO3**

UNIT IV CORPORATE GOVERNANCE **9**

Concept of Corporate governance – Concept of extended view of corporate citizenship, Owners and stakeholders, Types of owners, Rights and privileges of shareholders, Ownership structures and corporate governance- Need for investor protection. **CO4**

UNIT V THEORIES AND PRACTICE OF CORPORATE GOVERNANCE **9**

Theory & practices of corporate governance, corporate governance mechanism and overview – land marks in emergence of corporate governance. Perspectives on Corporate Governance-Board of Directors: Powerful Instrument of Governance - Types of Directors - Importance of Independent Directors. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. W.H. Shaw, Business Ethics, Cengage Learning, 2017.

REFERENCE BOOKS

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.
3. Mandal, S.K Ethics in Business and Corporate Governance, 2/e; New Delhi: McGraw Hill Education.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of ethical behavior.

CO2 To develop the knowledge on ethical theories.
CO3 To understand the legal aspects of ethics.
CO4 To understand the concepts of corporate governance.
CO5 To understand the theories, practices, and the various models of corporate governance.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	3	-	-	-	-	-	3	3	3	2	1
CO2	-	-	-	-	3	-	-	-	-	-	3	3	3	2	1
CO3	-	-	-	-	3	-	-	-	-	-	3	3	2	2	1
CO4	-	-	-	-	3	-	-	-	-	-	3	3	2	2	2
CO5	-	-	-	-	3	-	-	-	-	-	3	3	2	2	2

MI1803 **CREATIVITY AND INNOVATION**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the nuances involved in Creativity & Innovation.
- To get hands on experience in applying creativity in problem solving.

UNIT I INTRODUCTION **9**

Need for Creative and innovative thinking for quality – components of Creativity, Methodologies and approaches, individual and group creativity, types of innovation, barriers to innovation, innovation process, establishing criterion for assessment of creativity & innovation. **CO1**

UNIT II MECHANISM OF THINKING AND VISUALIZATION **9**

Approaches and Actions that support creative thinking - Advanced study of visual elements and principles- line, plane, shape, form, pattern, texture gradation, color symmetry. Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation – Animation aerodynamics – virtual environments in scientific Visualization – Unifying principle of data management for scientific visualization – Visualization benchmarking **CO2**

UNIT III CREATIVITY **9**

Methods and tools for Directed Creativity – Basic Principles – Tools that prepare the mind for creative thought – stimulation – Development and Actions: - Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation. **CO3**

UNIT IV CREATIVITY IN PROBLEM SOLVING **9**

Generating and acquiring new ideas, product design, service design – case studies and hands-on exercises, stimulation tools and approaches, six thinking hats, lateral thinking – Individual activity, group activity, contextual influences. **CO4**

UNIT V INNOVATION **9**

Achieving Creativity – creating and sustaining successful growth – New market disruption - Commoditation and Decommoditation – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. Rousing Creativity: Think New Now Floyd Hurr, ISBN 1560525479, Crisp Publications Inc. 1999.
2. Geoffrey Petty," howto be better at Creativity", The Industrial Society 1999
3. Clayton M. Christensen Michael E. Raynor," The Innovator"s Solution", Harvard Business School Press Boston, USA, 2003
4. Semyon D. Savransky," Engineering of Creativity – TRIZ", CRC Press New York USA," 2000

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Student will be equipped to apply his/her creative and innovative skills in solving complex problems.
CO2	Students will be enriched the innovation concept theoretically and practically.
CO3	Students will be trained to apply their knowledge to come out with innovative products or services.
CO4	Students are encouraged to present their innovative concepts and ideas similar to a Seminar.
CO5	Students are encouraged to interact with entrepreneurs and alumni to enhance their innovative concepts.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	1	1	-	-	1	1	1	-	-	-	1	1	-
CO2	1	-	1	1	-	-	1	1	1	-	-	-	1	1	-
CO3	1	-	1	1	-	-	1	1	1	-	-	-	1	1	-
CO4	1	-	1	1	-	-	1	1	1	-	-	-	1	1	-
CO5	1	-	1	1	-	-	1	1	1	-	-	-	1	1	-

MI1804	**ENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To equip and develop the entrepreneurial skills and qualities essential to undertake business.
- To impart the entrepreneurial competencies needed for managing business efficiently and effectively.

UNIT I ENTREPRENEURAL COMPETENCE **9**

Entrepreneurship concepts – Entrepreneurship as a Career – Entrepreneurial Personality-Characteristics of Successful Entrepreneur – Knowledge and Skills of Entrepreneur. **CO1**

UNIT II ENTREPRENEURAL ENVIRONMENT **9**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations. **CO2**

UNIT III BUSINESS PLAN PREPARATION **9**

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital Budgeting- Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria. **CO3**

UNIT IV LAUNCHING OF SMALL BUSINESS **9**

Finance and Human Resource Mobilization - Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT Start-ups. **CO4**

UNIT V MANAGEMENT OF SMALL BUSINESS **9**

Monitoring and Evaluation of Business - Business Sickness - Prevention and Rehabilitation of Business Units - Effective Management of small Business - Case Studies. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

3. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016.
4. R.D.Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
5. Rajeev Roy ,Entrepreneurship, Oxford University Press, 2nd Edition, 2011. DonaldFKuratko,T.VRao.Entrepreneurship: A South Asian perspective.Cengage Learning, 2012.
6. Dr. Vasant Desai, “Small Scale Industries and Entrepreneurship”, HPH,2006.
7. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra, 2nd Edition, 2005.

REFERENCE BOOKS

8. Arya Kumar. Entrepreneurship, Pearson,2012.
9. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
10. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chenna 1997.
11. S Anil Kumar, SC Poornima, Mini K Abraham, K Jayashree, Entrepreneurship Development, New Age International Publishers, First Edition, ISBN-10 8122414346, June 2021.
12. Entrepreneurship Development - SHARMA, SANGEETA, PHI Learning, 2nd edition, ISBN 9789390544257, February 2022.
13. Entrepreneurship Development, Nirjar A., ISBN-13: 9788123924618, CBS Publication, 1ST edition (2005).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 The learners will understand entrepreneurial competence to run the business efficiently.
CO2 The learners will know the entrepreneurial environment and how it will supporting a business.
CO3 To create a capability of preparing business plans and undertake feasible projects.
CO4 The learners to understand efficient in launching and develop their business and required resources for a successful business.
CO5 The learners realize monitoring and evaluation of business and its growth.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)	PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO 1	P O2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-

MI1805	EVENT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- This course is designed to provide an introduction to the principles of event management. The course aims to impart knowledge on the various events and how these events can be organized successfully.

UNIT I EVENT CONTEXT 9

Evolution – Types of events – MICE – Types of Meeting, Trade Shows, Conventions, Exhibitions- Structure of event industry – Event Management as a profession – Perspectives on event: Government, Corporate & Community – Code of Ethics **CO1**

UNIT II EVENT PLANNING & LEGAL ISSUES 9

Conceptualizing the event – Host, sponsor, Media, Guest, Participants, Spectators – Crew – Design of concept – Theme and content development – Visualization – Event objectives – initial planning – Budgeting – Event design and budget checklist – Preparation of functional sheets –Timing – Contracts and Agreements – Insurance, Regulation, License and Permits – Negotiation. **CO2**

UNIT III EVENT MARKETING 9

Role of Strategic Marketing Planning - Pricing – Marketing Communication Methods & Managing Marketing Communication & Elements – Sponsorship – Event sponsorship – Managing, Measuring & Evaluating. **CO3**

UNIT IV EVENT OPERATION 9

Site Selection – Types of location – Venue Requirements – Room, Stage, Audio-Visual, Lighting, Performers, Decors, Caterer, Photography & Videography – Protocols – Guest list – Guest demographics – Children at event – Invitation – Media – Freelance Event Operation – Road show- Food & Beverage – Entertainment – Event Logistics– Onsite and event logistics **CO4**

UNIT V SAFETY & EVENT EVALUATION 9

Risk assessment – Safety officer, Medical Manager – Venue, Structural safety – Food safety Occupational safety – Fire Prevention – Sanitary facilities – Vehicle traffic – Waste Management- Event Evaluation Process & Event control **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Lynn Van Der Wagen, Event Management for Tourism, Cultural Business & Sporting Events,4th Edition, Pearson Publications, 2014
2. Lynn Van Der Wagen, & Brenda R. Carlos, Successful Event Management.

REFERENCE BOOKS

1. Judy Allen, Event Planning 2nd Edition, Wiley & Sons, Canada, 2014.
2. G.A.J. Bowdin, Events Management , Elseiver Butterworth

OURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the principles of event management and their types

CO2 To design event planning and execute various activities relating to implementing events and their budgeting.

CO3 To design marketing mix for various types of events

CO4 To have an understanding of various operations pertaining to event industry

CO5 To access the various risk and safety issues associated with event industry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	2	3	-	-	-	-	-	-	2	2	2
CO2	2	-	-	-	2	2	-	-	-	-	-	-	3	2	2
CO3	3	-	-	-	2	3	-	-	-	-	-	-	1	2	2
CO4	2	-	-	-	2	3	-	-	-	-	-	-	2	2	2
CO5	3	-	-	-	2	3	-	-	-	-	-	-	2	2	2

MI1806 INTERNATIONAL BUSINESS MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES

- To familiarize the students to the basic concepts of international business management.

UNIT I Overview of International Business **9**

Definition – features - importance of International Business, International Business environment – Economic – Political – cultural, Country differences and attractiveness, Globalization – Effects and Benefits of Globalization. **CO1**

UNIT II Theories of International Trade and Investment **9**

Theories of International Trade: Mercantilism – Absolute Advantage Theory – Comparative Cost Theory – Hecksher Ohlin Theory, Theories of Foreign Direct Investment: Product Life Cycle – Eclectic – Market Power, Regional Trade Agreements – system – trade blocs. **CO2**

UNIT III Global Entry and Global Monetary Systems **9**

Strategies for International business, Global entry strategy, different forms of international business, Organizational structures, Global Financial Management – The Foreign Exchange Market – International Monetary System – Global Capital Market and Portfolio Management, Controlling of international business – approaches to control. **CO3**

UNIT IV International Business Operations **9**

Global production – Standardization Vs Differentiation – Make or Buy decisions – global supply chain issues, Globalization of markets: Marketing strategy - Challenges in product development – pricing – promotion and channel management, Global Human Resources Management – Selection of Managers – Training and development – Compensation. **CO4**

UNIT V Regulation of International Business **9**

Conflict in international business - Sources and types of conflict – Conflict resolutions – Negotiation – Ethical issues in international business, International Institutions: UNCTAD, IBRD, WTO – Role and Importance, Advantages and Disadvantages of international business.	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Charles W. I. Hill and Arun Kumar Jain, International Business,6th edition, Tata McGraw Hill, New Delhi, 2010
2. Michael R. Czinkota, Ilkka A. Ronkainen and Michael H. Moffet, International Business, 7 Edition, Cengage Learning, NewDelhi, 2010
3. K. Aswathappa, International Business,5th Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCE BOOKS

1. John D. Daniels and Leeh Radebaugh, International Business, Pearson Education Asia, New Delhi, 12th edition.
2. Vyuptakesh Sharan, International Business,3rd Edition, Pearson Education in South Asia, New Delhi, 2011
3. Rakesh Mohan Joshi, International Business, Oxford University Press, New Delhi, 2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the global economic, political, cultural and social environment within which firms operate
CO2	To understand the various theories of International Trade and Investment
CO3	To understand the importance and issues in entering Global market and global investments
CO4	To understand the issues in Production, Marketing, HR of Global Business
CO5	To understand the regulatory environment in International Business

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**											**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	2	3	-	-	-	-	-	-	-	3	1	1
CO2	-	-	-	2	2	-	-	-	-	-	-	-	3	1	1
CO3	-	-	-	3	3	-	-	-	-	-	-	-	3	1	1
CO4	-	-	-	3	3	-	-	-	-	-	-	-	3	1	1
CO5	-	-	-	3	1	-	-	-	-	-	-	-	3	1	3

MI1807	**SOFT SKILLS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

- To equip students with required soft skills and leadership skills that will build their confidence in interacting effectively in professional tasks, through activity-based learning, enable the students in developing their soft skills.

Activities need to be conducted in the below mentioned areas:

1. Leadership skills
2. Self awareness –Johari window
3. Team Building Skills

4. Problem Solving - analytical, creative and critical skills
5. Decision Making
6. Negotiation skills
7. Managing Conflicts
8. Prioritizing skills
9. Lateral thinking
10. Disruptive thinking

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Edward Holffman, "Ace the Corporate Personality", McGraw Hill,2001
2. John Adair Kegan Page, "Leadership for Innovation" 1st ed., Kogan, 2007 .
3. K.R. Lakshminarayana & T. Murugavel, "Managing Soft Skills", Scitech Publications. 2009.
4. Dr. S.P. Dhanvel, English and Soft Skills, Orient Blackswan, 2011
5. Rajiv K. Mishra, Personality Development-, Rupa & Co. 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Student will be equipped to apply his/her leadership skills.
CO2 Students will be enriched with team building and problem solving kills.
CO3 Students will be trained to apply their negotiation skills and decision making skills.
CO4 Student will be equipped in manage conflicts.
CO5 Students will be trained to apply their Lateral thinking and disruptive thinking.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1		-	-	3	-	2	1	-	1	-	-	-	1	1	-
CO2		-	-	3	-	3	2	-	2	-	-	-	1	1	-
CO3		-	-	2	-	2	1	-	2	-	-	-	1	1	-
CO4		-	-	3	-	3	1	-	1	-	-	-	1	1	-
CO5		-	-	2	-	2	1	-	2	-	-	-	1	1	-

MI1808 **SEMINAR V** **L T P C**

0 0 2 2

COURSE OBJECTIVES

- To introduce the students to Corporate Social Responsibility Practices.
- To Analyse the importance and implication of CSR in Organisational Development

UNIT I INTRODUCTION **6**

Introduction to CSR and Emergence of CSR **CO1**

UNIT II CSR ENVIRONMENT **6**

Stakeholders of CSR (Environments); Planning of CSR **CO2**

UNIT III IMPLEMENTATION **6**

Implementation of CSR; Evaluation of CSR **CO3**

UNIT IV DEVELOPMENT **6**

Development CSR; Corporate Governance **CO4**

UNIT V MAINTAIN **6**

CSR and sustainability; Current Scenario of CSR **CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. Strategic Corporate Social Responsibility: Stakeholders in a Global Environment By William B Werther and David Chandler.

REFERENCE BOOKS

1. Case studies for listed private and foreign companies

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will gain knowledge about Corporate Social Responsibility Practices in Business Organisations.
CO2	The Students will learn about requirements of CSR stakeholder
CO3	To Plan and Develop CSR Activities
CO4	To successfully implement the CSR programme
CO5	To understand the implication of CSR in business organization

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	-	-	-	-	-	-	-	-	-	-	-	3	2	3	1
CO2	-	-	-	-	-	-	-	-	-	-	-	3	2	3	2
CO3	-	-	-	-	-	-	-	-	-	-	-	3	2	3	1
CO4	-	-	-	-	-	-	-	-	-	-	-	3	2	3	1
CO5	-	-	-	-	-	-	-	-	-	-	-	3	2	3	1

SEMESTER – IX

MI1907	**SUMMER INTERNSHIP**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

- To introduce the students to industries and their working style.

TOTAL: 60 PERIODS

Students are expected to submit the internship report - events / things learned at the industries

COURSE OUTCOME

Upon completion of the course, students will be able to

CO1 The students will be able to understand the functioning of the organizations

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-

MI1908 PROFESSIONAL SKILL DEVELOPMENT LABORATORY **L T P C**

0 0 4 2

COURSE OBJECTIVES

- To enable learners to develop professional and corporate skills

Activities need to be conducted in the below mentioned areas:

1. Group Discussion
2. Preparation for an Interview
3. Facing Interviews
4. Stress interview
5. Multitasking
6. Time management
7. Work-life balance
8. Lifelong learning
9. Speed reading skills
10. Organising events

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Through activity based sessions students will develop various professional and employability skills

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-

MI1909 **SEMINAR VI** **L T P C**

0 0 2 1

COURSE OBJECTIVES

- To enable the learners in understanding of the basic concepts of Indian Ethos and familiarise about ethical behavior and value systems at work.
- To enable the learners to have exposure on business ethics and ethical business perspectives.

Students are expected to prepare and present on Topics suggested below:

1. Indian Ethos
2. Work ethos
3. Indian Values, Value Systems and Wisdom for modern managers
4. Management Lessons from Thirukural
5. Spirituality in business management
6. Individual Culture and Ethics
7. Ethical codes of conduct and value Systems
8. Loyalty and Ethical Behavior
9. Ethical business issues and solutions
10. Social Responsibilities of Business

TOTAL: 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 The learners are able to apply the basic concepts of Indian ethos and value systems at work
CO2 The learners can handle issues of business ethics and offer solutions ethical perspectives

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	-		-	-	-	-	-	-	-	1	-	-	1
CO2	-	-	-		-	-	-	-	-	-	-	1	-	-	1

SEMESTER – X

MI1100 **PROJECT WORK** **L T P C**

0 0 24 12

COURSE OBJECTIVES

- To provide detailed knowledge regarding the various business management domains to fulfill the industry demand.

The MBA project is the culmination of MBA course. The project Work provides with an opportunity to apply the skills and knowledge that students have acquired to the resolution of a business problem, or to investigate an area that interests to them further. Project Work can be organisation-based, desk research based or entrepreneurial in nature, depending upon students aims and ambitions.

TOTAL: 360 PERIODS

COURSE OUTCOME:

Upon completion of the course, students will be able to

CO1 Apply knowledge of management theories and practices to solve business problems.

CO2 Foster Analytical and critical thinking abilities for data-based decision making.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	1	1	1	1	1	-	-	-	2	2	1
CO2	1	3	1	1	1	1	1	1	1	-		-	1	3	1

MARKETING ELECTIVES

MI1M001 BRAND MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand the methods of managing brands and strategies for brand management.

UNIT I INTRODUCTION 9

Basic understanding of Brands – Definitions - Branding Concepts – Functions of Brand – Significance of Brands – Different Types of Brands–Co branding – Store brands. **CO1**

UNIT II BRAND STRATEGIES 9

Strategic Brand Management process – Building a strong brand – Brand positioning – Establishing Brand values – Brand vision – Brand Elements – Branding for Global Markets – Competing with foreign brands. **CO2**

UNIT III BRAND COMMUNICATIONS 9

Brand image Building – Brand Loyalty programme – Brand Promotion Methods – Role of Brand ambassadors, celebrities– On line Brand Promotions. **CO3**

UNIT IV BRAND EXTENSION 9

Brand Adoption Practices – Different type of brand extension – Factors influencing Decision for extension– Re-branding and Re-launching. **CO4**

UNIT V BRAND PERFORMANCE 9

Measuring Brand Performance – Brand Equity Management - Global Branding strategies – Brand Audit – Brand Equity Measurement – Brand Leverage -Role of Brand Managers– Branding challenges& opportunities **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kevin Lane Keller,Strategic Brand management,Pearson Publication,India 2015
2. Lan Batey, Asian Branding–A Great way to fly, PHI,Singapore,2002.
3. Paul Tmepoal, Branding in Asia,John Willy, 20002.

REFERENCE BOOKS

1. Ramesh Kumar,Managing Indian Brands,Vikas Publication,India,2002.
2. JagdeepKapoor,Brandex,Biztranza,India,2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Developing a basic understanding of branding its functions, Significance and various types of brands.
CO2	Highlighting the strategic issues in branding.
CO3	Brand loyalty programmes, brand promotion, and brand personality.
CO4	To provide an understanding of brand adoption and practices and basic issues in brand.
CO5	Develop critical perspectives in evaluating research in branding and applying the strategic management of brands in creative industries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	P O2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	3	-	3	-	3	-	-	-	-	3	3	2
CO2	3	-	3	3	-	2	-	3	-	-	-	-	3	2	2
CO3	3	-	3	3	-	2	-	3	-	-	-	-	3	2	3
CO4	3	-	2	3	-	3	-	2	-	-	-	-	3	2	2
CO5	3	-	3	3	-	3	-	3	-	-	-	-	3	2	2

MI1M002	CONSUMER BEHAVIOR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study and understand the consumer' behavior in-order to effectively utilize the market' potential.

UNIT I INTRODUCTION 9

Consumer behavior - Introduction – Understanding Consumers – Factors influencing - Buyers Decision making process - Market segmentation – Identifying market segments - Demographics and Economy on Consumer behavior. **CO1**

UNIT II INTERNAL INFLUENCES 9

Influences on consumer behavior – motivation – perception – Attitudes and Beliefs - Learning and Experience - Personality & Self Image. **CO2**

UNIT III EXTERNAL INFLUENCES 9

Environmental Influences - Socio-Cultural, Cross Culture - Family group – Reference group – Communication - Influences on Consumer behavior - and Diffusion of Innovation. **CO3**

UNIT IV CONSUMER BEHAVIOR MODELS 9

Customer behavior model – Meaning – important – types of Customer behaviour – Customer behavior models - Customer behavior segmentation. **CO4**

UNIT V PURCHASE DECISION PROCESS 9

Consumer purchase decision making process – Steps – Decision making process – Problem Recognition - Search and Evaluation - Purchasing Process - Post-purchase Behavior - Evolving Indian consumers – Opinion Leadership - Diffusion and Adoption. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. RamanujMajumdar, Consumer Behavior - Insights from Indian Market, PHI, 2010.
2. Leon G.Schiffman and Leslie Lasar Kanuk, Consumer Behavior, Pearson Education, India, ninth edition, 2010.
3. Barry J.B., Eric G.H., Ashutosh M., Consumer Behavior - A South Asian Perspective, Cengage Learning, 2016.
4. Paul Peter et al., Consumer Behavior and Marketing Stratergy, Tata McGraw Hill, Indian Edition, 7th Edition 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To know the introduction and understanding concepts of the Consumer behaviour.
CO2 To know the internal influences of the consumer behavior.
CO3 To know the external influences of the consumer behavior.
CO4 To know the overview of Customer behavior models and its segmentation.
CO5 To know the Consumer decision making process of the consumers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	2	-	2	2	2	-	-	-	-	3	3	3
CO2	3	-	-	2	-	2	2	2	-	-	-	-	3	2	3
CO3	3	-	-	2	-	2	2	2	-	-	-	-	3	2	2
CO4	2	-	-	3	-	2	2	2	-	-	-	-	3	2	2
CO5	3	-	-	3	-	2	3	3	-	-	-	-	3	3	3

MI1M003 DIGITAL MARKETING L T P C

3 0 0 3

COURSE OBJECTIVES

- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilised by organisations and how its effectiveness can have measured.

UNIT I INTRODUCTION 9

Definition of digital marketing; origin of digital Marketing, Traditional VS Digital Marketing, Benefits of Digital marketing, The internet micro- and macro-environment, Internet users in India, Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand- Website. **CO1**

UNIT II SEARCH ENGINE OPTIMIZATION 9

Search Engine optimization - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- advantages and disadvantages of SEO; best practice in SEO – Paid search engine marketing - pay per click (PPC) advertising -Display Advertisement. **CO2**

UNIT III E- MAIL MARKETING **9**

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns- Profiling and targeting. **CO3**

UNIT IV SOCIAL MEDIA MARKETING **9**

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing. Digital Transformation & Channel Attribution- Analytics- Social Media, Web Analytics - Changing your strategy based on analysis. **CO4**

UNIT V DESIGN DIGITAL MARKETING PLAN **9**

Design digital marketing plan, SWOT, situational analysis, key performance Indicators in internet marketing, Digital Landscape, Paid, Owned, and Earned Media (P-O-E-M) Framework. Segmenting and Customizing Messages, Digital Advertising Market in India - Recent trends in Digital marketing. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
2. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015)
3. ISBN-10: 0199455449;ISBN-13: 978-0199455447
4. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN13: 9788126566938;ASIN: 8126566930
5. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited.
6. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education.
7. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To examine and explore the role and importance of digital marketing in today’s rapidly changing business environment.
CO2	To focusses on how digital marketing can be utilised by organizations and how its effectiveness can have measured.
CO3	To know the key elements of a digital marketing strategy.
CO4	To study how the effectiveness of a digital marketing campaign can be measured.
CO5	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	3	3	-	3	2	3	-	-	-	-	3	2	2
CO2	2	-	2	2	-	2	2	2	-	-	-	-	2	3	3

CO3	2	-	2	3	-	2	3	2	-	-	-	-	3	2	3
CO4	2	-	3	3	-	3	2	3	-	-	-	-	2	3	2
CO5	2	-	2	3	-	2	3	3	-	-	-	-	2	3	2

MI1M004	INTEGRATED MARKETING COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- This course introduces students to the essential concepts and techniques for the development and designing an effective Integrated Marketing Communication programme.

UNIT I AN INTRODUCTION TO INTEGRATED MARKETING COMMUNICATION (IMC) 9

An Introduction to Integrated Marketing Communication (IMC): Meaning and role of IMC in Marketing process, one voice communication V/s IMC. Introduction to IMC tools – Advertising, sales promotion, publicity, public relations, and event sponsorship; The role of advertising agencies and other marketing organizations providing marketing services and perspective on consumer behavior. **CO1**

UNIT II UNDERSTANDING COMMUNICATION PROCESS 9

Understanding communication process: Source, Message and channel factors, Communication response hierarchy- AIDA model, Hierarchy of effect model, Innovation adoption model, information processing model, The standard learning Hierarchy, Attribution Hierarchy, and low 20% involvement hierarchy Consumer involvement- The Elaboration Likelihood (ELM) model, The Foote, Cone, and Belding (FCB) Model. **CO2**

UNIT III PLANNING FOR MARKETING COMMUNICATION (MARCOM) 9

Establishing marcom Objectives and Budgeting for Promotional Programmes-Setting communication objectives, Sales as marcom objective, DAGMAR approach for setting ad objectives. Budgeting for marcom-Factors influencing budget, Theoretical approach to budgeting viz. Marginal analysis and Sales response curve, Method to determine marcom budget. **CO3**

UNIT IV DEVELOPING THE INTEGRATED MARKETING COMMUNICATION PROGRAMME 9

Planning and development of creative marcom, Creative strategies in advertising, sales promotion, publicity, event sponsorships etc. Creative strategy in implementation and evaluation of marcom- Types of appeals and execution styles. Media planning and selection decisions- steps involved and information needed for media planning. Measuring the effectiveness of all Promotional tools and IMC. **CO4**

UNIT V DIGITAL MEDIA & ADVERTISING 9

Digital Media, Evolution of Technology, Convergence of Digital Media, E- Commerce and Digital Media, Advertising on Digital Media, Social Media, Mobile Adverting, E-PR Advertising Laws & Ethics: Adverting & Law, Advertising & Ethics. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

8. Dr. Niraj Kumar, Integrated Marketing Communication, Himalaya Publishing House 2015.
9. Jaishri Jefh waney, Advertising Management, Oxford University Press,2nd Edition, 2013.
10. George Belch, Michael Belch &Keyoor Purani, Advertising & Promotion- An Integrated Marketing Communications Perspective, TATA McGraw Hill 8th edition.

REFERENCE BOOKS

14. Wells, Moriarty & Burnett, Advertising, Principles & Practice, Pearson Education, 7th Edition, 2007.
15. Kenneth Clow. Donald Baack, Integrated Advertisements, Promotion and Marketing communication, Prentice Hall of India, New Delhi, 3rd Edition, 2006.
16. Terence A. Shimp and J.Craig Andrews, Advertising Promotion and other aspects of Integrated Marketing Communications, CENGAGE Learning, 9th edition, 2016
17. 4. S. H. H. Kazmi and Satish K Batra, Advertising & Sales Promotion, Excel Books, New Delhi, 3rd Revised edition edition, 2008.
18. 5. Julian Cummings, Sales Promotion: How to Create, Implement and Integrate Campaigns that Really Work, Kogan Page, London, Fifth Edition Edition ,2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To review and give a general understanding of the basics of traditional communication forms, such as advertising, personal selling, sales promotion and indirect promotion within various delivery vehicles from broadcast to targeted social media.
CO2	This course introduces students to the essential concepts and techniques for the development and designing an effective Integrated Marketing Communication programme.
CO3	To Know how IMC fits into the marketing mix.
CO4	To develop an awareness about marketing communications tools, and how each can be used effectively- individually or in an integrated mix.
CO5	To examine the process by which integrated marketing communications programs are planned, developed, executed, and measured.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	3	-	2	2	1	-	-	-	-	2	2	2
CO2	3	-	2	2	-	1	3	1	-	-	-	-	3	2	2
CO3	1	-	1	3	-	2	1	2	-	-	-	-	3	3	3
CO4	2	-	3	3	-	2	3	1	-	-	-	-	2	3	3
CO5	1	-	2	3	-	2	3	3	-	-	-	-	3	2	3

MI1M005	SALES AND DISTRIBUTION MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain insights into the selling and distribution process.

UNIT I INTRODUCTION **9**

Sales management - nature and scope. Sales management positions. Personal Selling - Scope, theories and strategies. Sales forecasting and budgeting decisions. Online selling - scope, potential, Merits and Demerits. **CO1**

UNIT II PERSONAL SELLING, TERRITORIES & QUOTAS **9**

Selling process and relationship selling. Designing Sales Territories and quotas. Sales organization structures.	**CO2**
UNIT III MANAGING THE SALES FORCE	**9**
Sales force - recruitment, selection, training, motivating, compensation and control.	**CO3**
UNIT IV MANAGING DISTRIBUTION CHANNELS	**9**
Distribution Management - Introduction need and scope. Channels - Strategies and levels, retailing and wholesaling. Designing channel systems and channel management.	**CO4**
UNIT V ELEMENTS OF SUPPLY CHAIN	**9**
Managing FG Inventory & warehousing. Transportation - Scope, Modes and role in Supply Chain effectiveness. Use of Information Technology in Online Selling and Goods tracking.	**CO5**

TOTAL :45 PERIODS

TEXT BOOKS

Krishna K. Havaldar, Vasant M. Cavale, Sales and Distribution Management - Text and Cases, Third Edition, McGraw Hill Education, 2017

REFERENCE BOOKS

1. Gupta S.L., Sales and Distribution Management - Text and Cases - An Indian Perspective, Excel Books, 2008
2. Pingali Venugopal, Sales and Distribution Management - An Indian Perspective, Response Books from Sage Publications, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basics of sales management, theories and strategies
CO2 To learn the process of personal and relationship selling
CO3 To understand the managing of sales force
CO4 To learn the management of distribution channels
CO5 To learn the inventory and supply chain management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	P O5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	1	-	-	-	1	-	-	-	-	2	2	2
CO2	3	-	-	1	-	-	-	1	-	-	-	-	3	2	2
CO3	3	-	-	2	-	-	-	1	-	-	-	-	3	3	3
CO4	2	-	-	2	-	-	-	1	-	-	-	-	2	3	3
CO5	3	-	-	2	-	-	-	3	-	-	-	-	3	2	3

MI1M006	SERVICES MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To appreciate the challenges involved in managing the services and analyse the strategies to deal with these challenges.
- To give insights about the foundations of services marketing, customer expectations of services and gap existing in the service delivery processes and service Quality.

UNIT I	**INTRODUCTION**	**9**
Introduction– Definition– Service Economy – Evolution and growth of service sector – Nature and Scope of Services – Product - Service Continuum – Challenges and issues in Services Marketing.		**CO1**
UNIT II	**SERVICE MARKETING OPPORTUNITIES**	**9**
Classification of services – Expanded marketing mix – Service marketing – Environment and trends – Service market segmentation, targeting and positioning.		**CO2**
UNIT III	**SERVICE DESIGN AND DEVELOPMENT**	**9**
Service Life Cycle – New service development – Service Blue Printing – GAP model of service quality – Measuring service quality – SERVQUAL.		**CO3**
UNIT IV	**SERVICE DELIVERY**	**9**
Positioning of services – Designing service delivery System, Service Channel — Service marketing triangle – managing Demand and Supply of Service.		**CO4**
UNIT V	**SERVICE PROMOTION**	**9**
Integrated Service marketing communication - Challenges in Service Communication - Strategies to Match Service Promises and Delivery. Pricing of services - methods.		**CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Chiristropher H. Lovelock and Jochen Wirtz, Services Marketing: People, Technology, strategy Pearson Education, New Delhi,8th edition, 2016.
1. John.E.G.Bateson, K.Douglas Hoffman, Services Marketing, South Western Cengage learning, 4th Edition, 2011.

REFERENCE BOOKS

1. Kenneth E Clow, et al, Services Marketing Operation Management and Strategy, Biztantra, 2nd Edition, New Delhi, 2004.
2. Valarie Zeithaml, Mary Jo Bitner, Services Marketing, 5th International Edition, Tata McGraw Hill, 2007.
3. Christian Gronroos, Services Management and Marketing a CRM in Service Competition, 3rd Edition,Wiley,2007.
4. R. Srinivasan, SERVICES MARKETING, Prentice Hall of India Private Limited,4th Edition 2014, NewDelhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To make students understand the evolution, growth, challenges and the characteristics of services marketing.
CO2	To learn the service marketing opportunities in terms of marketing mix and STP
CO3	To Demonstrate integrative knowledge of marketing issues associated with service quality, perceived quality, customer satisfaction and loyalty
CO4	To comprehend Service delivery system using various channels.
CO5	To understand the Integrated services marketing communication activities in service sector.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)											PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	2	3	-	1	1	-	-	-	-	2	2	2

CO2	3	-	-	2	3	-	1	1	-	-	-	-	3	2	2
CO3	3	-	-	2	1	-	3	1	-	-	-	-	3	3	3
CO4	2	-	-	1	3	-	1	1	-	-	-	-	2	3	3
CO5	3	-	-	2	1	-	1	3	-	-	-	-	3	2	3

FINANCE ELECTIVES

MI1F001 BANKING AND FINANCIAL SERVICES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- Grasp how banks raise their sources and how they deploy it and manage the associated risks.
- Understand e-banking and the roles of financial institutions

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM AND PERFORMANCE EVALUATION **9**

Overview of Indian Banking system – Structure – Functions – Key Regulations in Indian Banking sector –RBI Act, 1934/ 2006 –Banking Regulation Act, 1949– Negotiable Instruments Act 1881/ 2002 – Provisions Relating to CRR – Provision for NPA's. **CO1**

UNIT II MANAGING BANK FUNDS/ PRODUCTS & RISK MANAGEMENT **9**

Deposit and Non-deposit sources – Designing deposit schemes and pricing of deposit sources – loan management – Investment Management – Asset and Liability Management – Financial Distress –Signal to borrowers – Prediction Models – Risk Management – Interest rate — Credit market –operational and solvency risks. **CO2**

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY **9**

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative. **CO3**

UNIT IV ASSET BASED FINANCIAL SERVICES **9**

Introduction – Need for Financial Services – Financial Services Market in India –NBFC – RBI framework and act for NBFC – Leasing and Hire Purchase – Financial evaluation – underwriting – mutual funds. **CO4**

UNIT V INSURANCE AND OTHER FEE BASED FINANCIAL SERVICES **9**

Insurance Act, 1938 –IRDA – Regulations – Products and services –Venture Capital Financing –Bill discounting –factoring – Merchant Banking – Role of SEBI **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2012.

REFERENCE BOOKS

1. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
2. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2012.
3. Madura, Financial Institutions & Markets, 10th edition, Cengage, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the overall structure and functions of Indian Financial System

CO2	Gain knowledge about regulations governing the Indian Banking system
CO3	Price various types of loans proposed by banks to various prospective borrowers with different risk profiles and evaluate the performance of banks
CO4	Familiarise the students with the concept of e-banking
CO5	In-depth understanding of fee-based and fund-based financial services in India

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	1	-	1	-	3	-	2	-	-	3	2	1
CO2	2	-	1	3	-	2	-	2	-	3	-	-	1	1	3
CO3	1	-	2	2	-	3	-	2	-	1	-	-	2	3	3
CO4	2	-	2	3	-	2	-	3	-	2	-	-	2	1	2
CO5	3	-	3	2	-	2	-	1	-	3	-	-	3	3	1

MI1F002	**BEHAVIORAL FINANCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To identify and understand systematic behavioral factors that influences the investment behavior.

UNIT I INTRODUCTION: WHY BEHAVIORAL FINANCE **9**

The role of security prices in the economy – EMH – Failing EMH – EMH in supply and demand framework – Equilibrium expected return models – Investment decision under uncertainty – Introduction to neoclassical economics and expected utility theory – Return predictability in stock market - Limitations to arbitrage **CO1**

UNIT II DECISION AND BEHAVIORAL THEORIES **9**

Nash Equilibrium: Keynesian Beauty Context and The Prisoner's Dilemma - The Monty Hall Paradox - The St. Petersburg Paradox - The Allais Paradox - The Ellsberg Paradox - Prospects theory – CAPM - behavioral portfolio theory – SP/A theory – brief history on rational thought – pascal – Fermat to Friedman - savage **CO2**

UNIT III DECISION MAKING BIASES **9**

Information screening bias - Heuristics and behavioral biases of investors – Bayesian decision making – cognitive biases – forecasting biases – emotion and neuroscience – group behaviour – investing styles and behavioral finance **CO3**

UNIT IV ARBITRAGEURS **9**

Definition of arbitrageur - Long-short trades - Risk vs. Horizon - Transaction costs and short-selling costs - Fundamental risk - Noise-trader risk - Professional arbitrage - Destabilizing informed trading **CO4**

UNIT V MANAGERIAL DECISIONS **9**

Supply of securities and firm investment characteristics (market timing, catering) by rational firms - Associated institutions - Relative horizons and incentives - Biased managers **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Prasanna Chandra, Behavioural Finance, Mc Graw Hill Publication
2. Shuchita Singh, Shilpa Bahi, Behavioural Finance, Vikas Publication

REFERENCE BOOKS

1. Shleifer, Andrei (2000). Inefficient Markets: An Introduction to Behavioral Finance. Oxford, UK: Oxford University Press.
2. Daniel Kahneman, Paul Slovic, and Amos Tversky (eds.). (1982) Judgment under Uncertainty: Heuristics and biases, Oxford; New York: Oxford University Press.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To Understand the need of behavioral finance.

CO2 To Know about various decision and behavioral theories

CO3 To learn about heuristic and behavioral biases of investors

CO4 To Analyse and understand about arbitragers and managerial decision

CO5 To understand about the price discovery in markets

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	3	2	-	1	-	3	-	-	-	-	3	3	2
CO2	3	-	3	3	-	2	-	3	-	-	-	-	3	2	2
CO3	2	-	2	3	-	3	-	3	-	-	-	-	3	3	3
CO4	3	-	3	3	-	3	-	3	-	-	-	-	3	2	2
CO5	2	-	3	3	-	3	-	3	-	-	-	-	3	2	3

MI1F003	**FINANCIAL DERIVATIVES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the nuances involved in derivatives and to understand the basic operational mechanisms in derivatives.
- This course aims at providing an in-depth understanding of financial derivatives in terms of concepts, structure, instruments and trading strategies for profit and risk management.

UNIT I INTRODUCTION **9**

Derivatives – Definition – Types – Forward Contracts – Futures Contracts – Options – Swaps – Differences between Cash and Future Markets – Types of Traders – OTC and Exchange Traded Securities –Uses and Advantages of Derivatives – Risks in Derivatives. **CO1**

UNIT II FUTURES CONTRACT **9**

Specifications of Futures Contract - Margin Requirements – Marking to Market – Hedging uses Futures – Types of Futures Contracts – Securities, Stock Index Futures, Currencies and **CO2**

Commodities – Delivery Options – Relationship between Future Prices, Forward Prices and Spot Prices.

UNIT III OPTIONS **9**

Definition – Exchange Traded Options, OTC Options – Specifications of Options – Call and Put Options – American and European Options – Intrinsic Value and Time Value of Options – Option payoff, options on Securities, Stock Indices, Currencies and Futures – Options pricing models – Differences between future and Option contracts. **CO3**

UNIT IV SWAPS **9**

Definition of SWAP – Interest Rate SWAP – Currency SWAP – Role of Financial Intermediary – Warehousing – Valuation of Interest rate SWAPs and Currency SWAPs Bonds and FRNs – Credit Risk. **CO4**

UNIT V DERIVATIVES IN INDIA **9**

Evolution of Derivatives Market in India – Regulations - Framework – Exchange Trading in Derivatives – Commodity Futures – Contract Terminology and Specifications for Stock Options and Index Options in NSE – Contract Terminology and specifications for stock futures and Index futures in NSE – Contract Terminology and Specifications for Interest Rate Derivatives. **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. David Dubofsky – 'Option and Financial Futures – Valuation and Uses, McGraw Hill International Edition.
2. Don M. Chance, Robert Brooks, An Introduction to Derivatives and Risk Management, 9th edition, Cengage, 2015.

REFERENCE BOOKS

1. John. C. Hull, Options, Futures and Other Derivative Securities', PHI Learning, 9th Edition, 2012
2. Keith Redhead, 'Financial Derivatives – An Introduction to Futures, Forwards, Options and SWAPs', PHI Learning, 2011.
3. S. L. Gupta, Financial Derivatives- Theory, Concepts and Practice, Prentice Hall of India, 2011.
4. Stulz, Risk Management and Derivatives, Cengage, 2nd Edition, 2011.
5. Varma, Derivatives and Risk Management, 2nd Edition, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Possess good skills in hedging risks using derivatives
CO2 Understand about future contract and options
CO3 Learning in depth about options and swaps
CO4 Knowing about the evolution of derivative markets
CO5 Develop in depth knowledge about stock options and index futures in NSE

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	3	-	-	-	1	-	-	-	-	3	2	3
CO2	3	-	2	2	-	-	-	3	-	-	-	-	3	2	3
CO3	1	-	2	1	-	-	-	2	-	-	-	-	2	3	1

CO4	2	-	1	2	-	-	-	3	-	-	-	-	1	3	2
CO5	2	-	2	2	-	-	-	2	-	-	-	-	2	2	2

MI1F004 FINANCIAL MARKETS L T P C

3 0 0 3

COURSE OBJECTIVES

- To understand the types and functions of the various financial markets in India, its instruments and Regulations.

UNIT I FINANCIAL MARKETS IN INDIA **9**

Indian financial system and markets – structure of financial markets in India –Types-Participants in financial Market – Recent Developments in the financial market - Capital market – Evolution and growth of capital market - Significance and functions of capital market - Capital market instruments **CO1**

UNIT II INDIAN CAPITAL MARKET- PRIMARY MARKET **9**

Primary Market - Primary market system - Types of scripts - Issue of capital: process, regulation pricing of issue, – Methods of floating new issues, Book building- Primary markets intermediaries: commercial banks, development banks, Merchant banker, issue managers, rating agencies etc – Role of primary market **CO2**

UNIT III SECONDARY MARKET **9**

Stock exchanges in India - History and development -listing - Depositaries - Stock exchange mechanism: Trading, Settlement, risk management, Basics of pricing mechanism - Player and stock exchange - Regulations of stock exchanges –Role of SEBI – BSE, OTCEI, NSE, ISE, - Stock market indices. **CO3**

UNIT IV DEBT MARKET AND FOREX MARKET **9**

Bond markets in India: Government bond market and its interface with capital market - Components of bond market - G-Sec, T-Bills, Corporate Bonds, Yield conventions, Role of primary dealers, Auction Markets - Pricing of Bonds. Introduction to Forex markets, basics in exchange rates theory - Forex risk exposures and basics of corporate Forex risk management. **CO4**

UNIT V MUTUAL FUNDS AND VENTURE CAPITAL **9**

Mutual funds institutions in India. Types of mutual funds, Basics in portfolio management, Metrics of performance for fund manager - Venture capital. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. E.Gordon., K.Natarajan, Financial Markets and Services, S. Himalaya Publishing House
2. Bimal Jaiswal, Dr.Bhuvana Venkatraman, Dr.Richa Banerjee,Financial Markets,Institutions and Financial Services, Sahitya Bhawan Publications.

REFERENCE BOOKS

1. Christopher Viney and Peter Phillips, Financial Institutions, Instruments and Markets (2015), 8th Edition published by McGraw Hill.
2. Pathak, Bharati V., Indian Financial System: Markets, Institutions and Services, Pearson education (Singapore), New Delhi, Fourth edition, 2014.
4. Bhole, L.M, Financial institutions and Markets: Structure, Growth and Innovations, McGraw Hill, New Delhi, Sixth edition, 2017.
5. Saunders, Anthonu and Cornett, Marcia Millon, Financial markets and Institutions: An Introduction to the risk management approach, McGraw Hill, Irwin, New York, 3rd Edition,2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To Understand the basic concepts of the finance markets in India

CO2 To identify the underlying structure and functions of Indian financial markets

CO3 To familiarise the methods of issuing shares and the role of intermediaries in the primary market
CO4 To learn about the trading mechanism in stock market
CO5 To describe the instruments, participants and trading in debt market

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	3	-	1	-	3	-	-	-	-	3	2	3
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CO3	3	-	2	3	-	3	-	3	-	-	-	-	3	3	3
CO4	2	-	3	3	-	2	-	3	-	-	-	-	3	2	2
CO5	3	-	3	3	-	3	-	3	-	-	-	-	3	3	3

MI1F005	INTERNATIONAL FINANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the International Financial Environment, Management and Risks involved.

UNIT I INTERNATIONAL TRANSACTIONS 9

Overview and Evolution of International Finance –Institutions for International Finance – Internationalization process –International Monetary and Financial System – Balance of Payments – Exchange rate and money supply – International parity relations – Purchasing power parity – interest rate parity – Forward rate parity. **CO1**

UNIT II MULTINATIONAL FINANCIAL MANAGEMENT 9

Process of overseas expansion – Reasons for cross-border investing – The theory of investment – techniques of project evaluation - Approaches for investment under uncertainty - FDI – Measuring and Managing Risk – International M&A – Financial Techniques in M&A – Regulations of M&A in major countries. **CO2**

UNIT III INTERNATIONAL MONETARY SYSTEM 9

Introduction to Institutions of the Foreign Exchange Interbank Market - Foreign Exchange Spot Transactions – forward market — Hedging and Speculation - Hedging FX Transaction Exposure - The Eurocurrency market – international banking – structure and instruments. **CO3**

UNIT IV BORROWING AND LENDING: INTERNATIONAL SOURCES OF FINANCE 9

Bond Markets of various countries – Fixed and floating rate notes - Syndicate loans – Syndicated Euro credits – ADR – GDR – Managing interest rate risk – Bond prices and yields – Bond Management – tools and techniques. **CO4**

UNIT V INTERNATIONAL RISK ASSESSMENT AND OTHER INTERNATIONAL MARKETS 9

Country and political risk analysis – benefits and risks of international portfolio investment – assessing country creditworthiness – futures markets and instruments – option markets and instruments – option pricing – option pricing theory in financial risk assessment **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1.Apte P.G., International Financial Management, Tata McGraw Hill, 2011.

2. Jeff Madura, International Corporate Finance, Cengage Learning, 9th Edition, 2011.

REFERENCE BOOKS

1. Alan C. Shapiro, Multinational Financial Management, PHI Learning, 5th Edition, 2010.
2. Eunand Resnik, International Financial Management, Tata McGraw Hill, 5th Edition, 2011.
3. Website of Indian Government on EXIM policy

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To gain the conceptual clarity of the theoretical aspects of international trade and Transactions
CO2	To understand international investment, risk, Mergers and acquisitions.
CO3	To analyse the nature and functioning of foreign exchange markets, determination of exchange rates and interest rates and the forecasting.
CO4	To understand the international sources of finance.
CO5	To analyze the international risk and various Markets and instruments.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	2	3	-	-	3	-	3	-	-	3	1	3
CO2	3	-	2	3	3	-	-	3	-	3	-	-	3	1	3
CO3	3	-	2	3	3	-	-	3	-	3	-	-	3	1	3
CO4	3	-	3	3	3	-	-	3	-	3	-	-	3	1	3
CO5	3	-	3	3	3	-	-	3	-	3	-	-	3	1	3

MI1F006	SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Understand the nuances of stock market operations.
- Understand the techniques involved in deciding upon purchase or sale of securities.

UNIT I INVESTMENT SETTING **9**

Financial and economic meaning of Investment – Characteristics and objectives of Investment – Types of Investment – Investment alternatives – Choice and Evaluation – Risk and return concepts. **CO1**

UNIT II FUNDAMENTAL ANALYSIS **9**

Economic Analysis – Economic forecasting and stock Investment Decisions – Forecasting techniques. Industry Analysis : Industry classification, Industry life cycle – Company Analysis **CO2**

UNIT III TECHNICAL ANALYSIS **9**

Fundamental Analysis Vs Technical Analysis -- Dow theory – Charting methods - Chart Patterns Trend – Trend reversals – Market Indicators -Moving Average – Exponential moving Average Oscillators -RSI -ROC - MACD. Efficient Market theory - Forms of market efficiency -weak, semi-strong, strong form. **CO3**

UNIT IV PORTFOLIO CONSTRUCTION AND SELECTION **9**

Portfolio analysis - Reduction of portfolio risk through diversification – Portfolio risk - Portfolio Selection - Feasible set of portfolios - Efficient set - Markowitz model - Single index model - Construction of optimum portfolio - Multi-index model. **CO4**

9

UNIT V PORTFOLIO MANAGEMENT

Capital Asset Pricing model - Lending and borrowing - CML - SML - Pricing with CAPM - Arbitrage pricing theory– Portfolio Evaluation - Sharpe's index Treynor's index, Jensen's index – Mutual Funds – Portfolio Revision. **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Donald E.Fischer & Ronald J.Jordan, Security Analysis & Portfolio Management, PHI Learning., New Delhi, 8th edition, 2011.

REFERENCE BOOKS

1. Prasannachandra, Investment analysis and Portfolio Management, Tata McGraw Hill, 2011.
2. Reilly & Brown, Investment Analysis and Portfolio Management, Cengage, 10th edition, 2016.
3. S. Kevin , Securities Analysis and Portfolio Management , PHI Learning , 2012.
4. Punithavathy Pandian, Analysis & Portfolio Management, Vikas publishing house PVT LTD, second edition, 2013.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Understand the concept of investment and identify the investment alternatives to investors
CO2 Learn the nuances of fundamental analyses and technical analyses
CO3 Analyse and evaluate the value of securities
CO4 Explain how to construct an efficient portfolio
CO5 Explore the various methods through which portfolio evaluation could be done

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	3	3	-	-	2	-	1	-	-	3	3	3
CO2	2	-	3	2	1	-	-	2	-	3	-	-	3	2	3
CO3	2	-	3	2	2	-	-	1	-	3	-	-	2	3	2
CO4	1	-	2	1	1	-	-	2	-	2	-	-	3	1	3
CO5	2	-	1	3	3	-	-	3	-	1	-	-	2	3	2

HUMAN RESOURCE MANAGEMENT ELECTIVES

		L	T	P	C
MI1H001	**INDUSTRIAL RELATIONS AND LABOUR LEGISLATIONS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

- To explore contemporary knowledge and gain a conceptual understanding of industrial relations.

- To have a broad understanding of the legal principles governing the employment relationship at individual and collective level.

UNIT I	**INDUSTRIAL RELATIONS**	**9**
Concept, scope- objectives- Importance - Approaches to IR- Industrial relations system in India. Trade Unions Act 1926.		**CO1**
UNIT II	**INDUSTRIAL CONFLICTS AND LABOUR WELFARE**	**9**
The Industrial Disputes Act, 1947– Impact – Causes – Strikes – Prevention – Industrial Peace – Conciliation – Arbitration – Adjudication. Labour welfare- statutory-Voluntary welfare funds.		**CO2**
UNIT III	**LABOUR LEGISLATIONS I**	**9**
Factories Act 1948 - Minimum Wages Act, 1948- Payment of Wages Act, 1936- Payment of Bonus Act, 1965		**CO3**
UNIT IV	**LABOUR LEGISLATIONS II**	**9**
The Apprentices act, 1961-The Equal Remuneration act, 1976- Payment of Gratuity act 1972- Employee compensation act in 2013		**CO4**
UNIT V	**LABOUR LEGISLATIONS-III**	**9**
Employees' Provident fund and Miscellaneous provisions act, 1952- Employees' state insurance (ESI) Act, 1948- Maternity Benefit Act, 1961- Contract Labour Regulations and Abolition Act, 1970		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Mamoria C.B. and Sathish Mamoria, Dynamics of Industrial Relations, Himalaya Publishing House, New Delhi, 2016.
2. Kapoor N. D , Elements of Mercantile Law, Sultan Chand, 2014.
3. Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. Industrial relations &Labour Laws. Tata McGraw Hill. 2012
4. P.K. Padhi, Industrial Laws, PHI, 2017.
5. P.R.N Sinha, Indu Bala Sinha, Seema Priyardarshini Shekhar. Industrial Relations, Trade Unions and Labour Legislation. Pearson. 2017
6. Tax Mann, Labour Laws, 2018.
7. Srivastava, Industrial Relations and Labour laws, Vikas, 2015.
8. P.N.Singh, Neeraj Kumar. Employee relations Management. Pearson. 2011.
9. Ratna Sen, Industrial Relations in India, Shifting Paradigms, Macmillan India Ltd., New Delhi, 2007.
10. C.S.VenkataRatnam, Globalisation and Labour Management Relations, Response Books, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Industrial relations system and Trade unions
CO2	Industrial Disputes and labour welfare measures
CO3	Labour legislation introduction and legal provisions for factory workers, wages and Bonus
CO4	Legal provisions for equal remuneration, gratuity, compensation, industrial employment and Apprenticeship
CO5	Legal provisions for EPF, ESI, Maternity, contract labours, and child labour prevention.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	3	3	2	-	-	2	-	-	1	-	2	3	-

CO2	1	-	3	3	2	-	-	2	-	-	1	-	2	3	-
CO3	1	-	3	3	2	-	-	2	-	-	1	-	2	3	-
CO4	1	-	3	3	2	-	-	2	-	-	1	-	2	3	-
CO5	1	-	3	3	2	-	-	2	-	-	1	-	2	3	-

MI1H002 INTERNATIONAL HUMAN RESOURCE MANAGEMENT **L T P C**

3 0 0 3

COURSE OBJECTIVES

- The course aims to provide students insights to HR practices followed in Global organizations.

UNIT I INTRODUCTION TO IHRM **9**

Definition – Evolution of HRM- Importance of IHRM, Models of IHRM – Matching Model, Harvard Model, European Model, IHRM policies, Standardization and Localization of HRM practices **CO1**

UNIT II IHRM STRATEGIES **9**

Internationalization and world business – Strategic orientation, IHRM in cross border Mergers and Acquisitions, International Alliances – IHRM & Competitive advantage- Cultural context of IHRM **CO2**

UNIT III RECRUITMENT AND SELECTION **9**

International Managers staffing – Approaches to staffing – Role of Expatriates – Role of impatriate – Role of Non expatriates- recruitment and selection methods- Current practices. **CO3**

UNIT IV TRAINING AND DEVELOPMENT, PERFORMANCE APPRAISAL **9**

Expatriate training program, types, effectiveness measures, HCN training- Trends in international training and development – repatriation process and training. International performance Management methods & issues. **CO4**

UNIT V INTERNATIONAL COMPENSATION **9**

Components of international compensation-Approaches to international compensation – Challenges and choices -International Labor Standards – emerging Issues. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

5. Chris Brewster Paul Sparrow Guy Vernon & Elizabeth Houldsworth, International Human Resource Management, Viva Books Private Limited, 2017.
6. Peter J. Dowling, Marion Festing, Allen D. Engle, International Human Resource Management, Cengage India, 2017.Peter J Dowling & D E. Welch: International Human Resource Management, Cengage Learning 7th Edition IE.,2017
7. Monir H. Tayeb: International Human Resource Management, A Multinational Company Perspective Oxford University Press, IE
8. Ibraiz Tarique, Dennis Briscoe & Randall, International Human Resource Management- Policies and practices for Multinational Enterprises, Routledge, 5th edition
9. Anne- WilHarZing, Ashly Pinnington, International human Resource Management, 3rd edition, Sage Publication
10. P L Rao, International Human resource Management- Text and Cases, Excel Books
11. Christopher Brewster, Guy Vernon, Paul Sparrow, Elizabeth Houldsworth – International Human Resource Management, Kogan Page Publishers

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 The basics of IHRM, models and practices
CO2 Strategic orientation and cultural context towards IHRM
CO3 International practices on recruitment and selection
CO4 International perspectives on Training, development, performance appraisal
CO5 International practices on Compensation management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	2	-	-	-	1	-	-	-	-	1	1	-
CO2	2	-	2	2	1	-	-	2	-	-	-	-	1	1	-
CO3	2	-	2	2	1	-	-	2	-	-	2	-	1	-	-
CO4	2	-	2	2	1	-	-	2	-	-	2	-	1	1	-
CO5	2	-	2	2	3	-	-	2	-	-	2	-	1	1	-

		L	T	P	C
MI1H003	**NEGOTIATION AND CONFLICT MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE:

- To develop an understanding of the nature and strategies of negotiation.
- To understand conflict and strategies to resolve the conflict

UNIT I FUNDAMENTALS OF NEGOTIATION **9**

Nature, Characteristics of negotiation- Dimensions of Negotiation-Structure- Types of Negotiation- Negotiation process- Techniques of Negotiation- Issues in negotiation. **CO1**

UNIT II NEGOTIATION STRATEGIES **9**

Strategy and planning for negotiation- Strategy and Tactics for distributive bargaining - Integrative negotiation- Negotiation power- source of power- Cross culture Negotiation-Ethics in negotiation. **CO2**

UNIT III INTRODUCTION TO CONFLICT MANAGEMENT **9**

Understanding conflict, components - Types of conflict - Sources of conflict- Contingency approach, conflict management process - conflict mapping and tracking conflict & performance. **CO3**

UNIT IV MANAGING INTERPERSONAL, GROUP AND ORGANIZATIONAL CONFLICT **9**

Individual difference- Personalities & abilities- Interpersonal conflict- Group conflict- Organizational conflict- organizational conflict strategies. **CO4**

UNIT V CONFLICT RESOLUTION AND COST **9**

Conflict resolution models- new developments in conflict -gender and conflict resolution- Assessing the cost of workplace conflict **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Roy J. Lewicki, Bruce Barry, David M. Saunders, Kevin Tasa Essentials of Negotiation - McGraw-Hill Education, 2020

2. Eirene Rout, Nelson Omika, Corporate Conflict Management - concepts & skills, PHI, 2007
3. Michael Spangle, Negotiation- Communication for diverse settings-, Sage Publication, 2008
4. B.D. Singh, Managing conflict and negotiation, 1st edition, Excel books, 2008.
5. Barbara A Budjac Corvette Conflict Management: Practical guide to develop negotiation strategies, , Pearson Prentice Hall, 2006, ISBN: 8174466428, 9788174466426
6. M. Afzalur Rahim, Managing Conflict in Organizations, Transaction Publishers, 2011.
7. David Oliver How to negotiate effectively, The Sunday Times, Kogan Page, 2010
8. Subbulakshmi, Conflict Resolution Techniques,ICFAI University press, 2005
9. Andrew.J Dubrin Negotiation And Conflict Resolutions In Organisation, Academic Media Solutions, 2020

COURSE OUTCOMES

Upon completion of the course, students gets to learn about

CO1 The fundamentals of Negotiation, Types, process and techniques
CO2 Strategies and tactics in Negotiation
CO3 The basics of Conflict management, models, approaches and process
CO4 Managing interpersonal, group and organizational conflict
CO5 Conflict resolution models and cost of workplace conflict

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	3	2	-	1	-	2	-	-	-	-	2	1	-
CO2	1	-	2	2	-	-	-	2	-	-	-	2	2	1	2
CO3	1	-	2	2	-	2	-	2	-	-	-	-	2	1	-
CO4	1	-	2	2	3	2	-	2	-	-	-	-	2	1	-
CO5	3	-	2	2	-	2	-	2	-	-	-	-	2	1	-

MI1H004	ORGANIZATIONAL DESIGN, CHANGE AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To help the students to gain knowledge about the concepts of change management and to acquire the skills required to manage any change effectively
- To understand the concept and techniques of OD and to enable the skills for the application of OD in organizations.

UNIT I ORGANIZATIONAL DESIGN **9**

Organizational Design – Components – Basic Challenges of design – Differentiation, Integration, Centralization, Decentralization, Standardization, Mutual adjustment -Mechanistic and Organic Structures- Importance of Design – Success and Failures in design. **CO1**

UNIT II ORGANIZATIONAL CHANGE **9**

Meaning, Nature, Forces for change- change agents- Change process-Types and forms of change- Models of change- Resistance to change – individual factors – organizational factors – techniques to overcome change. **CO2**

UNIT III ORGANIZATIONAL DEVELOPMENT **9**

Introduction- Process of OD- managing the phases of OD- Organizational diagnosis-Process-stages- Techniques-Questionnaire, interview, workshop, task-force- collecting, analysing-feedback of diagnostic information. **CO3**

UNIT IV OD INTERVENTION **9**

Human process interventions-Individual, group and inter-group human relations- structure and technological interventions- strategy interventions – sensitivity training – survey feedback, process consultation – team building – inter-group development. **CO4**

UNIT V ORGANIZATIONAL EVOLUTION AND SUSTENANCE **9**

Organizational life cycle – Models of Organizational Decision making – Organizational Learning – Innovation, Intrapreneurship and Creativity. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. French & Bell: Organisational Development, McGraw-Hill, 2005
2. Wendell L. French, Cecil H. Bell, Jr, Veena Vohra - Organization Development : Behavioural Science Interventions for Organizational Improvement, Sixth Edition 2017
3. Rajiv Shaw: Surviving Tomorrow: Turnaround Strategies in Organisational Design and Development, Vikas Publishing House.
4. Thomas G. Cummings, Christopher G. Worley: Organisation Development and Change, Thomson Learning.
5. S. Ramnarayan, T. Venkateswara Rao, Kuldeep Singh: Organization Development: Interventions And Strategies, Sage Publications
6. Wendell French, Cecil H.Bell, Veena, Jr Organization Development, behavioral science interventions for Organization Improvement, , Pearson, PHI
7. R.L. Nandeshwar, Bala Krishna Jayasimha Change & Knowledge Management-, Excel Books, 1st Ed.
8. K Harigopal, Management of Organizational Change– Response BOOKS, 2nd editon,2006
9. Gareth R. Jones, Organizational, Design, and Change-, Pearson Education, 7th edition, 2021.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 The fundamentals of organizational design and structure
CO2 Change process, types, and models of change in organizations
CO3 The fundamentals of organizational development
CO4 Organizational development Interventions
CO5 Organizational evolution and sustenance

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	2	1	-	-	1	-	-	-	-	1	1	-
CO2	2	-	2	2	1	-	-	2	-	-	-	-	1	1	-
CO3	2	-	3	2	-	-	-	2	-	-	-	-	1	1	-
CO4	2	-	2	2	-	-	-	2	-	-	-	-	1	1	-
CO5	2	-	2	2	-	-	-	2	-	-	-	-	1	1	-

MI1H005	**REWARD AND COMPENSATION MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart skills in designing analysing and restructuring reward management systems, policies and strategies.
- To understand the various dimensions of Compensation Management.

UNIT I INTRODUCTION	**9**
Compensation - Definition - objectives- principles of compensation formulation- Compensation Design and strategy- Wage Structure -types of wages- compensation trends and reward system in India.	**CO1**
UNIT II EMPLOYEE COMPENSATION AND LABOUR MARKET	**9**
Macroeconomics of Labour markets- Unemployment and its impact on labour market- Implications on employee compensation- valuation of employee compensation.	**CO2**
UNIT III MANAGING EMPLOYEE BENEFITS AND REWARDS	**9**
Nature and types of employee benefits- statutory employee benefits in India- Non-monetary benefits. Reward - Meaning, Elements, Types- Basic concepts of reward management - Approaches to reward system.	**CO3**
UNIT IV PERFORMANCE RELATED COMPENSATION	**9**
Performance management system (PMS)-performance objectives - indicators- standards and metric - competency based pay. Team Compensation – Gain Sharing Incentive Plan – Enterprise Incentive Plan – Profit Sharing Plan- ESOPs.	**CO4**
UNIT V EXECUTIVE AND SALES COMPENSATION PLAN	**9**
Executive Compensation – Components - Relationship between Fixed and variable pay-Executive Incentive Programmes. Sale Compensation plan- design and administration- sales incentives and motivations.	**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. B. D. Singh , Compensation and Reward Management, Excel Books, 2017.
2. Richard.I. Henderson: Compensation Management In A Knowledge Based World – Prentice Hall, 2007.
3. Richard Thrope& Gill Homen: Strategic Reward Systems- Prentice-Hall, 2000
4. Armstrong, Michael and Marlis, Reward Management: A Handbook of salary administration,, Kogan page business books, 2005
5. Michael Armstrong & Helen Murlis: Hand Book of Reward Management – Crust Publishing House.
6. Joseph.J. Martocchio: Strategic Compensation – A Human Resource Management Approach – Prentice-Hall, 2014
7. Edwarde .E.Lawler III, Rewarding Excellence (Pay Strategies for the New Economy) – Jossey-Bass, 2020

COURSE OUTCOMES

Upon completion of the course, students gets to learn about

CO1 The basics of Compensation Management and Reward system, Theories and strategies
CO2 Macro and micro economics of labour market and employee compensation
CO3 Managing employee benefits and rewards
CO4 Performance related compensation
CO5 Executive and sales compensation plans, theories and design

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	3	2	-	1	-	2	-	-	-	-	2	1	-
CO2	1	-	2	2	2	2	-	2	-	-	-	1	2	1	1
CO3	1	-	2	2	-	2	-	2	-	-	-	-	2	1	-
CO4	1	-	2	2	-	2	-	2	-	-	-	-	2	1	-
CO5	1	-	2	2	-	2	-	2	-	-	-	-	2	1	-

MI1H006	**STRATEGIC HUMAN RESOURCE MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To help students understand the transformation in the role of HR functions from being a support function to strategic function.

UNIT I CONTEXT OF SHRM **9**

SHRM - SHRM models - Strategic HRM vs Traditional HRM - Barriers to Strategic HR- Understanding and Measuring Human capital –Human side of corporate strategies - Strategic work redesign - Strategic Capability - Bench Marking. **CO1**

UNIT II HUMAN RESOURCE DEVELOPMENT **9**

Strategic framework for HRM and HRD– Importance – Challenges to Organisations – HRD Functions - Roles of HRD Professionals - HRD Needs Assessment - HRD practices –HRD Program Implementation and Evaluation – Recent trends –HRD Audit. **CO2**

UNIT III E-HRM **9**

e- Employee profile– e- selection and recruitment - e - training and development – e-learning strategies- e- Performance management - and Compensation design - Use of mobile applications in HR functions– Development and Implementation of HRIS. **CO3**

UNIT IV CAREER & COMPETENCY DEVELOPMENT **9**

Career Concepts – Roles – Career stages – Career planning and Process –Career Motivation and Enrichment –Managing Career plateaus-– Competencies and Career Management – Competency Mapping Models – Equity and Competency based Compensation. **CO4**

UNIT V EMPLOYEE COACHING & COUNSELING **9**

Need for Coaching – Role of HR in coaching –Coaching Effectiveness– Need for Counselling – Role of HR in Counselling - Counselling Effectiveness – Employee Health and Welfare Programs. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Pulak Das. Strategic Human Resource Management- A Resource Driven Perspective- Cengage Learning 4th Indian Reprint- 2013.
2. Feza Tabassum Azmi, Strategic Human Resource Management Text and Cases, Cambridge University Press, 2019
3. Karen Beaven, Strategic Human Resource Management: An HR Professional's Toolkit, Kogan Page, 2019

4. Strategic HRM and Performance: A Conceptual Framework, Red Globe Press; 2019.
5. Randy L. Desimone, Jon M. Werner – David M. Mathis, Human Resource Development, Cengage Learning, 7th edition, 2016.
6. Jeffrey A Mello, Strategic Human Resource Management, Cengage Learning, 3rd edition, 2011.
7. Paul Boselie. Strategic Human Resource Management. Tata McGraw Hill. 2011
8. Michael Armstrong, Armstrong's Handbook of Strategic Human Resource Management, Kogan Page, 7th edition, 2020

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the SHRM models, Strategic HRM vs Traditional HRM and Barriers
CO2	Know the HRD Functions, HRD Needs Assessment, HRD practices and Recent trends in HRD
CO3	To design and develop E-HRM.
CO4	To evaluate career roles, career motivation, competency mapping models and equity and competency based compensation
CO5	To evaluate coaching, counselling and employee health & welfare programs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	3	1	-	-	-	-	-	-	-	1	1	-
CO2	2	-	2	3	1	-	-	-	-	-	-	-	2	2	-
CO3	2	-	2	3	-	-	-	2	-	-	-	-	2	2	-
CO4	2	-	2	3	-	-	-	2	-	-	-	-	2	2	-
CO5	2	-	2	3	-	-	-	2	-	-	2	-	2	2	-

OPERATIONS MANAGEMENT ELECTIVES

MI1O001	LOGISTICS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the need and importance of logistics in product flow.

UNIT I INTRODUCTION 9

Definition and Scope of Logistics – Functions & Objectives – Customer Value Chain – Service Phases and attributes – Value added logistics services – Role of logistics in Competitive strategy – Customer Service. **CO1**

UNIT II DISTRIBUTION CHANNELS AND OUTSOURCING LOGISTICS 9

Distribution channel structure - channel members, channel strategy, role of logistics and support in distribution channels. Logistics requirements of channel members; Logistics outsourcing – catalysts, benefits, value proposition, . 3PL, 4PL, 5PL, 6PL. **CO2**

UNIT III TRANSPORTATION AND PACKAGING 9

Transportation System – Evolution, Infrastructure and Networks. Freight Management – Vehicle Routing – Containerization; Modal Characteristics - Inter-Modal Operators and Transport Economies; International Logistics -objectives, importance in global economy, **CO3**

Characteristics of global supply chains, Incoterms. Selection of service provider; Packaging-Design considerations, Material and Cost. Packaging as Unitisation. Consumer and Industrial Packaging.

UNIT IV PERFORMANCE MEASUREMENT AND COSTS **9**

Performance Measurement–Need, System, Levels and Dimensions. Internal and External Performance Measurement. Logistics Audit. Total Logistics Cost – Concept, Accounting Methods: Cost – Identification, Time Frame and Formatting. **CO4**

UNIT V CURRENT TRENDS **9**

Logistics Information Systems – Need, Characteristics and Design. E-Logistics –Structure and Operation. Logistics Resource Management eLRM. Automatic Identification Technologies; Reverse Logistics – Scope, design and as a competitive tool. Global Logistics –Operational and Strategic Issues, ocean and air transportation. Strategic logistics planning; Green Logistics. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process, Tata McGraw Hill, 2010
2. Ronald H. Ballou, Business Logistics and Supply Chain Management, Pearson Education, 5 th Edition, 2007

REFERENCE BOOKS

1. Sople Vinod V, Logistics Management: The Supply Chain Imperative, Pearson Education, 3 rd Edition, 2012.
2. Coy leetal, The Management of Business Logistics, Thomson Learning, 7th Edition, 2004.
3. Ailawadi C Sathish & Rakesh Singh,Logistics Management,PHI,2005.
4. Bloomberg David Jetal., Logistics, Prentice Hall India, 2005.
5. Pierre David, International Logistics, Biztantra, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basics of logistics, customer value chain and the importance of logistics in strategy formulation.
CO2	To understand distribution channels, its structure and functions and how logistics function can be outsourced.
CO3	To evaluate the influencing characteristics for efficient transportation and packaging.
CO4	To analyse and evaluate the performance measurement and cost of logistics.
CO5	To understand and evaluate the current trends in logistics management

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**												**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PS O2**	**PSO 3**
CO1	2	-	3	-	-	-	-	-	-	-	-	-	2	3	1
CO2	1	-	3	-	-	-	-	-	-	-	-	-	2	3	2
CO3	3	-	2	-	-	-	-	-	-	-	-	-	2	2	1

CO4	2	-	3	-	-	-	-	-	-	-	-	2	3	2
CO5	2	-	3	-	-	-	-	-	-	-	-	3	3	1

MI1O002 MATERIALS MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. To understand why materials management should be considered for profit in operations.
2. To realize the importance of materials both in product and service.

UNIT I INTRODUCTION 9

Operating environment-aggregate planning-role, need, strategies, costs techniques, approaches -master scheduling - manufacturing planning and control system - manufacturing resource planning enterprise resource planning-making the production plan. **CO1**

UNIT II MATERIALS PLANNING 9

Materials requirements planning-bill of materials-resource requirement planning-manufacturing resource planning-capacity management-scheduling orders-production activity control-codification. **CO2**

UNIT III INVENTORY MANAGEMENT 9

Policy Decisions–objectives-control -Retail Discounting Model, News vendor Model; EOQ and EBQ models for uniform and variable demand with and without shortages -Quantity discount models. Probabilistic inventory models. **CO3**

UNIT IV PURCHASING MANAGEMENT 9

Establishing specifications-selecting suppliers - price determination-forward buying-mixed buying strategy-price forecasting-buying seasonal commodities-purchasing under uncertainty-demand management - price forecasting-purchasing under uncertainty-purchasing of capital equipment international purchasing. **CO4**

UNIT V WAREHOUSE MANAGEMENT 9

Warehousing functions – types - Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification - Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency-productivity -cost effectiveness. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. J.R.Tony Arnold, Stephen N. Chapman, Lloyd M. Clive, Materials Management, Pearson, 2012.
1. 2. P. Gopalakrishnan, Purchasing and Materials Management, Tata McGraw Hill, 2012

REFERENCE BOOKS

1. A.K.Chitale and R.C.Gupta, Materials Management, Text and Cases, PHI Learning, 2nd Edition, 2006
2. A.K.Datla, Materials Management, Procedure, Text and Cases, PHI Learning, 2nd Edition, 2006
2. 3. Ajay K Garg, Production and Operations Management, Tata McGraw Hill , 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To Understand the planning horizons and activities of scheduling.
CO2	To understand materials planning with respect to the available capacity.
CO3	To understand and evaluate inventory models.
CO4	To understand and evaluate the planning for the purchasing function in an organization.
CO5	To understand and evaluate the warehouse requirement and analyze the efficiency.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PS O2	PSO 3
CO1	2	-	-	-	3	-	-	-	-	-	-	-	2	3	1
CO2	1	-	-	-	3	-	-	-	-	-	-	-	2	3	1
CO3	3	-	-	-	2	-	-	-	-	-	-	-	2	3	1
CO4	2	-	-	-	3	-	-	-	-	-	-	-	2	3	1
CO5	2	-	-	-	3	-	-	-	-	-	-	-	3	3	1

MI1O003	PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the fundamental principles and practices of managing projects.
- To create and execute an integrated project plan

UNIT I INTRODUCTION TO PROJECT MANAGEMENT **9**

Project Management – Definition –Goal - Lifecycles. Project Environments. Project Manager – Roles- Responsibilities and Selection - Project Teams. **CO1**

UNIT II PLANNING, BUDGETING AND RISK MANAGEMENT **9**

The Planning Process – Work Break down Structure. Cost Estimating and Budgeting - Process, Summaries, schedules and forecasts. Managing risks - concepts, identification, assessment and response planning. **CO2**

UNIT III SCHEDULING & RESOURCE ALLOCATION **9**

PERT & CPM Networks - Project durations and floats - Crashing – Resource loading and leveling. Simulation for resource allocation. Goldratt's Critical Chain. **CO3**

UNIT IV PROJECT ORGANIZATION & CONFLICT MANAGEMENT **9**

Formal Organization Structure – Organization Design – Types of project organizations. Conflict – Origin & Consequences - Managing conflict – Team methods for resolving conflict. **CO4**

UNIT V CONTROL AND COMPLETION **9**

Project Control – Process, Monitoring, Internal and External control, Performance analysis, Performance Index Monitoring. Project Evaluation, Reporting and Termination. Project success and failure - Lessons. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. John M. Nicholas, Project Management for Business and Technology - Principles and Practice, Second Edition, Pearson Education, 2006.

1. Clifford Gray and Erik Larson, Project Management, Tata McGraw Hill Edition, 2005.

REFERENCE BOOKS

1. Gido and Clements, Successful Project Management, Second Edition, Thomson Learning, 2003.
2. Samuel J.M., Jack R.M., Scott M.S., Margaret M.S., and Gopalan M.R., Project Management, First Indian edition, Wiley-India, 2006.
2. Harvey Maylor, Project Management, Third Edition, Pearson Education, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to understand and analyze process of project management and project teams effectively
CO2	To plan for the effective use of resources and to estimate budgets for the implementation
CO3	Understand and analyze the ways of completing projects on time and scheduling resources effectively
CO4	To understand the organization structure & critically analyse conflicts and ways of resolving conflicts
CO5	To understand reporting and control methods

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	3	-	1	-	-	-	-	-	-	-	2	3	1
CO2	3	-	2	-	2	-	-	-	-	-	-	-	2	3	2
CO3	3	-	3	-	3	-	-	-	-	-	-	-	2	3	1
CO4	3	-	3	-	3	-	-	-	-	-	-	-	2	3	1
CO5	3	-	2	-	2	-	-	-	-	-	-	-	2	3	1

MI1O004	SERVICES OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To help understand how service performance can be improved by studying services operations management

UNIT I INTRODUCTION **9**

Services – Importance, role in economy, service sector – nature, growth. Nature of services - distinctive characteristics, Service Package, Service classification, service - dominant logic, open-systems view. Service Strategy –Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness. **CO1**

UNIT II SERVICE DESIGN **9**

New Service Development – Design elements – Service Blue-printing - process structure – generic approaches. Service Encounter – triad, creating service orientation, service profit **CO2** chain; Front-office Back-office Interface– service decoupling. Technology in services – self-service, automation, ecommerce, e-business, technology innovations.

UNIT III SERVICE QUALITY **9**

Service Quality- Dimensions, Service Quality Gap Model; Measuring Service Quality – SERVQUAL, Walk-through Audit, Quality service by design, Service Recovery, Service Guarantees. Process Improvement –productivity improvement - DEA, quality tools, benchmarking, Quality improvement programs. **CO3**

UNIT IV SERVICE FACILITY **9**

Supporting facility – Services capes, Facility design – nature, objectives, process analysis, Service facility layout. Service Facility Location – considerations, facility location techniques – metropolitan metric, Euclidean, centre of gravity, retail outlet location, location set covering problem. Vehicle routing and Scheduling. **CO4**

UNIT V MANAGING CAPACITY AND DEMAND **9**

Managing Demand – strategies; Managing capacity – basic strategies, supply management tactics, operations planning and control; Yield management; Inventor y Management in Services – Retail Discounting Model, Newsvendor Model; Managing Waiting Lines – Queuing systems, psychology of waiting; Managing for growth- expansion strategies, franchising , globalization. **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

3. James A. Fitzsimmons, Mona J, Fitzsimmons, Sanjeev Bordoloi, Service Management – Operations, Strategy, Information Technology, McGraw-Hill Education – 8th Edition 2018.

REFERENCE BOOKS

4. Richard D. Metters, Successful Service Operations Management, Cengage Learning, 2nd Edition, 2012.
5. CengizHaksever, Barry Render, Service Management, Pearson Education, 2013.
6. Robert Johnston, Graham Clark, Service Operations Management, Pearson Education, 2ndEdition, 2005.
7. Bill Hollins and Sadie Shinkins, Managing Service Operations, Sage, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To familiarize the concept of Services and its role in economy. To understand the service strategies, Service vision, Generic strategy and its competitive environment. To understand the role of Information Technology in Service firm competitiveness.
CO2	To understand the concept of new service development. To explain the retail design strategies and value to customer. To analyse the network configuration and key dimensions in service. To Study the concept of vehicle routing.
CO3	To explain the different dimension of service quality and service quality gap. To understand the concept of SERVQUAL and Walk- through. To familiarize the concept of quality service by design and service encounter.
CO4	To Understand the concept of Servicescape framework and its environmental dimensions. . To explain the process analysis and its steps. To familiarize the concept of Service facility Location and its techniques.
CO5	To explain the concept of strategies of managing demand and capacity. To analyze the concept of yield management. To understand the role of inventory management in services. To study the concept of Queuing system.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	1	-	3	-	-	-	-	-	-	-	3	1	3
CO2	1	-	1	-	2	-	-	-	-	-	-	-	3	1	1
CO3	1	-	1	-	2	-	-	-	-	-	-	-	2	1	1
CO4	2	-	1	-	3	-	-	-	-	-	-	-	2	2	2
CO5	1	-	2	-	3	-	-	-	-	-	-	-	2	2	3

MI1O005	SUPPLY CHAIN ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the subject in depth by emphasizing on the advanced quantitative models and methods in logistics and supply chain management and its practical aspects and the latest developments in the field.

UNIT I	INTRODUCTION	9
Introduction to analytics – Importance of supply chain analytics – descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains, Barriers to implementation, Road Map.		CO1
UNIT II	**FOUNDATION OF BUSINESS ANALYTICS**	**9**
Mathematical Programming Models - P-Median Methods - Guided LP Approach - Balmer – Wolfe Method, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods		CO2
UNIT III	**INVENTORY MANAGEMENT**	**9**
Inventory aggregation Models, Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain - Measuring transit risks, supply risks, delivering risks, Risk pooling strategies.		CO3
UNIT IV	**TRANSPORTATION AND NETWORK MODELS**	**10**
Notion of Graphs, Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Multistage Transshipment and Transportation Problems, Set covering and Set Partitioning Problems, Traveling Salesman Algorithms, Advanced Vehicle Routing Problem Heuristics, Scheduling Algorithms-Deficit function Approach and Linking Algorithms.		CO4
UNIT V	**MCDM MODELS**	**8**
Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS-Application in SCM.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

REFERENCE BOOKS

1. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
2. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmya Narayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management, I.K. International Publishing House Pvt. Ltd., 2016.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the basics of analytics and its application in supply chain management
CO2	Understand the different business analytical models
CO3	Understand the management of inventory
CO4	Understand the analytical models for transportation and distribution network
CO5	Understand the different Multi-Criteria Decision Making Models

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	P O4	P O5	P O6	P O7	P O8	P O9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	-	2	-	-	-	-	-	-	-	-	1	3	1
CO2	-	3	-	3	-	-	-	-	-	-	-	-	2	3	1
CO3	-	3	-	2	-	-	-	-	-	-	-	-	3	3	1
CO4	-	1	-	3	-	-	-	-	-	-	-	-	1	2	1
CO5	-	3	-	2	-	-	-	-	-	-	-	-	2	2	1

MI1O006	**SUPPLY CHAIN MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVE:
- To help understand the importance of and major decisions in supply chain management for gaining competitive advantage.

UNIT I	**INTRODUCTION**	**9**
Supply Chain – Fundamentals, Evolution, Supply chain processes and decisions, Enablers & Drivers of Supply Chain Performance; Supply chain strategy; Supply Chain Performance Measures.		**CO1**
UNIT II	**STRATEGIC SOURCING**	**9**
Outsourcing – Make or buy decisions – Strategic Outsourcing – Vendor assessment tools – Supplier selection - Supply chain Contract and Negotiations. Creating a world class supply base- Supplier Development - World Wide Sourcing.		**CO2**
UNIT III	**DISTRIBUTION NETWORK DESIGN**	**9**
Distribution Network Design – Role in supply chain, influencing factors, e-business and distribution network, Distribution Strategies, Models for facility location and capacity allocation; Models for network optimization, Impact of uncertainty on network design.		**CO3**
UNIT IV	**INVENTORY AND WAREHOUSING**	**9**
Managing supply chain cycle inventory and safety inventory, Bullwhip Effect, Managing inventory for short life-cycle products, Warehouse operations and management, Vendor Managed Inventory.		**CO4**
UNIT V	**SUPPLY CHAIN INNOVATIONS**	**9**

IT in Supply Chain; Agile Supply Chains, Green Supply Chain, Reverse Supply chain; Supply chain technology trends – AI, Predictive analytics and SC Intelligence, Internet of Things, Block chain.	**CO5**
TOTAL : 45 PERIODS	

TEXT BOOKS

1. Sunil Chopra, Peter Meindl and Dharam Vir Kalra, Supply Chain Management-Strategy Planning and Operation, Pearson Education, Sixth Edition, 2016.
2. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5thEdition, 2007.

REFERENCE BOOKS

1. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 2009
2. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the SupplyChain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
3. Pierre David, International Logistics, Biztantra, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals of supply chain
CO2	Understand the importance of outsourcing
CO3	Ability to design supply chain networks to enhance supply chain performance
CO4	Understand inventory and warehousing for supply chain
CO5	Awareness of innovations for sustainable supply chains

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	2	-	-	-	-	-	-	3	1	1
CO2	3	-	-	-	-	2	-	-	-	-	-	-	2	1	1
CO3	3	-	-	-	-	3	-	-	-	-	-	-	3	1	1
CO4	3	-	-	-	-	3	-	-	-	-	-	-	3	1	1
CO5	3	-	-	-	-	2	-	-	-	-	-	-	3	3	1

BUSINESS ANALYTICS ELECTIVES

MI1B001 **CLOUD COMPUTING** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To know how to derive meaning form huge volume of data and information
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION **9**

History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds. **CO1**

UNIT II	**INTRODUCTION TO CLOUD COMPUTING**	**9**
	Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .	**CO2**
UNIT III	**CLOUD COMPUTING APPLICATIONS**	**9**
	Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Overview on Amazon AWS and Microsoft Azure – Overview on Google App Engine – Emerging Cloud software Environment.	**CO3**
UNIT IV	**CLOUD SECURITY**	**9**
	Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.	**CO4**
UNIT V	**GOVERNANCE AND THE FUTURE OF CLOUD**	**9**
	Organizational Readiness and Change Management in the Cloud Age, Legal Issues in Cloud Computing, Achieving Production Readiness for Cloud Services, How Cloud Will Change Operating Systems, Future of Cloud TV & Cloud-Based Smart Devices, Cloud and Mobile, Home-Based Cloud Computing.	**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and cloud computing from Parallel Processing to the Internet of Things, Morgan Kaufmann, Elsevier, 2012
2. RajkumarBuyya, James Broberg and Andrzej Goscinski, Cloud Computing – Principles and Paradigms, John Wiley & Sons, 2011
3. Kris Jamsa, Cloud Computing, Jones & Bartlett Learning, 2013
4. Kumar Saurahb, Cloud Computing – Insights into new era infrastructure, Wiley India, 2nd Edition, 2012
5. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2011
6. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Students will get to know the history of cloud computing.
CO2	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO3	Provide the appropriate cloud computing solutions and recommendations according to the applications used.
CO4	Understand the core issues of cloud computing such as security, privacy.
CO5	Students will get the idea about the future of cloud computing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)	PROGRAMME SPECIFIC OUTCOMES (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	3	-	3	-	-	1	-	-	-	2	1	2
CO2	1	2	-	2	-	2	-	-	2	-	-	-	1	2	1
CO3	3	1	-	3	-	2	-	-	3	-	-	-	2	1	2
CO4	2	3	-	2	-	1	-	-	2	-	-	-	2	1	3
CO5	1	2	-	1	-	2	-	-	1	-	-	-	2	1	2

MI1B002	**DATA MINING FOR BUSINESS INTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To know how to derive meaning form huge volume of data and information
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION **9**

Data mining, Text mining, Web mining, Spatial mining, Process mining, Data ware house and datamarts. **CO1**

UNIT II DATA MINING PROCESS **9**

Data mining process – KDD, CRISP-DM, SEMMA and Domain-Specific, Classification and Prediction performance measures -RSME, MAD, MAP, MAPE, Confusion matrix, Receiver Operating Characteristic curve & AUC; Validation Techniques - hold-out, k-fold cross-validation, LOOCV, random subsampling, and bootstrapping. **CO2**

UNIT III PREDICTION TECHNIQUES **9**

Data visualization, Time series – ARIMA, Winter Holts, Vector Autoregressive analysis, Multivariate regression analysis. **CO3**

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES **9**

Classification- Decision trees, k nearest neighbour, Logistic regression, Discriminant analysis; Clustering; Market basket analysis; **CO4**

UNIT V MACHINE LEARNING AND AI **9**

Genetic algorithms, Neural network, Fuzzy logic, Support Vector Machine, Optimization techniques – Ant Colony, Particle Swarm, DEA. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India pvt. Ltd. 2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition,2013.
5. 5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition, 2011
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
7. G. K. Gupta, Ïntroduction to Data mining with Case Studies, Prentice hall of India, 2011
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009
9. Elizabeth Vitt, Michael LuckevichStaciaMisner, Business Intelligence, Microsoft, 2011

10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriac C, Adaptive Business Intelligence, Springer – Verlag, 2007
11. GalitShmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010. 4. Enterprise Resource Planning - Murthy CSV, Himalaya Publishing House Pvt. Ltd., 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Learn to apply various data mining techniques into various areas of different domains.
CO2	Be able to interact competently on the topic of data mining for business intelligence.
CO3	Know the basics of data mining processes, algorithms, & systems well enough to interact with CTOs, expert data miners, consultants, etc.
CO4	Apply various prediction techniques.
CO5	Learn about supervised and unsupervised learning techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	2	1	-	1	-	1	-	-	-	-	2	2	2
CO2	-	1	1	2	-	2	-	3	-	-	-	-	3	1	1
CO3	-	2	3	3	-	3	-	2	-	-	-	-	2	2	3
CO4	-	1	2	2	-	2	-	3	-	-	-	-	2	1	1
CO5	-	1	1	1	-	1	-	2	-	-	-	-	3	1	1

MI1B003	**DEEP LEARNING AND ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To expose various algorithms related to Deep Learning and Artificial Intelligence.
- To prepare students to apply suitable algorithm for the specified applications.

UNIT I DEEP NETWORKS **9**

Deep Networks: Modern Practices: Deep Forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design - Regularization for Deep Learning. **CO1**

UNIT II MODELS **9**

Optimization for Training Deep Models: How Learning Differs from Pure Optimization - Challenges in Neural Network Optimization - Basic Algorithms - Parameter Initialization Strategies - Algorithms with Adaptive Learning Rates - Approximate Second-Order Methods - Optimization Strategies and Meta Algorithms. **CO2**

UNIT III INTELLIGENT SYSTEMS **9**

Introduction to Artificial Intelligence: Intelligent Systems - Foundations of AI - Applications - Tic-Tac-Toe Game Playing - Problem Solving: State-Space Search and Control Strategies: Introduction - General Problem Solving - Exhaustive Searches - Heuristic Search Techniques. **CO3**

UNIT IV KNOWLEDGE REPRESENTATION **9**

Advanced Problem-Solving Paradigm: Planning: Introduction - Types of Planning Systems - Knowledge Representation: Introduction - Approaches to Knowledge Representation - Knowledge Representation using Semantic Network - Knowledge Representation using Frames. **CO4**

UNIT V APPLICATIONS **9**

Expert Systems and Applications: Blackboard Systems - Truth Maintenance Systems - Applications of Expert Systems - Machine-Learning Paradigms: Machine-Learning Systems - Supervised and Unsupervised Learnings. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Jared P.L., R for Everyone - Advanced Analytics and Graphics, Addison Wesley Data and Analytics series, 2015.
2. SandipRakshit, R Programming for Beginners, McGraw Hill Education, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Learn the modern practices on deep forward networks, Architecture designs and regularization for deep learning.
CO2	Build models to optimize and solve challenges in Neural network optimization, Approximate Second order models and meta algorithms.
CO3	Learn about the foundations of the AI applications, Tic-tac-toe Game playing, Problem solving: state-space search, Exhaustive searches and heuristic search techniques.
CO4	Learn about advanced problem solving paradigm, types of planning systems, knowledge representation using semantic network and frames.
CO5	Learn about expert systems and applications like Blackboard systems, machine learning paradigms, supervised and unsupervised learnings.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	-	3	-	3	-	3	-	-	-	-	3	3	1
CO2	2	3	-	2	-	3	-	1	-	-	-	-	-	2	-
CO3	1	2	-	1	-	2	-	1	-	-	-	-	3	-	2
CO4	3	1	-	3	-	2	-	2	-	-	-	-	2	2	-
CO5	2	3	-	2	-	1	-	3	-	-	-	-	-	3	3

MI1B004	e - BUSINESS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the practices and technology to start an online business.

UNIT I INTRODUCTION TO E-BUSINESS	**9**	
E-business, e-business vs e-commerce, Economic forces – advantages – myths – e-business models, design, develop and manage e-business, Web 2.0 and Social Networking, Mobile Commerce, S-commerce	**CO1**	
UNIT II BUSINESS APPLICATIONS	**9**	
Internet and World Wide Web, internet protocols - FTP, intranet and extranet, information publishing technology- basics of web server hardware and software.	**CO2**	
UNIT III BUSINESS APPLICATIONS	**9**	
Consumer oriented e-business – e-tailing and models - Marketing on web – advertising, e-mail marketing, affiliated programs - e-CRM; online services, Business oriented e-business, e-governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals – social media marketing	**CO3**	
UNIT IV e-BUSINESS PAYMENTS AND SECURITY	**9**	
E-payments - Characteristics of payment of systems, protocols, e-cash, e-cheque and Micro payment systems- internet security – cryptography – security protocols – network security.	**CO4**	
UNIT V LEGAL AND PRIVACY ISSUES	**9**	
Legal, Ethics and privacy issues – Protection needs and methodology – consumer protection, cyber laws, contracts and warranties, Taxation and encryption policies.	**CO5**	

TOTAL : 45 PERIODS

TEXT BOOKS

1. Harvey M.Deitel, Paul J.Deitel, Kate Steinbuhler, e-business and e-commerce for managers, Pearson, 2011.
1. Efraim Turban, Jae K. Lee, David King, Ting Peng Liang, Deborrah Turban, Electronic Commerce –A managerial perspective, Pearson Education Asia, 2010.

REFERENCE BOOKS

1. Parag Kulkarni, Sunita Jahirabadkao, Pradeep Chande, e business, Oxford University Press, 2012.
2. Bharat Bhasker, Electronic Commerce – Frame work technologies and Applications, 3rd Edition. Tata McGrawHill Publications, 2009
3. Kamlesh K.Bajaj and Debjani Nag, Ecommerce- the cutting edge of Business, Tata McGrawHill Publications, 7th reprint, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand basic concepts of e-Business
CO2 To understand the tools and applications of e-Business with the tools and techniques
CO3 To understand the business process used in e-Business
CO4 To understand the different payment systems used in e-Business
CO5 To understand the legal formalities attached with the e-Business

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	3	3	-	-	2	-	-	-	-	1	2	2
CO2	-	-	-	2	1	-	-	1	-	-	-	-	1	2	1
CO3	2	-	-	3	2	-	-	3	-	-	-	-	2	1	1
CO4	3	-	-	1	3	-	-	3	3	-	-	-	3	3	2
CO5	3	-	-	2	3	-	-	3	3	-	-	-	3	3	2

MI1B005	**R PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study the fundamentals of R programming to apply in quantitative analysis.

UNIT I	**GETTING STARTED WITH R**	**9**
Installing R - The R environment - R packages - Basics of R - Data Structures - Reading data into R - Graphics in R		**CO1**
UNIT II	**FUNCTIONS AND STATEMENTS**	**9**
Writing R functions - Control Statements (if and else, switch, ifelse, compound tests) - Loops in R (for, while, controlling loops) - Applications using the functions and loops.		**CO2**
UNIT III	**DATA MANIPULATION AND ANALYSIS**	**9**
Group manipulation - Data Reshaping - Manipulating Strings - Basic Statistics using R (Summaries, Correlation, t-tests, ANOVA)		**CO3**
UNIT IV	**LINEAR MODELS USING R**	**9**
Linear Models - Simple and Multiple regression, GLM - Logit Regression, Model diagnostics - Residuals, Cross validation, Boot strapping.		**CO4**
UNIT V	**NON-LINEAR MODELS, TIME SERIES AND CLUSTERING USING R**	**9**
Nonlinear Models - Non-Linear least square, Splines, Generalized Additive Models, Decision trees, Random forests. Time Series - Autoregressive moving average, VAR, GARCH. Clustering - K means, PAM and Hierarchical Clustering.		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Jared P.L., R for Everyone - Advanced Analytics and Graphics, Addison Wesley Data and Analytics series, 2015.
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Explore R language fundamentals, including basic syntax, variables, and types.
CO2 How to create functions and use control flow.
CO3 Work with data in R.
CO4 Understand the liner models using R.
CO5 The student will learn to use R programming to solve decision models.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	3	-	3	-	2	-	-	-	-	1	-	2
CO2	-	-	-	2	-	1	-	1	2	-	-	-	1	-	1
CO3	2	-	-	3	-	2	-	3	-	-	-	-	2	1	-
CO4	3	-	-	1	-	3	-	3	3	-	-	-	3	3	2
CO5	3	-	-	2	-	3	-	3	3	-	-	-	3	3	2

MI1B006 SOCIAL MEDIA AND WEB ANALYTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the practices and technology involved in web marketing in real time business environment.

UNIT I INTRODUCTION TO WEB AND SOCIAL MEDIA **9**

Introduction - Web and social media - Website, Web apps - Social Media, Usability - User friendliness - Customer Experience - Web marketing, Competitive analysis - Web analytics framework - Analytics and outcomes, Competitive analysis. **CO1**

UNIT II BUSINESS ENVIRONMENT **9**

Data - Types of Data, primary data, secondary, Big Data - Data Analysis - tools used for analysis - descriptive statistics, comparing means, correlations, nonparametric tests **CO2**

UNIT III MEASURING USER EXPERIENCE **9**

Usability metrics - performance metrics, issues-based metrics, self-reported metrics - Planning and performing a usability study - study goals, user goals, metrics and evaluation methods, participants, data collection, data analysis, comparing alternative designs, comparing with competition, completing a task or transaction **CO3**

UNIT IV WEB ANALYSIS AND METRICS **9**

PULSE metrics on business and technical issues - Page views, Uptime, Latency, Seven-day active users HEART metrics - Happiness, Engagement, Adoption, Retention, and Task success on user behavior issues - On-site web analytics, off-site web analytics, the goal-signal-metric process **CO4**

UNIT V SOCIAL MEDIA ANALYTICS **9**

Social media analytics - Reasons for the growth - Social media KPIs - reach and engagement, Performing social media analytics - Business goal, KPIs, data gathering, analysis, measure and feedback **CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons
2. Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann
3.

REFERENCE BOOKS

1. Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons.
2. Brian Clifton, Advanced Web Metrics with Google Analytics, John Wiley & Sons; 3rd Edition edition
3.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the introduction and its impact in business process
CO2 To understand the tools and applications of data analysis
CO3 To understand the impact of data analysis and measuring in business process
CO4 To understand the different analysis metrics used to measure business process
CO5 To understand the various KPI to analyze the use and to achieve business goals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)												PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	-	-	3	-	3	-	2	-	-	-	-	2	2	2
CO2	3	-	-	2	-	2	-	2	-	-	-	-	2	1	1
CO3	2	-	-	3	-	2	-	3	-	-	-	-	2	2	1
CO4	3	-	-	2	-	3	-	3	-	-	-	-	3	3	2
CO5	3	-	-	2	-	3	-	3	-	-	-	-	3	3	2

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You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

MASTER OF BUSINESS ADMINISTRATION (2YEARS)

AUTONOMOUS CURRICULUM AND SYLLABUS 2021

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

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OMR, Chennai - 119.

FACULTY OF MANAGEMENT SCIENCES
MASTER OF BUSINESS ADMINISTRATION (2YEARS)
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

MBA programme curriculum is designed to prepare the post graduate students

I. To have a thorough understanding of the core aspects of the business.

II. To provide the learners with the management tools to identify, analyze and create business opportunities as well as solve business problems.

III. To prepare them to have a holistic approach towards management functions.

IV. To motivate them for continuous learning.

V. To inspire and make them practice ethical standards in business.

PROGRAMME OUTCOMES (POs)

On successful completion of the program,

1. Ability to understand the principles and concepts in management.
2. Ability to apply knowledge of management theories and practices.
3. Ability to understand the situations, analyze and solve business problems.
4. Ability to communicate and negotiate effectively, to achieve organizational and individual goals.
5. Ability to work in teams to meet organizational goals.
6. Ability to exhibit leadership skills appropriate for managerial roles in organizations.
7. Ability to analyse global, economic, and ethical aspects of business.
8. Ability to pursue lifelong learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Ability to gain knowledge, skills and attitudes to become an effective manager.
2. Ability to provide socially acceptable technical solutions to complex managerial problems with the application of modern and appropriate techniques for sustainable development relevant to professional managerial practice.
3. Ability to apply the knowledge of ethical and management principles required to work in a team as well as to lead a team.

MAPPING OF PEOS WITH POS

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I	3	3	2	2	3	3	2	2
II	1	3	1	2	3	1	3	2
II	3	3	2	3	3	2	3	3
IV	2	1	2	3	3	1	3	3
V	1	3	3	2	2	3	1	2

MAPPING OF SUBJECTS WITH POS

SEM	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
I	Statistics for Management	√	√	√	√				
	Management Concepts and Organizational Behavior	√	√	√	√	√	√		
	Managerial Economics	√	√	√	√				
	Accounting for Decision Making	√	√	√	√				√
	Legal Aspects of Business	√	√	√	√	√			√
	Information Management	√	√	√	√	√	√	√	√
	Research Methodology and IPR								
	Indian Ethos and Business (Ethics Seminar)	√		√	√	√		√	√
	Business Communications (Laboratory)	√			√	√	√		
	Quantitative Techniques for Decision Making	√		√					
	Financial Management	√	√	√	√				
	Human Resource Management	√	√	√	√	√	√	√	
	Operations Management	√	√	√	√			√	√
	Marketing Management	√	√	√	√	√	√	√	√
	Business Analytics	√		√	√	√	√	√	√
	Non-Functional Elective	*** shown in separate table**							
	Data Analysis and Business Modelling (Laboratory)	√	√	√	√				√
	Strategic Management	√	√	√	√	√	√	√	
	International Business	√	√	√	√	√	√	√	√
	Creativity and Innovation Laboratory		√	√	√	√	√		√
	Elective I	*** shown in separate table**							
	Elective II								

	Elective III								
	Elective IV								
	Elective V								
	Elective VI								
	Summer Internship	√	√	√	√	√	√	√	√
IV	Project work	√	√	√	√				√

MAPPING OF NON-FUNCTIONAL ELECTIVES WITH PO'S

Sl.No.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
1	Entrepreneurship Development	√	√	√	√	√	√		√
2	Business Ethics and Corporate Governance	√	√	√	√			√	√
3	Event Management	√	√	√	√	√	√	√	√
4	Sustainability Management	√	√	√	√				√

MAPPING OF FUNCTIONAL ELECTIVES WITH POS

Sl.No.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Marketing Management									
1	Retail Marketing	√	√	√	√	√			√
2	Consumer Behavior	√	√	√	√				√
3	Integrated Marketing Communications	√	√	√	√	√			√
4	Services Marketing	√	√	√	√	√	√		√
5	Sales and Distribution Management	√	√	√	√	√	√		√
6	Brand Management	√	√	√	√	√	√		√
7	Customer Relationship Management	√	√	√	√				√
8	Marketing Analytics	√	√	√	√	√		√	√
Financial Management									
1	Security Analysis and Portfolio Management	√	√	√	√			√	√
2	Financial Markets	√	√	√				√	√
3	Banking and Financial Services	√	√	√	√	√	√		√
4	Financial Derivatives	√	√	√	√	√	√		√
5	Financial Modelling	√	√	√	√		√		√
6	International Trade Finance	√	√	√	√	√		√	√
7	Behavioral Finance	√	√	√	√	√	√	√	√

Human Resource Management									
1	Strategic Human Resource Management	√	√	√	√			√	√
2	Industrial Relations and Labour Welfare	√	√	√	√			√	√
3	Social Psychology	√	√	√	√	√	√	√	√
4	Organizational, Design, Change and Development	√	√	√	√			√	√
5	Managerial Behavior and Effectiveness	√	√	√	√	√	√	√	√
6	Personal Effectiveness	√	√	√	√	√	√	√	√
7	Labour Legislation	√	√	√	√			√	√
8	Human Resource Analytics	√	√	√	√	√	√	√	√
Business Analytics									
1	Data Mining for Business Intelligence	√	√	√	√				√
2	Big Data Analytics	√	√	√	√			√	√
3	Cloud computing	√	√	√	√			√	√
4	Deep Learning and Artificial intelligence	√	√	√	√			√	√
5	R Programming	√	√	√	√			√	√
6	Multivariate Data Analysis	√	√	√	√			√	√
7	Social Media and Web Analytics	√	√	√	√			√	√
Operations Management									
1	Logistics Management	√	√	√	√	√		√	√
2	Materials Management	√	√	√	√				√
3	Product Design	√	√	√	√	√	√	√	√
4	Project Management	√	√	√	√	√			√
5	Service Operations Management	√	√	√	√	√	√		√
6	Supply Chain Management	√	√	√	√	√		√	√
7	Quality Management	√	√	√	√	√			√
Systems Management									
1	E-Business	√	√	√	√	√			√
2	Enterprise Resource Planning	√	√	√	√	√			√
3	Software Project and Quality Management	√	√	√	√	√			√
4	Data Mining for Business Intelligence	√	√	√	√	√			√
5	Internet of Things	√	√	√	√	√			√
6	Advanced Database	√	√	√	√	√			√
	Management System	√	√	√	√	√			√

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS -2021
CHOICE BASED CREDIT SYSTEM
MASTER OF BUSINESS ADMINISTRATION (2YEARS)
CURRICULA AND SYLLABI I TO IV SEMESTERS

SEMESTER -I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MA1171	Statistics for Management	PCC	3	0	0	3
2	MB1101	Management Concepts and Organizational Behavior	PCC	3	0	0	3
3	MB1102	Managerial Economics	PCC	3	0	0	3
4	MB1103	Accounting for Management	PCC	3	0	0	3
5	MB1104	Legal Aspects of Business	PCC	3	0	0	3
6	MB1105	Information Management	PCC	3	0	0	3
7	MB1106	Research Methodology and IPR	PCC	3	0	0	3
PRACTICALS							
8	MB1107	Seminar -1 Indian ethos and business ethics	EEC	0	0	4	2
9	MB1108	Business Communications (Lab)	PCC	0	0	4	2
10	MB1109	Comprehensive Viva–I*	EEC	0	0	0	1
11	MB0101	Personality Enrichment	VAC	0	0	2	0
		TOTAL		**21**	**0**	**10**	**26**

*** Comprehensive Viva will be conducted at the end of the semester which will cover all theory subjects of that Semester by faculty; no end semester examination is required.**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MB1201	Quantitative Techniques For Decision Making	PCC	3	0	0	3
2	MB1202	Financial Management	PCC	3	0	0	3
3	MB1203	Human Resource Management	PCC	3	0	0	3
4	MB1204	Operations Management	PCC	3	0	0	3
5	MB1205	Marketing Management	PCC	3	0	0	3
6	MB1206	Business Analytics	PCC	3	0	0	3
7		Non-Functional Elective	OEC	3	0	0	3
PRACTICALS							
8	MB1207	Seminar – II Pro-social Behaviour	EEC	0	0	4	2

9	MB1208	Data analysis and Business Modelling (Laboratory)	PCC	0	0	4	2
10	MB1209	Comprehensive Viva-II*	EEC	0	0	0	1
11	MB0201	Fundamentals of Capital Markets / R Programming	VAC	0	0	2	0
		TOTAL		**21**	**0**	**10**	**26**

NOTE: In the second Semester

- Students need to choose one elective from the Non-Functional stream.
- Summer internship–minimum of 4 weeks of internship. The internship report has to be submitted to the department within 4 weeks of the reopening date of the 3rd semester. The report should contain the Training undergone the departments he/she was trained with and duration (chronological diary) along with the skill acquired.
- Comprehensive Viva will be conducted at the end of the semester which will cover all theory subjects of that Semester by faculty, no end semester examination is required.

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MB1301	Strategic Management	PCC	3	0	0	3
2	MB1302	International Business	PCC	3	0	0	3
3		Elective I	PEC	3	0	0	3
4		Elective II	PEC	3	0	0	3
5		Elective III	PEC	3	0	0	3
6		Elective IV	PEC	3	0	0	3
7		Elective V	PEC	3	0	0	3
8		Elective VI	PEC	3	0	0	3
PRACTICALS							
9	MB1309	Creativity and Innovation Laboratory	EEC	0	0	4	2
10	MB1310	Summer Internship	EEC	0	0	4	2
11	MB1311	Comprehensive Viva–III*	EEC	0	0	0	1
		TOTAL		**24**	**0**	**8**	**29**

NOTE:

- In the third semester Students need to choose three electives from 2 functional streams for Dual Specialization.

* Viva will be conducted at the end of 3rd semester which will cover all theory subjects of 3rd. semester.

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
PRACTICALS							
1	MB1401	Project Work	EEC	0	0	24	12
		TOTAL		**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 93

NON -FUNCTIONAL ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	MB1211	Entrepreneurship Development	PCC	3	0	0	3
2	MB1212	Business Ethics and Corporate Governance	PCC	3	0	0	3
3	MB1213	Event Management	PCC	3	0	0	3
4	MB1214	Sustainability Management	PCC	3	0	0	3

FUNCTIONAL ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
MARKETING MANAGEMENT							
1	MB1001	Retail Marketing	PEC	3	0	0	3
2	MB1002	Consumer Behavior	PEC	3	0	0	3
3	MB1003	Integrated Marketing Communications	PEC	3	0	0	3
4	MB1004	Services Marketing	PEC	3	0	0	3
5	MB1005	Sales and Distribution Management	PEC	3	0	0	3
6	MB1006	Brand Management	PEC	3	0	0	3
7	MB1007	Customer Relationship Management	PEC	3	0	0	3
8	MB1041	Marketing Analytics	PEC	3	0	0	3
FINANCIAL MANAGEMENT							
1	MB1008	Security Analysis and Portfolio Management	PEC	3	0	0	3
2	MB1009	Financial Markets	PEC	3	0	0	3
3	MB1010	Banking and Financial Services	PEC	3	0	0	3
4	MB1011	Financial Derivatives	PEC	3	0	0	3
5	MB1012	Financial Modelling	PEC	3	0	0	3
6	MB1013	International Trade Finance	PEC	3	0	0	3
7	MB1014	Behavioral Finance	PEC	3	0	0	3
HUMAN RESOURCE MANAGEMENT							
1	MB1015	Strategic Human Resource Management	PEC	3	0	0	3
2	MB1016	Industrial Relations and Labour Welfare	PEC	3	0	0	3
3	MB1017	Social Psychology	PEC	3	0	0	3
4	MB1018	Organizational Design, Change and Development	PEC	3	0	0	3
5	MB1019	Managerial Behavior and Effectiveness	PEC	3	0	0	3
6	MB1020	Personal Effectiveness	PEC	3	0	0	3

7	MB1021	Labour Legislation	PEC	3	0	0	3
8	MB1042	Human Resource Analytics	PEC	3	0	0	3
BUSINESS ANALYTICS							
1	MB1022	Data Mining for Business Intelligence	PEC	3	0	0	3
2	MB1023	Big Data Analytics	PEC	3	0	0	3
3	MB1024	Cloud computing	PEC	3	0	0	3
4	MB1025	Deep Learning and Artificial intelligence	PEC	3	0	0	3
5	MB1026	R Programming	PEC	3	0	0	3
6	MB1027	Multivariate Data Analysis	PEC	3	0	0	3
7	MB1040	Social Media and Web Analytics	PEC	3	0	0	3
OPERATIONS MANAGEMENT							
1	MB1028	Logistics Management	PEC	3	0	0	3
2	MB1029	Materials Management	PEC	3	0	0	3
3	MB1030	Product Design	PEC	3	0	0	3
4	MB1031	Project Management	PEC	3	0	0	3
5	MB1032	Service Operations Management	PEC	3	0	0	3
6	MB1033	Supply Chain Management	PEC	3	0	0	3
7	MB1034	Quality Management	PEC	3	0	0	3
SYSTEMS MANAGEMENT							
1	MB1035	e-Business	PEC	3	0	0	3
2	MB1036	Enterprise Resource Planning	PEC	3	0	0	3
3	MB1037	Software Project and Quality Management	PEC	3	0	0	3
4	MB1038	Internet of Things	PEC	3	0	0	3
5	MB1039	Advanced Database Management System	PEC	3	0	0	3
6	MB1022	Data Mining for Business Intelligence	PEC	3	0	0	3

AUDIT COURSES*

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1.	AX1001	English for Research Paper Writing	AC	2	0	0	0
2.	AX1002	Disaster Management	AC	2	0	0	0
3.	AX1003	Value Education	AC	2	0	0	0
4.	AX1004	Constitution of India	AC	2	0	0	0
5.	AX1006	Stress Management by Yoga	AC	2	0	0	0

Note: * Registration for any of these courses is optional to students

OPEN ELECTIVE COURSES

(OFFERED TO OTHER DEPT)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
	OMB101	Total Quality Management	OEC	3	0	0	3
1	OMB102	Logistics and Supply Chain Management	OEC	3	0	0	3
2	OMB103	Cost Management of Engineering Projects	OEC	3	0	0	3

PROFESSIONAL ELECTIVE COURSES
(OFFERED TO OTHER DEPT)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1.	MG1001	Principles of Management	OEC	3	0	0	3
2.	MG1002	Operations Research	OEC	3	0	0	3
3.	MG1003	Applied Operations Research	OEC	3	0	0	3

CATEGORY BASED CREDIT AND SPLIT-UP – SEMESTER WISE

Semester	PCC	PEC	EEC	OEC	Total credit
I	23	-	3	-	26
2	20	-	3	3	26
3	6	18	5	-	29
4	-	-	12	-	12
Total Credit	**49**	**18**	**23**	**3**	**93**

MA1171 **STATISTICS FOR MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

- To learn the applications of statistics in business decision making.

UNIT I **PROBABILITY**		**9**
Basic definitions and rules for probability, conditional probability independence of events, Baye's theorem, and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.		**CO1**
UNIT II **SAMPLING DISTRIBUTION AND ESTIMATION**		**9**
Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.		**CO2**
UNIT III **TESTING OF HYPOTHESIS - PARAMETIRC TESTS**		**9**
Hypothesis testing: one sample and two sample tests for means and proportions of large samples(z-test), one sample and two sample tests for means of small samples (t-test), F- test for two sample standard deviations. ANOVA one and two way.		**CO3**
UNIT IV **NON-PARAMETRIC TESTS**		**9**
Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Kolmogorov-Smirnov – test for goodness of fit, comparing two populations. Mann –Whitney U test and Kruskal Wallis test. One sample run test.		**CO4**
UNIT V **CORRELATION, REGRESSION AND TIME SERIES ANALYSIS**		**9**
Correlation analysis, estimation of regression line. Time series analysis: Variation in time series, trend analysis, cyclical variations, seasonal variations and irregular variations.		**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Richard I. Levin, David S. Rubin, Masood H. Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition,2017.
2. Prem S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
3. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.

REFERENCE BOOKS

1. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James J. Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore,2016.
3. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand and apply the concepts of probability distributions
CO2	To apply and analyse sampling techniques for research
CO3	To apply and analyse various parametric tests for hypothesis testing
CO4	To apply and analyse various non-parametric tests for hypothesis testing
CO5	To apply and analyse correlation, regression techniques

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	3	3	2	-
CO2	3	3	2	1	-	-	-	3	3	2	-
CO3	3	2	2	1	-	-	-	3	3	2	-
CO4	3	2	2	1	-	-	-	3	3	2	-
CO5	3	3	2	1	-	-	-	3	3	2	-

MB1101	MANAGEMENT CONCEPTS AND ORGANIZATIONAL BEHAVIOR	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.
- To acquaint the students with the fundamentals of managing business and to understand individual and group behaviour at workplace so as to improve the effectiveness of an organization. The course will use and focus on Indian experiences, approaches and cases.

UNIT I NATURE AND THEORIES OF MANAGEMENT **9**

Evolution of management Thought - Classical, Behavioral and Management Science Approaches Management - meaning, levels, management as an art or science, Managerial functions and Roles, Evolution of Management Theory - Classical era - Contribution of F. W. Taylor, Henri Fayol, Neo – Classical - Mayo & Hawthorne Experiments. Modern era – system & contingency approach Managerial Skills. **CO1**

UNIT II PLANNING AND ORGANISING **9**

Planning - Steps in Planning Process - Scope and Limitations - Forecasting and types of Planning - Characteristics of a sound Plan - Management by Objectives (MBO) - Policies and Strategies -Scope and Formulation - Decision Making - Types, Techniques and Processes. Organisation Structure and Design - Authority and Responsibility Relationships - Delegation of Authority and Decentralisation – Interdepartmental Coordination – Impact of Technology on Organisational design – Mechanistic vs Adoptive Structures -Formal and Informal Organisation. Control: meaning, function, Process and types of Control. **CO2**

UNIT III INDIVIDUAL BEHAVIOUR **9**

Meaning of Organizational behavior, contributing disciplines, importance of organizational behavior, Perception and Learning - Personality and Individual Differences - Motivation theories and Job Performance - Values, Attitudes and Beliefs – Communication Types - Process – Barriers – Making Communication Effective. **CO3**

UNIT IV GROUP BEHAVIOUR **9**

Groups and Teams: Definition, Difference between groups and teams, Stages of Group Development, Group Cohesiveness, Types of teams, Group Dynamics - Leadership – Styles -Approaches – Power and Politics – Organisational Structure – Organisational Climate and Culture, Conflict: concept, sources, Types, Stages of conflict, Management of conflict Organisational Change and Development. **CO4**

UNIT V EMERGING ASPECTS OF ORGANIZATIONAL BEHAVIOUR 9

Comparative Management Styles and approaches - Japanese Management Practices Organisational Creativity and Innovation – Organizational behavior across cultures - Conditions affecting cross cultural organizational operations, Managing International Workforce, Productivity and cultural contingencies, Cross cultural communication, Management of Diversity. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Stephen P. Robbins, David De Cenzo and Mary Coulter, Fundamentals of Management, Prentice Hall of India, 9th edition 2016.
2. Andrew J. Dubrin, Essentials of Management, Thomson Southwestern, 10th edition, 2016.
3. Samuel C. Certoand S. Trevis Certo, Modern Management: Concepts and Skills, Pearson education, 15th edition, 2018.
4. Charles W. L Hill and Steven L Mc Shane, Principles of Management, McGraw Hill Education, Special Indian Edition, 2017.

REFERENCE BOOKS

1. Harold Koontz and Heinz Weihrich, Essentials of Management: An International, Innovation, And Leadership Perspective, 10th edition, Tata McGraw – Hill Education, 2015.
2. Stephen P. Robbins, Timothy A. Judge, Organisational Behavior, PHIL earning / Pearson Education, 16th edition, 2014.
3. Fred Luthans, Organisational Behavior, McGraw Hill, 12th Edition, 2013.
4. Don Hellriegel, Susan E. Jackson and John W, Jr Slocum, Management: A competency – Based Approach, Thompson South Western, 11th edition, 2008.
5. Heinz Weihrich, Mark V Cannice and Harold Koontz, Management – Aglobal entrepreneurial perspective, Tata McGraw Hill, 12th edition, 2008

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understanding various management concepts and skills required in the business world
CO2 To apply knowledge of various functions of management in areal time management context
CO3 To understand the complexities associated with management of individual behavior in the organizations
CO4 To apply the skill set to manage group behaviour in Organizations
CO5 To evaluate the current trends in managing organizational behavior

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	3	3	2	-
CO2	3	2	2	1	-	-	-	3	3	2	-
CO3	3	2	2	1	-	-	-	3	3	2	-
CO4	3	2	2	1	-	-	-	3	3	2	-
CO5	3	3	2	1	-	-	-	3	3	2	-

MB1102 MANAGERIAL ECONOMICS

	L	T	P	C
	3	0	0	3

OBJECTIVES

- To introduce the concepts of scarcity and efficiency; to explain principles of micro economics relevant to managing an organization; to describe principles of macroeconomics to have the understanding of economic environment of business.

UNIT I INTRODUCTION **9**

The themes of economics – scarcity and efficiency – three fundamental economic problems – society's capability – Production possibility frontiers (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Microeconomics and Macroeconomics – the role of markets and government – Positive Vs negative externalities. **CO1**

UNIT II CONSUMER AND PRODUCER BEHAVIOUR **9**

Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behaviour – consumer equilibrium – Approaches to consumer behaviour – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short-run and long-run cost function – Relation between Production and cost function. **CO2**

UNIT III PRODUCT AND FACTOR MARKET **9**

Product market – perfect and imperfect market – different market structures – Firm's equilibrium and supply – Market efficiency – Economic costs of imperfect competition –factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets. **CO3**

UNIT IV PERFORMANCE OF AN ECONOMY – MACRO ECONOMICS **9**

Macro – economic aggregates – circular flow of macroeconomic activity –National income determination – Aggregate demand and supply – Macroeconomic equilibrium – Components of aggregate demand and national income – multiplier effect – Demand side management – Fiscal policy in theory. **CO4**

UNIT V AGGREGATE SUPPLY AND THE ROLE OF MONEY **9**

Short – run and Long – run supply curve – Unemployment and its impact – Okun's law – Inflation and the impact – reasons for inflation – Demand Vs Supply factors –Inflation Vs Unemployment tradeoff – Phillips's curve – short-run and long-run – Supply side Policy and management - Money market - Demand and supply of money – money - market equilibrium and national income – the role of monetary policy. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics, 19thedition, Tata McGraw Hill, New Delhi, 2011
2. N. Gregory Mankiw, Principles of Economics, 8th edition, Thomson learning, New Delhi, 2017.

REFERENCE BOOKS

1. William Boyes and Michael Melvin, Textbook of economics, Biztantra, 7th edition 2008.
2. Richard Lipsey and Ale Chrystal, Economics, 13th edition, Oxford, University Press, New Delhi, 2015.
3. Karl E. Case and Ray C. Fair, Principles of Economics, 12th edition, Pearson, Education Asia, New Delhi, 2017.
4. Panneer selvam. R, Engineering Economics, 2nd Edition, PHIL earning, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the utility concepts of Micro and Macro Economics

CO2 To analyse the consumer and producer behaviours; production function and cost analysis
CO3 To apply, how factors of production can be used optimally to produce product and service and; to analyze market structure.
CO4 To evaluate the performance of an macro-economic activity and macro-economic environment
CO5 To understand economic policies that regulate economic veriables

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	3	3	3	2	-
CO2	3	3	2	1	-	-	3	3	3	2	-
CO3	3	2	2	1	-	-	3	3	3	2	-
CO4	3	2	2	1	-	-	3	3	3	2	-
CO5	3	3	2	1	-	-	3	3	3	2	-

MB1103 ACCOUNTING FOR MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- Acquire a reasonable knowledge in accounts analysis and evaluate financial statements

UNIT I FINANCIAL ACCOUNTING **9**

Introduction to Financial, Cost and Management Accounting – Generally accepted accounting principles – Double Entry System – Preparation of Journal, Ledger and Trial Balance Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet – Reading the financial statements. **CO1**

UNIT II ANALYSIS OF FINANCIAL STATEMENTS **9**

Financial ratio analysis, Interpretation of ratio for financial decisions – DuPont Ratios – Comparative statements – common size statements. Cash flow (as per Accounting Standard 3) and Fund's flow statement analysis –Trend Analysis. **CO2**

UNIT III COST ACCOUNTING **9**

Cost Accounts – Classification of costs – Job cost sheet – Job order costing – Process costing (excluding Interdepartmental Transfers and equivalent production) – Joint and By Product Costing – Activity Based Costing, Target Costing. **CO3**

UNIT IV MARGINAL COSTING **9**

Marginal Costing and profit planning – Cost, Volume, Profit Analysis – Break Even Analysis – Decision making problems -Make or Buy decisions -Determination of sales mix - Exploring new markets - Add or drop products -Expand or contract. **CO4**

UNIT V BUDGETING AND VARIANCE ANALYSIS **9**

Budgetary Control – Sales, Production, Cash flow, fixed and flexible budget – Standard costing and Variance Analysis – (excluding overhead costing) - Accounting standards and accounting disclosure practices in India. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. M. Y. Khan & P. K. Jain, Management Accounting, Tata McGraw Hill, 8th edition, 2018.
2. T. S. Reddy & A. Murthy, Financial Accounting, Margham Publications, 2014

3. M. Y. Khan & P. K. Jain, Management Accounting, Tata McGraw Hill, 8th edition, 2018.

REFERENCE BOOKS

1. Jan Williams, Susan Haka, Mark Sbettner, Joseph V Carcello, Financial and Managerial Accounting The basis for business Decisions, 18th edition, Tata McGraw Hill Publishers, 2017
2. Charles T. Horngren, Gary L. Sundem, David Burgstahler, Jeff Schatzberg, Introduction to Management Accounting, PHIL earning, 2014, 16th edition.
3. Earl K. Stice & James D. Stice, Financial Accounting, Reporting and Analysis, 8th edition, Cengage Learning, 2015.
4. N. M. Singhvi, Ruzbeh J. Bodhanwala, Management Accounting–Text and cases, 3rd edition PHIL earning, 2018
5. Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsiever, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to remember and understand the financial accounting concepts.

CO2 Ability to understand the financial statement analysis.

CO3 To apply and analyse the cost accounting techniques

CO4 To apply the marginal costing and profit planning techniques.

CO5 To analyse and evaluate the cost and management accounting techniques like budgeting, standard costing and variance analysis.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	3	3	2	-
CO2	3	3	2	2	-	-	-	3	3	2	-
CO3	3	2	2	2	-	-	-	3	3	2	-
CO4	3	2	2	2	-	-	-	3	3	2	-
CO5	3	3	2	2	-	-	-	3	3	2	-

MB1104 LEGAL ASPECTS OF BUSINESS

L	T	P	C
3	0	0	3

OBJECTIVES

- The objective of this course is to familiarize the students with various laws that will help them to refine their understanding of how law affects the different aspects of business.

UNIT I COMMERCIAL LAW **9**

THE INDIAN CONTRACT ACT1872: Definition of contract, essentials elements and types of a contract, Formation of a contract, performance of contracts, breach of contract and its remedies, Quasi contracts – Contract of Agency: Nature of agency, Creation and types of agents, Authority and liability of Agent and principal: Rights and duties of principal and agents, termination of agency. **CO1**

THE SALE OF GOODS ACT 1930: Nature of Sales contract, Documents of title, risk of loss, Guarantees and Warranties, performance of sales contracts, conditional sales and rights of an unpaid seller-

NEGOTIABLE INSTRUMENTS ACT 1881: Nature and requisites of negotiable instruments. Types of negotiable instruments, liability of parties, holder in due course, special rules for Cheque and drafts, discharge of negotiable instruments.

UNIT II	**COMPANY LAW**	**9**
COMPANY ACT 1956&2013 Major principles – Nature and types of companies, Formation, Memorandum and Articles of Association, Prospectus, Power, duties and liabilities of Directors, winding up of companies, Corporate Governance.		**CO2**
UNIT III	**INDUSTRIAL LAW**	**9**
An Overview of Factories Act – Payment of Wages Act – Payment of Bonus Act – Industrial Disputes Act.		**CO3**
UNIT IV	**CORPORATE TAX & GST**	**9**
Corporate Tax Planning, Corporate Taxes and Overview of Latest Developments in Indirect tax Laws relating to GST: An introduction including constitutional aspects, Levy and collection of CGST & IGST, Basic concept of time and value of supply, Input tax credit, Computation of GST Liability, Registration, Tax Invoice, Credit & Debit Notes, Electronic Way bill, Returns, Payment of taxes including Reverse Charge.		**CO4**
UNIT V	**CONSUMER PROTECTION ACT AND INTRODUCTION OF CYBER LAWS**	**9**
Consumer Protection Act – Consumer rights, Procedures for Consumer grievances redressal, Types of consumer Redressal Machineries and Forums - Cyber-crimes, IT Act 2000 and 2002, Cyber Laws.		**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. N. D. Kapoor, Elements of Mercantile Law, Sultan Chand and Company, India, 2017.
2. P. K. Goel, Business Law for Managers, Biztantatara Publishers, India, 2017.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill, 6th Edition, 2018.

REFERENCE BOOKS

1. Ravinder Kumar, Legal Aspects of Business, New Delhi: Cengage Learning, 4th edition, 2016.
2. Sinha P. K, Dr. Vinod Singhania, Text Book of Indirect Tax, Taxman Publication, New Delhi.
3. Taxmann, GST Manual with GST Law Guide & Digest of Landmark Rulings, 11th Edition, 2019
4. P. P. S. Gogna, Mercantile Law, S. Chand &Co. Ltd., India, Fourth Edition, 2015.
5. Richard Stim, Intellectual Property - Copy Rights, Trade Marks, and Patents, Cengage Learning,15th edition 2017.
6. Daniel Albuquerque, Legal Aspect of Business, Oxford, 2nd edition, 2017
7. Ravinder Kumar, Legal Aspect of Business, Cengage Learning, 4th Edition 2016.
8. V. S. Datey, GST Ready Reckoner, 9th edition, 2019

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the provisions of the law of contract, sale of goods act and negotiable instruments act
CO2	To remember the various forms of companies' origin and winding up procedures with the elements of corporate governance.
CO3	To understand the various provisions of labor law and industrial environment
CO4	Ability to understand the fundamental concepts of corporate tax and GST
CO5	To analyze the various forms of consumer complaints, and cybercrimes and use the legal provisions for redressal and avoid it.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	1	2	2	-	-	1	3	3	2	1
CO2	3	1	2	2	-	-	1	3	3	2	1
CO3	3	1	2	2	-	-	1	3	3	2	1
CO4	3	1	2	2	-	-	1	3	3	2	1
CO5	3	1	2	2	-	-	1	3	3	2	1

MB1105 INFORMATION MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the importance of information in business
- To know about the recent information systems and technologies.

UNIT I INTRODUCTION **9**

Data, Information, Information System, evolution, types based on functions and hierarchy, Enterprise and functional information systems. **CO1**

UNIT II SYSTEM ANALYSIS AND DESIGN **10**

System development methodologies, Systems Analysis and Design, Data flow Diagram (DFD), Decision table, Entity Relationship (ER), Object Oriented Analysis and Design (OOAD), UML diagram. **CO2**

UNIT III INTRODUCTION TO DATA BASE MANAGEMENT SYSTEMS **8**

DBMS – types and evolution, RDBMS, OODBMS, RODBMS, Data warehousing, Data Mart, Data mining. **CO3**

UNIT IV INTEGRATED SYSTEMS, SECURITY AND CONTROL **9**

Knowledge based decision support systems, integrating social media and mobile technologies in Information system, Security, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web. **CO4**

UNIT V NEW IT INITIATIVES **9**

Introduction to Deep learning, Big data, Pervasive Computing, Cloud computing, Advancements in AI, IoT, Block chain, Crypto currency, Quantum computing. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Rahul de, MIS in Business, Government and Society, Wiley India Pvt Ltd, 2012
2. Gordon Davis, Management Information System : Conceptual Foundations, Structure and Development, Tata McGraw Hill, 21st Reprint 2008.
3. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005. 9th edition, 2013.

REFERENCE BOOKS

1. Robert Schultheis and Mary Sumner, Management Information Systems –The Manager's View, Tata McGraw Hill, 2008.
2. Kenneth C. Laudon and Jane P Laudon, Management Information Systems –Managing the Digital Firm, 15th edition, 2018.
3. R Database Management Systems, 3rd Edition, PHI Learning, 2018

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basics of data and information system.
CO2 To apply the system development methodologies.
CO3 To analyse how database management system and its types helps to the information management.
CO4 To evaluate the various technologies in information system and its security.
CO5 To gain knowledge on effective applications of information systems in business.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	1	2	2	1	1	1	3	3	3	1
CO2	3	1	2	2	1	1	1	3	3	3	1
CO3	3	1	2	2	1	1	1	3	3	3	1
CO4	3	1	2	2	1	1	1	3	3	3	1
CO5	3	1	2	2	1	1	1	3	3	3	1

MB1106 RESEARCH METHODOLOGY AND IPR **L T P C**
3 0 0 3

OBJECTIVES

- To make the students understand the principles of scientific methodology in research enquiry, develop analytical skills of research, to prepare scientific reports and help them to get patent and copy right of their research work.

UNIT I INTRODUCTION **9**

Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research. **CO1**

UNIT II RESEARCH DESIGN AND MEASUREMENT **9**

Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument. **CO2**

UNIT III DATA COLLECTION AND SAMPLING DESIGN **9**

Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of questionnaire and instrument – Validation of questionnaire – Sampling plan – Sample size – determinants optimal sample size – sampling techniques – Probability Vs Non–probability sampling methods. **CO3**

UNIT IV DATA ANALYSIS AND REPORT WRITING **9**

Data Preparation – editing – coding –data entry – data analyses – parametric and non-parametric techniques - applications of bivariate and multivariate statistical techniques. Research report – contents of report – executive summary – types of report - ethics in research. **CO4**

UNIT V INTELLECTUAL PROPERTY RIGHTS ACT **9**

IPR – meaning - objectives - types of IPR – Patent, Copy right, Trademark – Procedure for registration – offence & penalties. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods, 12th Edition, Tata Mc Graw Hill, New Delhi, 2018.
2. Alan Bryman and Emma Bell, Business Research methods, 5th Edition, Oxford University Press, New Delhi, 2018.
3. William G Zikmund, Barry J Babin, Jon C. Carr, Atanu Adhikari, Mitch Griffin, Business Research methods, A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2016.
4. V K Ahuja, Law Relating to Intellectual Property Rights 3rd edition 2017, Publisher: LexisNexis, Universal bookstores, India.
5. Anil Kumar H S, Ramakrishna B, Fundamentals of Intellectual Property Rights, 2017 Notion press

REFERENCE BOOKS

1. Wilson, J (2013), Essential of Research Methods, SAGE Publication.
2. Lee, Nick & Lings, Ian (2009), Doing Business Research, Sage South Asia.
3. Mark Saunders, Lewis, P. & Thornhill, A. (2015), Research Methods for Business Students, Pearson Education,
4. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
5. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the types and process of research and to create the research objectives and hypothesis.

CO2 To apply the types of research design, measurement and scaling; to create the instrument and evaluate the validity and reliability of instrument.

CO3 To determine the types of data, sample size; applying the probability vs non–probability sampling techniques

CO4 To analyse data using parametric and non-parametric techniques; prepare the research reports.

CO5 To understand IPR and to get patent and copy right for research work

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2	-	3	3	3	-
CO2	3	3	3	2	1	2	-	3	3	3	1
CO3	3	3	3	2	1	2	-	3	3	3	-
CO4	3	3	3	2	1	2	-	3	3	3	-
CO5	3	3	3	2	1	2	-	3	3	3	3

SEMINAR - 1

MB1107 INDIAN ETHOS AND BUSINESS ETHICS

L	T	P	C
0	0	4	2

OBJECTIVES

- To enable the learners in understanding of the basic concepts of Indian Ethos and familiarize about ethical behaviour and value systems at work.
- To enable the learners to have exposure on business ethics and ethical business perspectives.

NOTE:

- The following is the list of topics suggested for preparation and presentation by students twice during the semester.
- This will be evaluated by the faculty member(s) handling the course and the final marks are consolidated at the end of the semester. No end semester examination is required for this course.

1. Indian Ethos and Personality Development
2. Work ethos and values for Professional Managers
3. Indian Values, Value Systems and Wisdom for modern managers
4. Management Lessons from the Vedas, Puranas, Indian religions
5. Spirituality in Business Management
6. Individual Culture and Ethics
7. Ethical codes of conduct and value Systems
8. Loyalty and Ethical Behaviour
9. Ethical business issues and solutions
10. Social Responsibilities of Business

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of Indian Ethos

CO2 To apply work ethos and values based on cultural differences

CO3 To determine the basic sources of Indian ethos and values

CO4 The apply the Indian Systems of learning in work place

CO5 The understand the Indian Heritage and its application in CSR

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	1	1	3	2	2	-
CO2	2	2	2	1	1	1	1	3	2	2	-
CO3	2	2	2	1	1	1	1	3	2	2	-
CO4	2	2	2	1	1	1	1	3	2	2	-
CO5	2	2	2	1	1	1	1	3	2	2	-

MB1108	BUSINESS COMMUNICATION (LABORATORY)	L	T	P	C
		0	0	4	2

OBJECTIVES

- To help the students to acquire some of the necessary skills to handle day-to-day managerial responsibilities, such as - making speeches, controlling one-to-one communication, enriching group activities and processes, giving effective presentations, writing letters, memos, minutes, reports

UNIT I INTRODUCTION AND TYPES OF BUSINESS COMMUNICATION

Introduction to Business Communication: Principles of effective communication, Target group profile, Barriers of Communication, Reading Skills, Listening, Feedback - Principles of Nonverbal Communication: Professional dressing and body language. Role Playing, Debates and Quiz. Types of managerial speeches - Presentations and Extempore - speech of introduction, speech of thanks, occasional speech, theme speech - Group communication: Meetings, group discussions – Other Aspects of Communication: Cross Cultural Dimensions of Business Communication Technology and Communication, Ethical & Legal Issues in Business Communication. **CO1 9**

UNIT II BUSINESS COMMUNICATION WRITING MODELS AND TOOLS

Business letters, Routine letters, Bad news and persuasion letters, sales letters, collection letters, Maintaining a Diary, Resume / CV, job application letters, proposals. Internal communication through - notices, circulars, memos, agenda and minutes, reports. Case Studies. Exercises on Corporate Writing, Executive Summary of Documents, Creative Writing, Poster Making, Framing Advertisements, Slogans, Captions, Preparing Press Release and Press Notes. **CO2 9**

UNIT III EFFECTIVE PRESENTATIONS **CO3**

Principles of Effective Presentations, Principles governing the use of audio-visual media. **9**

UNIT IV INTERVIEW SKILLS

Mastering the art of giving interview sin-selection or placement interviews, discipline interviews, appraisal interviews, exit interviews, web / video conferencing, tele-meeting. **CO4 9**

UNIT V REPORT WRITING

Objectives of report, types of report, Report Planning, Types of Reports, developing an outline, Nature of Headings, Ordering of Points, Logical Sequencing, Graphs, Charts, Executive Summary, List of Illustration, Report Writing. **CO5 9**

TOTAL: 60 PERIODS

Note: The emphasis of the entire subject should be on practical aspects.

Practical: Module 1-This module introduces both written and spoken communication skills to students to build their confidence in delivering clear and logical messages to their audience. They will develop written communication skills through crafting business messages such as business letters, emails, and meeting minutes. In addition, students will work through presentations and simulated meetings to refine their spoken communication skills, discussion techniques and people skills.

Practical-Module2-This module builds on the foundation of Business Communication and creates opportunities for students to strengthen their oral and written communication. Students will be required to enhance their presentation skills through impromptu speeches. Students will also learn how to prepare a formal business report. Job hunting and employment skills will be introduced to prepare students for a positive start to their careers. Students will be taught to write application letters and resumes. Additionally, students will learn job interview techniques through role-plays and simulations

Practical - Module 3 - This practical module aims to help students be persuasive in the business world. Students will learn listening and data gathering skills to better understand their target audience's needs and requirements and persuasive skills to convince the audience to accept a new policy / suggestion / product through role-playing a boardroom presentation. Students will also be taught business networking skills including conversation techniques, dining etiquette and personal branding through role-plays and simulations.

REFERENCE BOOKS

1. Rajendra Pal, J.S. Korlahalli, Essentials of Business Communication by, Sultan Chand & Sons, 13th Edition.
2. Meenakshi Raman, Prakash Singh, Business Communication, Oxford, 2nd edition, 2012
3. Raymond V. Lesikar, Flatley, Basic Business Communication Skills for Empowering the Internet Generation by, M.E., TMGH, New Delhi,10th edition, 2004
4. Ludlow R, Panton, The Essence of Effective Communications, Prentice Hall of India Pvt. Ltd. 2, 1995
5. C.S. Rayadu, Communication by, HPH, 2015
6. R.C. Sharma, Krishna Mohan, Business Correspondence & Report Writing, Tata McGraw Hill, 5th Edition, 2017
7. Malcolm Goodale, Developing Communication Skills, 2nd Edition Professional Presentations, Cambridge University Press
8. Supplementary Reading Material Business Communication – Harvard Business Essentials Series, HBS Press
9. Adair, J, Effective Communication, Pan Macmillan Excellence in Business Communication by Thill, J. V. & Bovee, G. L, McGraw Hill, New York.
10. Business Communications: From Process to Product by Bowman, J.P. & Branchaw, P.P., Dryden Press, Chicago.
11. **WEBSITES:**
    www.businesscommunicationskills.com
    www.kcitraining.com
    www.mindtools.com
    www.businesscmmunication.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To apply managerial communication skills
CO2 Ability to excel in different forms of written communication required in a business context
CO3 Develop good presentation skills
CO4 In-depth understanding of interview skills
CO5 To prepare Business reports

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	-	2	2	2	2	-	3	3	2	-
CO2	2	-	2	2	2	2	-	3	3	2	-
CO3	2	-	2	2	2	2	-	3	3	2	-
CO4	2	-	2	2	2	2	-	3	3	2	-
CO5	2	-	2	2	2	2	-	3	3	2	-

MB1201 QUANTITATIVE TECHNIQUES FOR DECISION MAKING

	L	P	T	C
	3	0	0	3

OBJECTIVES

- To learn the fundamentals of Quantitative techniques in decision making
- To understand the application of Linear Programming Extensions
- To understand the fundamentals of decision and Game Theories
- To understand the role of inventory and Job Sequencing Models
- To get knowledge about the machine translation

UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LP)	**9**	
Relevance of quantitative techniques in management decision making. Linear Programming - formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases. Sensitivity Analysis.		**CO1**
UNIT II LINEAR PROGRAMMING EXTENSIONS	**9**	
Transportation Models (Minimising and Maximising Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by N - W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI / Stepping Stone method. Case of Degeneracy. Transshipment Models. Assignment Models (Minimising and Maximising Problems) – Balanced and Unbalanced Problems. Solution by Hungarian and Branch and Bound Algorithms. Travelling Salesman problem. Crew Assignment Models.		**CO2**
UNIT III DECISION AND GAME THEORIES	**9**	
Decision making under risk – Decision trees – Decision making under uncertainty. Game Theory – Two-person Zero sum games - Saddle point, Dominance Rule, Convex Linear Combination (Averages), methods of matrices, graphical and LP solutions.		**CO3**
UNIT IV INVENTORY AND JOB SEQUENCING MODELS	**9**	
Inventory Models –EOQ and EBQ Models (With and without shortages), Quantity Discount Models. Job Sequencing algorithm (Johnson') - n jobs thro' 2 machines, n jobs thro' 3 machines and n jobs thro' m machines.		**CO4**
UNIT V QUEUING THEORY AND REPLACEMENT MODELS	**9**	
Queuing Theory – single and Multi – channel models –infinite number of customers and infinite calling source. Replacement Models – Individuals replacement Models (With and without time value of money) – Group Replacement Models.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. N. D Vohra, Quantitative Techniques in Management, Tata Mcgraw Hill, 2010.
2. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.
3. Hamdy A Taha, Introduction to Operations Research, Prentice Hall India, Tenth Edition, Third Indian Reprint 2019.

REFERENCE BOOKS

1. Bernard W. Taylor III, Introduction to Management Science, 9th Edition, Pearson Ed.
2. Frederick & Mark Hillier, Introduction to Management Science– A Modeling and case studies approach with spread sheets, Tata Mcgraw Hill,2010.
3. Nagraj B, Barry Rand Ralph M. S Jr., Managerial Decision Modelling with Spreads sheets, Second Edition, 2007, Pearson Education

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the fundamentals of linear programming and applying in real world situations for decision making

CO2	To apply the transportation and assignment models and to analyze the optimal allocation for Minimization of Cost
CO3	To apply the strategies in competitive real-world phenomena using concepts from game theory.
CO4	To analyze the efficiency of job sequencing models to minimize production time and costs
CO5	To apply and analyze the appropriate queuing models and optimal replacement period/policy for a given item/equipment/machine.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	3	3	3	-
CO2	3	-	3	-	-	-	-	3	3	3	-
CO3	3	-	3	-	-	-	-	3	3	3	-
CO4	3	-	3	-	-	-	-	3	3	3	-
CO5	3	-	3	-	-	-	-	3	3	3	-

MB1202	FINANCIAL MANAGEMENT	L	P	T	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of Finance
- To understand the importance of Investment Decisions
- To understand the fundamentals of Financing and Dividend Decision
- To understand the role of working capital management
- To understand the long-term sources of finance

UNIT I FOUNDATIONS OF FINANCE 9

Introduction to finance – Financial Management – Nature, scope and functions of Finance, organization of financial functions, objectives of Financial management, Major financial decisions – Time value of money – features and valuation of shares and bonds – Concept of risk and return – single asset and of a portfolio. **CO1**

UNIT II INVESTMENT DECISIONS 9

Capital Budgeting: Principles and techniques – Nature of capital budgeting – Identifying relevant cash flows - Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index - Comparison of DCF techniques -Concept and measurement of cost of capital – Specific cost and overall cost of capital. **CO2**

UNIT III FINANCING AND DIVIDEND DECISION 9

Leverages – Operating and Financial leverage – measurement of leverages – degree of Operating & Financial leverage – Combined leverage, EBIT– EPS Analysis – Indifference point. Capital structure – Theories – Net Income Approach, Net Operating Income Approach, MM Approach – Determinants of Capital structure. Dividend decision – Issues in dividend decisions, Importance, Relevance & Irrelevance theories - Walter's – Model, Gordon's model and MM model – Factors determining dividend policy – Types of dividend policies– forms of dividend. **CO3**

UNIT IV WORKING CAPITAL MANAGEMENT 9

Principles of working capital: Concepts, Needs, Determinants, issues and estimation of working **CO4** capital – Receivables Management - Inventory management – Cash management – Working capital finance: Commercial paper, Company deposit, Trade credit, Bank finance.

UNIT V LONG TERM SOURCES OF FINANCE 9

Indian capital market – New issues market – Secondary market – Long-term finance: Shares, debentures and term loans, lease, hire purchase, venture capital financing, Private Equity. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. IM. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018
2. M.Y. Khan and P.K. Jain Financial management, Text, Problems and cases Tata McGraw Hill, 8th edition, 2017.
3. Aswath Damodaran, Corporate Finance Theory and practice, John Wiley & Sons, 2011.

REFERENCE BOOKS

1. James C. Vanhorne –Fundamentals of Financial Management – PHI Learning, 13th Edition, 2014.
2. Brigham, Ehrhardt, Financial Management Theory and Practice, 14th edition, Cengage Learning 2015.
3. Prasanna Chandra, Financial Management, 9th edition, Tata McGraw Hill, 2017.
4. Srivatsava, Mishra, Financial Management, Oxford University Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To remember the basic concepts of financial management such as decisions and functions of financial management

CO2 To understand the long term investment techniques like payback period, accounting rate of return, net present value.

CO3 To apply the concepts of dividend and examine impact of dividend policy of a firm.

CO4 To analyse the different forms components of working capital such as receivables, payables, inventory etc.

CO5 To evaluate getting exposure of long term sources of fund namely debenture, term loans, private equity, venture capital etc.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	3	-	-	-	3	3	-	-
CO2	3	3	3	3	-	-	-	3	3	-	-
CO3	3	3	3	3	-	-	-	3	3	-	-
CO4	3	3	3	3	-	-	-	3	3	-	-
CO5	3	3	3	3	-	-	-	3	3	-	-

MB1203 **HUMAN RESOURCE MANAGEMENT**

	L	P	T	C
	3	0	0	3

OBJECTIVES

- To learn the basic concepts of Human Resource Management
- To understand the importance of Human Resource Planning and Recruitment
- To understand the fundamentals and importance of Training and Development
- To understand the intricacies in Employee Engagement
- To understand the importance of Performance Evaluation and Control

UNIT I PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT **9**

Evolution of human resource management – The importance of the human capital – Role of human resource manager – Challenges for human resource managers - trends in Human resource policies – Computer applications in human resource management – Human resource accounting and audit. **CO1**

UNIT II HUMAN RESOURCE PLANNING AND RECRUITMENT **9**

Importance of Human Resource Planning – Forecasting human resource requirement – matching supply and demand – Internal and External sources – Organizational Attraction - Recruitment, Selection, Induction and Socialization - Theories, Methods and Process. **CO2**

UNIT III TRAINING AND DEVELOPMENT **9**

Types of training methods – purpose – benefits - resistance. Executive development programme – Common practices – Benefits – Self-development – Knowledge management. **CO3**

UNIT IV EMPLOYEE ENGAGEMENT **9**

Compensation plan – Reward – Motivation – Application of theories of motivation – Career management – Mentoring - Development of mentor – Protégé relationships- Job Satisfaction, Employee Engagement, Organizational Citizenship Behavior: Theories, Models. **CO4**

UNIT V PERFORMANCE EVALUATION AND CONTROL **9**

Method of performance evaluation – Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance – Methods – Requirement of effective control systems grievances –Causes – Implications – Redressal methods. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gary Dessler and Biju Varkkey, Human Resource Management,14th Edition, Pearson Education Limited, 2015.
2. David A. Decenzo, Stephen. P. Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014.
3. Luis R. Gomez - Mejia, David B. Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012

REFERENCE BOOKS

1. Bernadin, Human Resource Management, Tata McGraw Hill, 8th edition 2012.
2. Wayne Cascio, Managing Human Resource, McGraw Hill, 2015.
3. Ivancevich, Human Resource Management, McGraw Hill 2012.
4. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the various aspects of HR

CO2 To analyse the human resource requirements and; to evaluate and create recruitment, selection, induction and socialization process.

CO3 To analyse, evaluate and create training and executive development programmes

CO4 To analyse mentoring, protégé relationships, job satisfaction, organizational citizenship behavior and; to create compensation plan, career management and employee engagement

CO5 To create a good performance appraisal system and grievance redressal methods

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	1	3	3	1	1
CO2	3	3	2	1	-	1	1	3	3	1	1
CO3	3	3	2	1	-	1	1	3	3	1	1
CO4	3	3	2	1	1	1	1	3	3	1	1
CO5	3	3	2	1	1	1	1	3	3	1	1

MB1204	**OPERATIONS MANAGEMENT**	**L**	**P**	**T**	**C**
		3	0	0	3

OBJECTIVES

- To learn the basic concepts of Operations Management
- To understand the importance of Operations and the value chain
- To understand concepts of Designing Operations
- To understand the importance of Planning and Control
- To understand the importance of Quality Management

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT **9**

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends. Operations Strategy – Strategic fit, framework. Productivity; World-class manufacturing practices **CO1**

UNIT II OPERATIONS AND THE VALUE CHAIN **9**

Capacity Planning – Long range, Types, Developing capacity alternatives, tools for capacity planning. Facility Location–Theories, Steps in Selection, Location Models. Sourcing and procurement-Strategic sourcing, make or buy decision, procurement process, managing vendors **CO2**

UNIT III DESIGNING OPERATIONS **9**

Product Design-Criteria, Approaches. Product development process-stage-gate approach tools for efficient development Process- design, strategy, types, analysis. Facility Layout–Principles, Types, Planning tools and techniques. **CO3**

UNIT IV PLANNING AND CONTROL OF OPERATIONS **9**

Demand Forecasting–Need, Types, Objectives and Steps- Overview of Qualitative and Quantitative methods. Operations planning-Resource planning-Inventory Planning and Control. Operations Scheduling- Theory of constraints-bottle necks, capacity constrained resources, synchronous **CO4**

UNIT V QUALITY MANAGEMENT **9**

Definitions of quality, The Quality revolution, quality gurus; TQM philosophies; Quality management tools, certification and awards. Lean Management - philosophy, elements of JIT **CO5** manufacturing, continuous improvement. Six sigma's.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Operations and Supply Chain Management, McGraw Hill Education (India) Pvt. Ltd,14th Edition, 2014.
2. Mahadevan B, Operations management: Theory and practice. Pearson Education India; 2015
3. William J Stevenson, Operations Management, Tata McGraw Hill, 9th Edition, 2009.
4. Russel and Taylor, Operations Management, Wiley, 5th Edition, 2006.

REFERENCE BOOKS

1. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage Learning, 9th edition, 2015.
2. Cecil C. Bozarth, Robert B. Handfield, Introduction to Operations and Supply Chain
3. Management, Pearson, 4th Edition, 2016.
4. Panneerselvam. R, Production and Operations Management, 3rd Edition, PHI Learning, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of operations management, its evolution, recent trends and challenges, and apply the techniques to improve productivity and ensure world class manufacturing.

CO2 To understand the issues involved in various level of operations planning and analyse the elements involved in product, process and services that add value to customers.

CO3 To understand the elements to be addressed in designing product, process, services and facilities and create the best of them.

CO4 To analyse the demand for product and services using quantitative and qualitative techniques and evaluate and find the requirement of inventory level and creating suitable inventory plan.

CO5 To remember and understand the various quality tools and techniques to create best product and services.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	-	1	3	3	2	-
CO2	3	3	2	1	-	-	1	3	3	2	-
CO3	3	3	2	1	-	-	1	3	3	2	-
CO4	3	3	2	1	-	-	1	3	3	2	-
CO5	3	3	2	1	-	-	1	3	3	2	-

MB1205 MARKETING MANAGEMENT

L	P	T	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of Marketing Management
- To understand the strategy followed in marketing
- To understand the fundamentals of marketing mix decisions

- To understand the role of buyer behaviour
- To understand the concepts of Marketing research & recent trends in marketing

UNIT I INTRODUCTION **9**

Defining Marketing – Core concepts in Marketing – Evolution of Marketing – Marketing Planning Process – Scanning Business environment: Internal and External – Value chain – Core Competencies – PESTEL − SWOT Analysis − Marketing interface with other functional areas– Production, Finance, Human Relations Management, Information System – Marketing in global environment – International Marketing – Rural Marketing−Prospects and Challenges. **CO1**

UNIT II MARKETING STRATEGY **9**

Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial Marketing – Consumer Marketing − Services marketing – Competition Analysis − Analysis of consumer and industrial markets – Influence of Economic and Behavioral Factors−Strategic Marketing Mix components. **CO2**

UNIT III MARKETING MIX DECISIONS **9**

Product planning and development – Product life cycle – New product Development and Management – Defining Market Segmentation – Targeting and Positioning − Brand Positioning and Differentiation – Channel Management – Managing Integrated Marketing Channels – Managing Retailing, Wholesaling and Logistics − Advertising and Sales Promotions – Pricing Objectives, Policies and Methods **CO3**

UNIT IV BUYER BEHAVIOUR **9**

Understanding Industrial and Consumer Buyer Behavior−Influencing factors – Buyer Behaviour Models – Online buyer behavior – Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection – Creating Long Term Loyalty Relationships. **CO4**

UNIT V MARKETING RESEARCH & TRENDS IN MARKETING **9**

Marketing Information System–Marketing Research Process–Concepts and applications: Product – Advertising – Promotion – Consumer Behaviour – Retail research –Customer driven organizations - Cause related marketing − Ethics in marketing – Online marketing trends – social media and digital marketing **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Philip T. Kotler and Kevin Lane Keller, Marketing Management, Prentice Hall India,15th Edition,2017.
2. K S Chandra sekar, “Marketing management – Text and Cases”, Tata Mc Graw Hill Education,2012
3. Lamb, Hair, Sharma, McDaniel – Marketing –An Innovative
4. Approach to learning and teaching - A south Asian perspective, Cengage Learning,2012.
5. Paul Baines, Chris Fill, Kelly Page, Marketing, Asian edition, Oxford University Press,5th edition,2019.

REFERENCE BOOKS

1. Ramasamy, V. S, Namakumari, S, Marketing Management: Global Perspective Indian Context, Macmillan Education, New Delhi, 6th Edition, 2018.
2. A. NAG, Marketing successfully – A Professional Perspective, Macmillan 2008.
3. Micheal R. Czinkota, Masaaki Kotabe, Marketing Management, Vikas Thomson Learning,2nd edition 2006.
4. Philip Kotler, Gay Armstrong, Prafulla Agnihotri, Principles of marketing, 7th edition,2018.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the fundamentals in marketing
CO2 To apply the marketing strategies followed in organizations
CO3 To analyse the applications marketing mix decisions
CO4 To evaluate the buyer behavior in marketing
CO5 To analyse and evaluate the applications of marketing research & trends in marketing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3		3	-	-	-	1	3	3	3	-
CO2	3		3	-	-	-	1	3	3	3	-
CO3	3		3	-	-	-	1	3	3	3	-
CO4	3		3	-	-	-	1	3	3	3	-
CO5	3		3	-	-	-	1	3	3	3	1

MB1206 **BUSINESS ANALYTICS** **L P T C**
3 0 0 3

OBJECTIVES

- To learn the fundamentals of Business Analytics
- To understand the importance of Resource Management in business Analytics
- To understand the fundamentals of Descriptive Analysis
- To understand the role of Predictive Analysis
- To understand the concepts of Prescriptive Analysis

UNIT I INTRODUCTION TO BUSINESS ANALYTICS (BA) **9**

Business Analytics- Terminologies, Process, Importance, Relationship with Organisational Decision Making, BA for Competitive Advantage. **CO1**

UNIT II MANAGING RESOURCES FOR BUSINESS ANALYTICS **9**

Managing BA Personnel, Data and Technology. Organisational Structures aligning BA. Managing Information policy, data quality and change in BA. **CO2**

UNIT III DESCRIPTIVE ANALYTICS **9**

Introduction to Descriptive analytics - Visualizing and Exploring Data - Descriptive Statistics – Sampling and Estimation – Probability Distribution for Descriptive Analytics – Analysis of Descriptive analytics **CO3**

UNIT IV PREDICTIVE ANALYTICS **9**

Introduction to Predictive analytics – Logic and Data Driven Models – Predictive Analysis Modeling and procedure – Data Mining for Predictive analytics. Analysis of Predictive analytics **CO4**

UNIT V PRESCRIPTIVE ANALYTICS **9**

Introduction to Prescriptive analytics – Prescriptive Modeling – Non Linear Optimisation – Demonstrating Business Performance Improvement. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, "Business Analytics Principles, Concepts, and Applications-What, Why, and How", Pearson,2014
2. Christian Albright Sand Wayne L. Winston, "Business Analytics-Data Analysis and Decision Making", Fifth edition, Cengage Learning, 2015.

REFERENCE BOOKS

1. James R. Evans, "Business Analytics - Methods, Models and Decisions", Pearson Ed,2012.
2. Newbold, Carlson, Thorne – Statistics for Business and Economics, 6th ed., Pearson
3. S. C.Gupta – Fundamentals of Statistics, Himalaya Publishing
4. Walpole – Probability and Statistics for Scientists and Engineers, 8th ed., Pearson

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the fundamentals of Business Analytics
CO2 To evaluate and manage resources for business Analytics
CO3 To apply descriptive analysis
CO4 To apply Predictive Analysis
CO5 To analyse and evaluate the applications of Prescriptive Analytics

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	3	3	2	-
CO2	3	3	3	1	-	-	-	3	3	2	-
CO3	3	3	3	1	-	-	-	3	3	2	-
CO4	3	3	3	1	-	-	-	3	3	2	-
CO5	3	3	3	1	-	-	-	3	3	2	-

MB1207	PRO-SOCIAL BEHAVIOUR	L	P	T	C
		0	0	4	2

OBJECTIVES

To introduce the students to the organization behaviour topics.

Exercises

1. Pygmalion Effect
2. Transaction analysis
3. Strokes
4. Life Positions
5. Self-efficacy/Confidence
6. Positive Psychology
7. Psychological Capital
8. Happiness/Subjective well-being
9. Emotional Labour
10. Creating Rapport

TOTAL : 30 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and analyse one self and others behaviour in organizations.
CO2 To analyse and improve self-confidence level.
CO3 To analyse and create good interpersonal relationship.
CO4 To create self-awareness.
CO5 To improve quality of life

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	3	3	3	-
CO2	3	-	3	-	-	-	-	3	3	3	-
CO3	3	-	3	-	-	-	-	3	3	2	-
CO4	2	-	2	-	-	-	-	3	3	2	-
CO5	3	-	3	-	-	-	-	3	3	3	-

MB1208 DATA ANALYSIS AND BUSINESS MODELING

L	P	T	C
0	0	4	2

OBJECTIVES

- To understand the importance of data analysis for business modelling.

Exercises

1. Descriptive Statistics
2. Parametric Tests
3. Non-parametric Tests
4. Correlation & Regression
5. Forecasting
   Extended experiment–1
6. Portfolio Selection
7. Risk Analysis & Sensitivity Analysis
8. Revenue Management
   Extended experiment–2
9. Transportation & Assignment
10. Networking Models
11. Queuing Theory
12. Inventory Models
    Extended experiments–3

TOTAL : 60 PERIODS

TEXT BOOKS

1. David R. Anderson, et.al, "An Introduction to Management Sciences: Quantitative approaches to Decision Making", (13th edition) South-Western College Pub, 2011.

2. William J. Stevenson, Ceyhun Ozgur,"Introduction to Management Science with Spread sheet", Tata McGraw Hill, 2009.
3. Hansa Lysander Manohar," Data Analysis and Business Modelling using Microsoft Excel" PHI, 2017.

REFERENCE BOOKS

1. David M. Levine etal, "Statistics for Managers using MS - Excel" (6th Edition) Pearson, 2010.
2. Minnick, C. Web Kit for Dummies. John Wiley & Sons,(2012).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To analyze data and test hypothesis using parametric test
CO2 To analyze data and test hypothesis using nonparametric test
CO3 To forecast business using analytical tools
CO4 To apply risk and sensitivity analysis and portfolio selection based on business data
CO5 To apply analytical tools related to networking, inventory models and queuing theory

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	3	3	3	-
CO2	3	3	3	1	-	-	-	3	3	3	-
CO3	3	3	3	1	-	-	-	3	3	3	-
CO4	3	3	3	1	-	-	-	3	3	3	-
CO5	3	3	3	1	-	-	-	3	3	3	-

MB1301 STRATEGIC MANAGEMENT

L	P	T	C
3	0	0	3

OBJECTIVES

- To learn the fundamentals of strategy and process
- To understand the competitive advantage for business organisation
- To understand various strategy adopted by organisations
- To understand the strategic implementation & Evaluation process
- To understand the issues in implementation of strategy

UNIT I STRATEGY AND PROCESS **9**

Conceptual framework for strategic management, the Concept of Strategy and the Strategy Formation Process – Stake holders in business – Vision, Mission and Purpose – Business definition, Objectives and Goals -Corporate Governance and Social responsibility-case study. **CO1**

UNIT II COMPETITIVE ADVANTAGE **9**

External Environment - Porter's Five Forces Model-Strategic Groups Competitive Changes during Industry Evolution – Globalisation and Industry Structure – National Context and Competitive advantage - Resources – Capabilities and competencies – core competencies – Low cost and differentiation Generic Building Blocks of Competitive Advantage – **CO2**

Distinctive Competencies - Resources and Capabilities durability of competitive Advantage- Avoiding failures and sustaining competitive advantage – Case study.

UNIT III STRATEGIES **9**

The generic strategic alternatives – Stability, Expansion, Retrenchment and Combination strategies – Business level strategy – Strategy in the Global Environment – Corporate Strategy – Vertical Integration - Diversification and Strategic Alliances - Building and Restructuring the corporation - Strategic analysis and choice – Managing Growth - Environmental Threat and Opportunity Profile(ETOP) - Organizational Capability Profile - Strategic Advantage Profile - Corporate Portfolio Analysis - SWOT Analysis - GAP Analysis - Mc Kinsey's 7s Framework - GE 9 Cell Model –Distinctive competitiveness - Selection of matrix - Balance Score Card- case study. **CO3**

UNIT IV STRATEGY IMPLEMENTATION & EVALUATION **9**

The Implementation process, Resource allocation, Designing organisational structure – Designing Strategic Control systems – Matching structure and control to strategy – Implementating strategic change – politics – power and conflict – Techniques of strategic evaluation & control - case study **CO4**

UNIT V OTHER STRATEGIC ISSUES **9**

Managing Technology and Innovation – Strategic issues for Non Profit organisations. New Business Models and strategies for Internet Economy – case study Challenges in Strategic Management: Introduction, Strategic Management as an Organisational Force, Dealing with Strategic Management in Various Situations, Strategic Management Implications and Challenges Recent Trends in Strategic Management: Introduction, Strategic Thinking, Organisational Culture and its Significance, Organisational Development and Change, Change Management, Strategic management in a new globalised economy **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Hill. Strategic Management: An Integrated approach,2009 Edition Wiley(2012).
2. John A. Parnell. Strategic Management, Theory and practice Biztantra (2012).
3. Azhar Kazmi, Strategic Management and Business Policy,3rdEdition,TataMcGrawHill,2008
4. Adriau H Aberberg and Alison Rieple, Strategic Management Theory & Application, Oxford University Press, 2008.

REFERENCE BOOKS

1. Gupta, Gollakota and Srinivasan, Business Policy and Strategic Management – Concepts and Application, Prentice Hall of India,2005.
2. Dr .Dharma Bir Singh, Strategic Management & Business Policy, Ko Gent Learning Solutions Inc., Wiley, 2012.
3. John Pearce, Richard Robinson and Amitha Mittal, Strategic Management, Mc Graw Hill, 12^{th} Edition, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and analyse the concept of strategic management process and formulations to gain knowledge about corporate governance and social responsibility.

CO2 To evaluate the external environment using tools like differentiation with distinctive advantage to avoid failures and sustaining competitive advantage.

CO3 To analyse internal business environment and create organizational level strategies

CO4 To apply strategies in practice. To evaluate and control strategies.

CO5 To create innovative technology and to analyse the issues of profit and nonprofit organisations.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	1	3	3	3	-
CO2	3	3	3	2	3	1	1	3	3	3	-
CO3	3	3	3	2	3	1	1	3	3	3	-
CO4	3	3	3	2	3	1	1	3	3	3	-
CO5	3	3	3	2	3	1	1	3	3	3	-

MB1302	INTERNATIONAL BUSINESS	L	P	T	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of International Business
- To understand the theories of International Trade and Investment
- To understand various strategy to enter global markets
- To understand the strategy in Marketing, Marketing, Financials of Global Business
- To understand the issues in Human Resource Management in International Business

UNIT I AN OVERVIEW OF INTERNATIONAL BUSINESS **9**

Definition and drivers of International Business- Changing Environment of International Business – Country attractiveness – Trends in Globalization – Effect and Benefit of Globalization – International Institution: UNCTAD Basic Principles and Major Achievements, Role of IMF, Features of IBRD, Role and Advantage of WTO. **CO1**

UNIT II THEORIES OF INTERNATIONAL TRADE AND INVESTMENT **9**

Theories of International Trade: Mercantilism, Absolute Advantage Theory, Comparative Cost Theory, Hecksher – Ohlin Theory – Theories of Foreign Direct Investment: Product Life Cycle, Eclectic, Market Power, Internationalisation – Instruments of Trade Policy : Voluntary Export Restraints, Administrative Policy, Anti-dumping Policy, Balance of Payment. **CO2**

UNIT III GLOBAL ENTRY **9**

Strategic compulsions-– Strategic options – Global portfolio management- Global entry strategy, different forms of international business, advantages – Organizational issues of international business – Organizational structures – Controlling of international business, approaches to control –Performance of global business, performance evaluation system. **CO3**

UNIT IV PRODUCTION, MARKETING, FINANCIALS OF GLOBAL BUSINESS **9**

Global production: Location, scale of operations – cost of production – Standardization Vs Differentiation – Make or Buy decisions – global supply chain issues – Quality considerations. Globalization of markets: Marketing strategy - Challenges in product development – pricing – production and channel management. Foreign Exchange Determination Systems: Basic Concepts – types of Exchange Rate Regimes-Factors Affecting Exchange Rates. **CO4**

UNIT V HUMAN RESOURCE MANAGEMENT IN INTERNATIONAL BUSINESS **9**

Selection of expatriate managers – Managing across cultures – Training and development – Compensation – Disadvantages of international business – Conflict in international business - **CO5**

Sources and types of conflict – Conflict resolutions – Negotiation –Ethical issues in international business–Ethical decision-making.

TOTAL : 45 PERIODS

TEXT BOOKS

1. CharlesnW.I.Hill and Arun Kumar Jain, International Business,6th edition, Tata McGraw Hill, New Delhi, 2010
2. Michael R.Czinkota, IlkkaA. Ronkainen and Michael H.Moffet, International Business,7Edition, Cengage Learning,NewDelhi,2010
3. K.Aswathappa, International Business, 5th Edition,TataMcGrawHill,NewDelhi,2012.

REFERENCE BOOKS

1. John D. Daniels and Leeh Radebaugh, International Business, Pearson Education Asia, New Delhi, 12th edition.
2. Vyuptakesh Sharan, International Business,3rd Edition, Pearson Education in South Asia, New Delhi, 2011
3. Rakesh Mohan Joshi, International Business, Oxford University Press, New Delhi, 2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and remember the concepts and importance of international business environment and globalization

CO2 To understand the different theories of international trade and investment and instruments of trade policy

CO3 To evaluate the effectiveness of global entry strategies

CO4 To apply the different functional strategies for effective global business

CO5 To evaluate the cultural aspects of international business

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	1	1	3	3	3	-
CO2	3	3	3	2	3	1	1	3	3	3	-
CO3	3	3	3	2	3	1	1	3	3	3	-
CO4	3	3	3	2	3	1	1	3	3	3	-
CO5	3	3	3	2	3	1	1	3	3	3	3

MB1309 CREATIVITY AND INNOVATION LABORATORY

L	P	T	C
0	0	4	2

OBJECTIVES

- To learn the fundamentals of creativity and Innovation
- To understand the mechanism of thinking and Visualization
- To understand various strategy in creativity
- To understand the problem solving in creativity
- To understand the issues in Innovation

UNIT I	**INTRODUCTION**	**12**	
Need for Creative and innovative thinking for quality – Essential theory about directed creativity, Components of Creativity, Methodologies and approaches, individual and group creativity, Organizational role in creativity, types of innovation, barriers to innovation, innovation process, establishing criterion for assessment of creativity & innovation			**CO1**
UNIT II	**MECHANISM OF THINKING AND VISUALIZATION**	**12**	
Definitions and theory of mechanisms of mind heuristics and models: attitudes, Approaches and Actions that support creative thinking-Advanced study of visual elements and principles - line, plane, shape, form, pattern, texture gradation, color symmetry. Spatial relationships and compositions in 2 and 3 dimensional space - procedure for genuine graphical computer animation –Animation aerodynamics – virtual environments in scientific Visualization–Unifying principle of data management for scientific visualization–Visualization bench marking			**CO2**
UNIT III	**CREATIVITY**	**12**	
Nature of Creativity: Person, Process, Product and Environment, Methods and tools for Directed Creativity – Basic Principles – Tools that prepare the mind for creative thought – stimulation – Development and Actions – Processes in creativity ICEDIP–Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation The Bridge between man creativity and there wards of innovativeness – Applying Directed Creativity.			**CO3**
UNIT IV	**CREATIVITY IN PROBLEM SOLVING**	**12**	
Generating and acquiring new ideas, product design, service design – case studies and hands –on exercises, stimulation tools and approaches, six thinking hats, lateral thinking – Individual activity, group activity, contextual influences. Assessing Your Personal Creativity and Ability to Innovate, Enhancing Your Creative and Innovative Abilities			**CO4**
UNIT V	**INNOVATION**	**12**	
Innovation- radical vs evolutionary,–Introduction to TRIZ methodology of Inventive Problem Solving – the essential factors – Innovator's solution – creating and sustaining successful growth –Disruptive Innovation model – Segmentive Models – New market disruption – Managing the Strategy Development Process – The Role of Senior Executive in Leading New Growth – Passing the Baton, Entrepreneurial Tools for Creativity and Innovation			**CO5**

TOTAL : 60 PERIODS

TEXT BOOKS

1. Rousing Creativity: Think New Now Floyd Hurt, ISBN1560525479, Crisp Publications Inc.1999
2. Geoffrey Petty, "how to be better at Creativity", The Industrial Society 2012
3. Clayton M. Christensen Michael E.Raynor, "The Innovator's Solution", Harvard Business School Press Boston, USA, 2007

REFERENCE BOOKS

1. Semyon D.Savransky," Engineering of Creativity–TRIZ", CRC Press New York USA," 1st edition 2000
2. CSG Krishnama Charyalu, Lalitha R Innovation management, Himalaya Publishing House 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the fundamentals of creativity and Innovation
CO2 To apply the mechanism of thinking and visualization
CO3 To apply creativity

CO4 To apply creativity in problem solving
CO5 To apply entrepreneurial tools for creativity and innovation

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	-	3	3	2	-
CO2	3	2	1	1	2	2	-	3	3	2	-
CO3	3	2	1	1	2	2	-	3	3	2	-
CO4	3	2	1	1	2	2	-	3	3	2	-
CO5	3	2	1	1	2	2	-	3	3	2	-

FUNCTIONALELECTIVES

MARKETING

MB1001 RETAIL MARKETING

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the concepts of effective retailing

UNIT I INTRODUCTION 9

An overview of Global Retailing – Challenges and opportunities – Retail trends in India – Socio economic and technological Influences on retail management- Government of India policy implications on retails. **CO1**

UNIT II RETAIL FORMATS 9

Organized and unorganized formats – Different organized retail formats – Characteristics of each format– Emerging trends in retail formats – MNC's role in organized retail formats. **CO2**

UNIT III RETAILING DECISIONS 9

Choice of retail locations - internal and external atmospherics – Positioning of retail shops – Building retail store Image - Retail service quality management – Retail Supply Chain Management– Retail Pricing Decisions. Merchandizing and category management – buying. **CO3**

UNIT IV RETAIL SHOP MANAGEMENT 9

Visual Merchandise Management–Space Management–Retail Inventory Management–Retail accounting and audits - Retail store brands – Retail advertising and promotions – Retail Management Information Systems -Online retail – Emerging trends. **CO4**

UNIT V RETAIL SHOPPER BEHAVIOUR 9

Understanding of Retail shopper behavior – Shopper Profile Analysis – Shopping Decision Process-Factorsinfluencingretailshopperbehavior–ComplaintsManagement- Retail sales force Management– Challenges in Retailing in India **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dr.Jaspreet Kaur, Customer Relationship Management, Kogent solution.
2. Ramkrishnan and Y.R. Srinivasan, Indian Retailing Text and Cases, Oxford University Press, 2008.

REFERENCE BOOKS

1) Dunne,Retailing,CengageLearning,2ndEdition, 2008
2) Swapna Pradhan, Retail Management -Text and Cases, Tata McGraw Hill, 3rd Edition,2009
3) Patrick M. Dunne and Robert FLusch, Retailing, Thomson Learning, 4th Edition 2008.

COURSE OUTCOMES

CO1 To understand the concept of retailing in India, analysis it with global level , government rules and implication on retailing

CO2 To understand and apply the chosen of various formats

CO3 To analyse the retail atmospheric, location, service quality management, supply chain management and pricing decision in retail management.

CO4 To understand about the interior maintenance of retail like inventory management, analyse the various visual display, advertisement and promotion necessary for retailing, role of it in retail management

CO5 To analyse the shopper behavior analysis, decision making process, complaints management and evaluate the challenges in retail

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	-	-	3	3	2	-
CO2	3	2	2	2	-	-	-	3	3	2	-
CO3	3	2	2	2	1	-	-	3	3	2	-
CO4	3	2	2	2	1	-	-	3	3	2	-
CO5	3	2	2	2	-	-	-	3	3	2	-

MB1002 CONSUMER BEHAVIOR

L	T	P	C
3	0	0	3

OBJECTIVES

- To study and understand the consumer behaviour in-order to effectively utilise the market potential

UNIT I INTRODUCTION 9

Understanding Consumer behavior, Consumption, Consumer orientation, Interpretive and Quantitative approaches - Effects of Technology, Demographics and Economy on Consumer behavior. **CO1**

UNIT II INTERNAL INFLUENCES 9

Influencesonconsumerbehavior–motivation–perception–AttitudesandBeliefs – learning and Experience-Personality & Self Image. **CO2**

UNIT III EXTERNAL INFLUENCES 9

Socio-Cultural, Cross Culture – Family group–Reference group–Communication – Influences on Consumer behavior **CO3**

UNIT IV CONSUMER BEHAVIOR MODELS 9

Traditional and Contemporary Consumer behavior model for Individual and industrial buying **CO4** behavior and decision making.

UNIT V PURCHASE DECISION PROCESS **9**

Consumer decision making process – Steps, Levels and decision rules - Evolving Indian consumers– Opinion Leadership-Diffusion and Adoption **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ramanuj Majumdar, Consumer Behaviour –Insights from Indian Market, PHI, 2010
2. Leon G.Schiffman and Leslie Lasar Kanuk, Consumer Behaviour, Pearson Education, India, ninth edition,2010

REFERENCE BOOKS

1. BarryJ.B., Eric G.H.,Ashutosh M.,Consumer Behaviour-A South Asian Perspective, Cengage Learning, 2016.
2. P.C.Jain and Monika Bhatt., Consumer Behavior in Indian Context, S.Chand & Company, 2013.
3. Srabanti Mukherjee, Consumer behavior, Cengage Learning, 2012.
4. Assael, Consumer Behavior - A Strategic Approach, Biztranza, 2008

COURSE OUTCOMES

CO1	To Understand Consumer orientation and consumption
CO2	To apply the internal factors influences in consumer behaviour
CO3	To analyse the effects of external influences in consumer behaviour
CO4	To evaluate the consumer behaviour models in consumer behaviour
CO5	To analyse and evalueate the purchae decision process in consumer behaviour

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	3	3	2	-
CO2	3	2	3	1	-	-	-	3	3	2	-
CO3	3	2	3	1	-	-	-	3	3	2	-
CO4	3	2	3	1	-	-	-	3	3	2	-
CO5	3	2	3	1	-	-	-	3	3	2	-

MB1003	INTEGRATED MARKETING COMMUNICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course introduces students to the essential concepts and techniques for the development and designing an effective Integrated Marketing Communication programme

UNIT I AN INTRODUCTION TO INTEGRATED MARKETING COMMUNICATION (IMC) **9**

An Introduction to Integrated Marketing Communication (IMC): Meaning and role of IMC in Marketing process, one voice communication V/s IMC- Introduction to IMC tools – Advertising, **CO1** sales promotion, publicity, public relations, and event sponsorship; role of advertising agencies and other marketing organizations providing marketing services and perspective on consumer behaviour.

UNIT II UNDERSTANDING COMMUNICATION PROCESS **9**

Understanding communication process: Source, Message and channel factors, Communication response hierarchy AIDA model, Hierarchy of effect model, Innovation adoption model , information processing model, The standard learning Hierarchy, Attribution Hierarchy, and low involvement hierarchy Consumer involvement- The Elaboration Likelihood (ELM) model, the Foote, Cone and Belding (FCB) Model. **CO2**

UNIT III PLANNING FOR MARKETING COMMUNICATION (MARCOM) **9**

Establishing marcom Objectives and Budgeting for Promotional Programmes –Setting communication objectives, Sales as marcom objective, DAGMAR approach for setting add objectives. Budgeting for marcom –Factors influencing budget, Theoretical approach to budgeting viz. Marginal analysis and Sales response curve, Method to determine marcom budget. **CO3**

UNIT IV DEVELOPING THE INTEGRATED MARKETING COMMUNICATION PROGRAMME **9**

Planning and development of creative marcom, Creative strategies in advertising-salespromotion-publicity-eventsponsorshipsetc.Creativestrategy in implementation and evaluation of marcom-Types of appeals and execution styles. Media planning and selection decisions-steps involved and information needed for media planning. Measuring the effectiveness of all Promotional tools and IMC. **CO4**

UNIT V DIGITAL MEDIA & ADVERTISING **9**

Digital Media, Evolution of Technology, Convergence of Digital Media, E- Commerce and Digital Media, Advertising on Digital Media, Social Media, Mobile Adverting, E-PR Advertising Laws & Ethics: Adverting & Law, Advertising & Ethics. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dr Niraj Kumar, Integrated Marketing Communication ,Himalaya Publishing House2015
2. Jaishri Jefhwaney, Advertising Management , Oxford University Press,2nd Edition,2013

REFERENCE BOOKS

1. Advertising & Promotion-An Integrated Marketing Communications Perspective, George Belch, Michael Belch & Keyoor Purani, TATA Mc GrawHill 8th edition
2. Terence A. Shimpand J.Craig Andrews, Advertising Promotion and other aspects of Integrated Marketing Communications, CENGAGE Learning, 9thedition, 2016

COURSE OUTCOMES

CO1 To understand the basics of traditional communication forms
CO2 To design and develop an effective Integrated Marketing Communication
CO3 To apply and analyse the marketing communication programme.
CO4 To develop integrated marketing communications tools
CO5 To develop and evaluate digital media & advertising

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	-	-	3	3	2	-

CO2	3	2	3	1	1	-	-	3	3	2	-
CO3	3	2	3	1	1	-	-	3	3	2	-
CO4	3	2	3	1	1	-	-	3	3	2	-
CO5	3	2	3	1	1	-	-	3	3	2	-

MB1004 SERVICES MARKETING L T P C
3 0 0 3

OBJECTIVES

- To appreciate the challenges involved in managing the services and analyze the strategies to deal with these challenges.

UNIT I INTRODUCTION 9

Introduction–Definition–Service Economy– Evolution and growth of service sector- Nature and Scope of Services –Difference between services and tangible products –Unique characteristics of services–Challenges and issues in Services Marketing. **CO1**

UNIT II SERVICE MARKETING OPPORTUNITIES 9

Assessing service market potential – Classification of services – Expanded marketing mix – Service marketing – Environment and trends – Service market segmentation, targeting and positioning. **CO2**

UNIT III SERVICE DESIGN AND DEVELOPMENT 9

Service Life Cycle – New service development – Service Blue Printing – GAP model ofservicequality–Measuringservicequality–SERVQUAL–ServiceQualityfunctiondevelopment. **CO3**

UNIT IV SERVICE DELIVERY AND PROMOTION 9

Positioning of services – Designing service delivery System, Service Channel – Pricing services, methods-Service marketing triangle, Managing demand, Managing supply, Managing Demand and Supply of Service–Integrated Service marketing communication. **CO4**

UNIT V SERVICE STRATEGIES 9

Service Marketing Strategies for Health – Hospitality – Tourism – Financial – Logistics– Educational – Marketing of Online Services– Entertainment & public utility Information technique services. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. VinnieJauhari & Kirti Dutta(2017),Services Marketing, Text and cases, 2nd edition
2. Valarie Zeithaml et al, Services Marketing, 5th International Edition, Tata McGraw Hill,2007
3. Gronroos, Service Management and Marketing –Wiley India, 3rd Edition, 2009

REFERENCE BOOKS

1. Kenneth EClow, etal, Services Marketing Operation Management and Strategy, 2nd Edition, New Delhi, 2004.
2. Chiristropher Lovelock and Jochen Wirtz, Services Marketing, Pearson Education, New Delhi, 7th edition, 2011.
3. Hoffman, Marketing of Services, Cengage, 4th Edition, 2010.
4. Kenneth E Clow, et al, Services Marketing Operation Management and Strategy, Biztantra, 2nd Edition, New Delhi, 2004.

COURSE OUTCOMES

CO1 To understand and analyse the basic concepts of service marketing and to gain knowledge about the evolution of service sector

CO2 To evaluate the service market potential and also analyze various service marketing opportunities with help of segmenting, targeting and positioning

CO3 To analyse service life cycle to design and develop new service, also evaluate quality of service using SERVQUAL

CO4 To understand and analyze the delivery system designing and various service channels and create various communication channels

CO5 To create innovative strategies and to analyse these strategies for various sectors of service

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	1	-	3	3	2	-
CO2	3	2	3	1	1	1	-	3	3	2	-
CO3	3	2	3	1	1	1	-	3	3	2	-
CO4	3	2	3	1	1	1	-	3	3	2	-
CO5	3	2	3	1	1	1	-	3	3	2	-

MB1005 SALES AND DISTRIBUTION MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To gain insights into the selling and distribution process.

UNIT I INTRODUCTION **9**

Sales management - Nature and scope. Sales management positions. Personal Selling - Scope, theories and strategies. Sales forecasting and budgeting decisions - Online selling – scope, potential, Merits and Demerits. **CO1**

UNIT II PERSONAL SELLING PROCESS, SALES TERRITORIES & QUOTAS **9**

Selling process and relationship selling. Designing Sales Territories and quotas. Sales organization structures. **CO2**

UNIT III MANAGING THE SALES FORCE **9**

Sales force -recruitment, selection, training, motivation, compensation and control. **CO3**

UNIT IV MANAGING DISTRIBUTION CHANNELS **9**

Distribution Management - Introduction need and scope. Channels - Strategies and levels, retailing and wholesaling. Designing channel systems and channel management. **CO4**

UNIT V BASICS OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT **9**

Logistics - Scope, definition and components. Managing FG Inventory & warehousing. Transportation, Scope, Modes and role in Supply Chain effectiveness .Use of Information Technology in Online Selling and Goods tracking. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Krishna K. Havaldar, Vasant M. Cavale, Sales and Distribution Management - Text and Cases, Third Edition, McGraw Hill Education, 2017
2. Panda Tapan, Sales and Distribution Management, 2nd edition, 2012, Publisher: OUP India

REFERENCE BOOKS

1. Pingali Venugopal, Sales and Distribution Management – An Indian Perspective, Response Books from Sage Publications, 2008

2. Richard R Still and Edward W Cundiff, Sales and Distribution Management 6th Edition 2017 Pearson India

COURSE OUTCOME

CO1 To understand basics of sales management
CO2 To design and develop Sales Territories
CO3 To develop and manage sales force
CO4 To develop and manage distribution channels
CO5 To understand inventory and supply chain management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	1	-	3	3	2	-
CO2	3	2	3	1	1	1	-	3	3	2	-
CO3	3	2	3	1	1	1	-	3	3	2	-
CO4	3	2	3	1	1	1	-	3	3	2	-
CO5	3	2	3	1	1	1	-	3	3	2	-

MB1006 BRAND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES

- To understand the methods of managing brands and strategies for brand management.

UNIT I INTRODUCTION **9**

Basic understanding of Brands – Definitions - Branding Concepts – Functions of Brand – Significance of Brands – Different Types of Brands–Co branding – Store brands. **CO1**

UNIT II BRAND STRATEGIES **9**

Strategic Brand Management process – Building a strong brand – Brand positioning – Establishing Brand values – Brand vision – Brand Elements – Branding for Global Markets – Competing with foreign brands **CO2**

UNIT III BRAND COMMUNICATIONS **9**

Brand image Building – Brand Loyalty programme – Brand Promotion Methods – Role of Brand ambassadors, celebrities– On line Brand Promotions. **CO3**

UNIT IV BRAND EXTENSION **9**

Brand Adoption Practices – Different type of brand extension – Factors influencing Decision for extension– Re-branding and Re-launching. **CO4**

UNIT V BRAND PERFORMANCE **9**

Measuring Brand Performance – Brand Equity Management - Global Branding strategies – Brand Audit – Brand Equity Measurement – Brand Leverage -Role of Brand Managers– Branding challenges& opportunities **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Lan Batey, Asian Branding–A Great way to fly, PHI, Singapore, 2002.
2. Paul Tmepoal, Branding in Asia, John Willy, 2000

REFERENCE BOOKS

1. Ramesh Kumar, Managing Indian Brands, Vikas Publication, India, 2002.
2. JagdeepKapoor,Brandex,Biztranza,India,2005

COURSE OUTCOMES

CO1 To understand branding concepts

CO2 To understand strategic brand management process and apply branding elements and create global branding strategies.

CO3 To create brand communication for brand promotion.

CO4 To understand the types of brand extension and remember the factors influencing brand extension decision.

CO5 To understand brand equity measurement techniques and analyze the branding challenges and opportunities in the global market.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	1	-	3	3	2	-
CO2	3	2	3	1	1	1	-	3	3	2	-
CO3	3	2	3	1	1	1	-	3	3	2	-
CO4	3	2	3	1	1	1	-	3	3	2	-
CO5	3	2	3	1	1	1	-	3	3	2	-

MB1007 CUSTOMER RELATIONSHIP MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To understand the need and importance of maintaining a good customer relationship

UNIT I INTRODUCTION **9**

Definitions - Concepts and Context of relationship Management – Evolution - Transactional Vs Relationship Approach –CRM as a strategic marketing tool–CRM significance to the stakeholders **CO1**

UNIT II UNDERSTANDING CUSTOMERS **9**

Customer information Database – Customer Profile Analysis - Customer perception, Expectations analysis – Customer behavior in relationship perspectives; individual and group customer's – Customer lifetime value – Selection of Profitable customer segments. **CO2**

UNIT III CRM STRUCTURES **9**

Elements of CRM – CRM Process – Strategies for Customer acquisition – Retention and Prevention of defection– Models of CRM–CRM road map for business applications **CO3**

UNIT IV CRM PLANNING AND IMPLEMENTATION **9**

Strategic CRM planning process – Implementation issues – CRM Tools- Analytical CRM – Operational CRM– Call centers management – Role of CRM Managers **CO4**

UNIT V TRENDS IN CRM **9**

e-CRM Solutions – Data Warehousing – Data mining for CRM – an introduction to CRM software packages **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Zikmund. Customer Relationship Management,Wiley2012
2. Francis Buttle, Customer Relationship Management:Concepts&Tools,Elsevier,2004
3. Kumar, Customer Relationship Management – A Database Approach, Wiley India,2007

REFERENCE BOOKS

1. Jim Catheart, The Eight Competencies of Relationship selling,MacmillanIndia,2005
2. H. Peeru Mohamed and A. Sahadevan, Customer Relation Management, Vikas Publishing 2005

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concepts of relationship management

CO2 To apply the various strategic for customer relationship, customer acquisition and customer retention techniques in CRM.

CO3 To analysis the strategies for customer acquisition, retention and prevention of defection and models of CRM, CRM road map for business applications.

CO4 To evaluate the various functional area coordinate with relationship management tools and Strategies.

CO5 To remember and gain the new technological development knowledge in CRM

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	3	3	2	-
CO2	3	2	3	1	-	-	-	3	3	2	-
CO3	3	2	3	1	-	-	-	3	3	2	-
CO4	3	2	3	1	-	-	-	3	3	2	-
CO5	3	2	3	1	-	-	-	3	3	2	-

MB1041	MARKETING ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- This course will provide you with an introduction to marketing analytics. We will study various tools for generating marketing insights from empirical data in such areas as segmentation, targeting and positioning, satisfaction management, customer life time analysis, customer choice, and product and price decisions using conjoint analysis

UNIT I INTRODUCTION TO MARKETING ANALYTICS **9**

Evolution and Scope of Analytics. Data for Marketing Analytics. Decision Models– Descriptive, Predictive and Prescriptive Models. Problem Solving and Decision making process. **CO1**

UNIT II DATA MANAGEMENT **9**

Exploring Data; Frequencies; Descriptive Statistics Cross tabulations; Independent Samples t-Test; One-Way ANOVA, Simple Regression and Correlation, Multiple Regression to Forecast sales, Modelling Trend and Seasonality, Ratio to Moving Average Method **CO2**

UNIT III CUSTOMER SEGMENTATION AND VALUATION **9**

Analytics for Segmentation– Introduction to Cluster analysis multivariate method. Estimation, Model performance and validation of assumptions for Cluster analysis. Customer Value Analysis, Customer Life time Value- Conjoint Analysis **CO3**

UNIT IV METRICS AND MEASUREMENT ANALYTICS 9

Product and Price analytics- Conjoint Analysis -Pricing -Estimating Demand Curves and optimize Price Retailing Analytics- Allocating Retail Space and Sales Resources- Market Basket Analysis. Advertising and Promotion Analytics-Promotion Analytics-Measuring the effectiveness of Advertising **CO4**

UNIT V WEB ANALYTICS 9

Search Engine Optimisation- Tracking the success of SEO. Web metrics - Google Ad words, Advertising & Analytics. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Evans, J.R. (2012). Business analytics methods, models and decisions. New Jersey: Pearson, Upper Saddle River.
2. Sorger, Stephan. ― Marketing Analytics: Strategic Models and Metrics. Admiral Press/Create Space, 2013

REFERENCE BOOKS

1. Cases and datasets for hands on learning. Pearson Education.
2. Grigsby, M. (2015). Marketing Analytics: A Practical Guide to Real Marketing Science. Kogan Page Publishers.
3. Sathi, A. (2014). Engaging customers using big data: how Marketing analytics are transforming Business. Palgrave Macmillan.
4. Rao, P. H. (2011). Predictive modelling for strategic marketing. New Delhi. Prentice Hall India

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and apply analytics models for problem solving and decision making

CO2 To analyse the data using different statistical tools

CO3 To understand segmentation and analyze the different analytical models for segmentation

CO4 To understand and apply analytical tools for decisions on the 4Ps of marketing

CO5 To understand web analytics and apply web analytics tools for optimization

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	3	3	2	-
CO2	3	2	3	2	-	-	-	3	3	2	-
CO3	3	2	3	2	-	-	-	3	3	2	-
CO4	3	2	3	2	-	-	-	3	3	2	-
CO5	3	2	3	2	-	-	1	3	3	2	-

FINANCE ELECTIVES

MB1008 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the techniques involved in deciding upon purchase or sale of securities.

UNIT I INVESTMENT SETTING		**9**
Financial and economic meaning of Investment– Characteristics and objectives of Investment – Investment process -Types of Investment – Investment alternatives – Choice and Evaluation– Risk and return concepts –Valuation of bonds and stock.	**CO1**	
UNIT II FUNDAMENTAL ANALYSIS		**9**
EconomicAnalysis–EconomicforecastingandstockInvestmentDecisions–Forecastingtechniques - Industry Analysis: Industry classification, Industry life cycle – Company Analysis Measuring Earnings – Forecasting Earnings – Applied Valuation Techniques – Graham and Dodds investor ratios.	**CO2**	
UNIT III TECHNICAL ANALYSIS		**9**
Fundamental Analysis Vs Technical Analysis -- Dow theory – Charting methods - Chart Patterns Trend – Trend reversals – Market Indicators-Moving Average – Exponential moving Average Oscillators-RSI-ROC -MACD. Efficient Market theory - Forms of market efficiency -weak, semi-strong, strong form – Empirical tests of market efficiency-its application	**CO3**	
UNIT IV PORTFOLIO CONSTRUCTION AND SELECTION		**9**
Portfolio analysis - Reduction of portfolio risk through diversification – Portfolio risk - Portfolio Selection- Feasible set of portfolios - Efficient set - Markowitz model - Single index model –Construction of optimum portfolio-Multi-index model.	**CO4**	
UNIT V CAPITAL ASSET PRICING MODEL		**9**
Capital Asset Pricing model – Lending and borrowing - CML - SML - Pricing with CAPM - Arbitrage pricing theory– Portfolio Evaluation - Sharpe's index Treynor's index, Jensen's index – Mutual Funds – Portfolio Revision.	**CO5**	

TOTAL: 45 PERIODS

TEXT BOOKS

1. V.K.Bhalla, InvestmentManagement,Chand&CompanyLtd.,2012
2. Bodi,Kane, Markus, Mohanty ,Investments, 8thedition, Tata Mc Graw Hill, 2011.
3. Donald E.Fischer & Ronald J.Jordan, Security Analysis & Portfolio Management, PHI Learning., New Delhi, 8th edition, 2011

REFERENCE BOOKS

1. S.Kevin, Securities Analysis and Portfolio Management, PHI Learning ,2012
2. Prasannachandra, Investment analysis and Portfolio Management, Tata McGraw Hill, 2011.
3. Reilly & Brown, Investment Analysis and Portfolio Management, Cengage Learning, 9th edition, 2011.
4. S. Kevin, Securities Analysis and Portfolio Management , PHI Learning , 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic environment of Indian financial systems especially investment options and their risk and return

CO2 To understanding the mechanism and functioning of primary and secondary markets of capital market and intermediaries

CO3 Ability to apply the securities risk and return using fundamental analysis

CO4 Skill to analyze and predict share price movements and make decisions using different methods of technical analysis

CO5 To analyze, and evaluate of manage portfolio of securities based on various techniques

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	2	3	3	-	-
CO2	3	3	2	2	-	-	2	3	3	-	-
CO3	3	3	2	2	-	-	2	3	3	-	-
CO4	3	3	2	2	-	-	2	3	3	-	-
CO5	3	3	2	2	-	-	2	3	3	-	-

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MB1009 FINANCIAL MARKETS

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the types and functions of the various financial markets in India, its instruments and Regulations

UNIT I FINANCIAL MARKETS IN INDIA. **9**

Indian financial system and markets – structure of financial markets in India –Types- Participants in financial Market–Regulatory Environment, - RBI, CCIL, Common securities market, Money market, - Capital market- Government's philosophy and financial market–financial instruments. **CO1**

UNIT II INDIAN CAPITALMARKET-PRIMARY MARKET **9**

Primary Market - Primary market system - Types of scripts - Issue of capital: process, regulation pricing of issue, – Methods of floating new issues, Book building- Primary markets intermediaries: commercial banks, development banks, Merchant banker, issue managers, rating agencies etc – Role of primary market– Regulation of primary market **CO2**

UNIT III SECONDARY MARKET **9**

Stock exchanges in India History and development – listing-Depositaries-Stock exchange mechanism: Trading, Settlement, risk management, Basics of pricing mechanism - Player and stock exchange - Regulations of stock exchanges – Role of SEBI – BSE, OTCEI, NSE, ISE, - Role of FIIs, MFs and investment bankers –Stock market indices – calculation **CO3**

UNIT IV DEBT MARKET AND FOREX MARKET **9**

Bond markets in India: Government bond market and its interface with capital market – Components of bond market - G-Sec, T-Bills, Corporate Bonds, Yield conventions, Role of primary dealers, Auction Markets-Pricing of Bonds Introduction to For ex markets, basics in exchange rates theory - Forex risk exposures and basics of corporate for ex risk management **CO4**

UNIT V MUTUAL FUNDS, DERIVATIVES MARKETS AND VENTURE CAPITALANDPRIVATE EQUITY **9**

Mutual funds institutions in India. Types of mutual funds, Basics in portfolio management, Metrics of performance for fund manager Introduction to Derivatives and the size of derivatives markets -Brief introduction to forwards, Options, Futures and Swaps. Role of VCs and Pes in financial markets – Venture capital and Private equity. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Saunders, Anthonu and Cornett, Marcia Millon, Financial markets and Institutions: An Introduction to the risk management approach, McGrawHill, Irwin, NewYork,3rdEdition,2017
2. V.K.Bhalla, Investment Management, S.Chand & Company Ltd., 2012

REFERENCE BOOKS

1. Pathak, BharatiV. Indian Financial System: Markets, Institutions and Services, (Singapore), New Delhi, Fourth edition, 2014.
2. Bodi, Kane, Markus, Mohanty, Investments, 8th edition, Tata McGraw Hill, 2011.
3. V.A.Avadhan, Securities Analysis and Portfolio Management, Himalaya Publishing House, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of the finance markets in India
CO2 To understand the mechanism of Indian Capital Market
CO3 To apply the right portfolio mix to reduce the risk in primary and secondary market
CO4 To analyse various investment avenues to find an optimum investment plan
CO5 To analyse and evaluate the various investment avenues for effective investment management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	2	3	3	3	2
CO2	3	3	2	-	-	-	2	3	3	3	2
CO3	3	3	2	-	-	-	2	3	3	3	2
CO4	3	3	2	-	-	-	2	3	3	3	2
CO5	3	3	2	-	-	-	2	3	3	3	2

MB1010 BANKING AND FINANCIAL SERVICES

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand about the asset based and fund based financial services in India.

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM AND PERFORMANCEVALUATION **9**

Overview of Indian Banking system – Structure – Functions – Key Regulations in Indian Banking sector –RBI Act, 1934/ 2006 –Banking Regulation Act, 1949– Negotiable Instruments Act 1881/2002– Provisions Relating to CRR – Provision for NPA's -Overview of Financial Statements of banks–Balance Sheet–Income Statement-CAMEL. **CO1**

UNIT II MANAGINGBANKFUNDS/PRODUCTS&RISKMANAGEMENT **9**

Capital Adequacy – Deposit and Non-deposit sources – Designing deposit schemes and pricing of deposit sources– loan management– Investment Management–Asset and Liability Management– Financial Distress –Signal to borrowers – Prediction Models – Risk Management –Interest rate – Forex– Credit market – operational and solvency risks–NPA's–Current issues on NPA's– M&A' soft banks into securities market. **CO2**

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY **9**

Payment system in India– paper based– e payment – electronic banking – plastic money –e-money–forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India –RBI's Financial Sector Technology vision document –security threats in e-banking & RBI' Initiative. Fin Tech - New operating models for banks-Banking as service and Open APIs - Neo banks **CO3**

UNIT IV ASSET BASED FINANCIAL SERVICES **9**

Introduction – Need for Financial Services – Financial Services Market in India– NBFC – RBI framework and act for NBFC – Leasing and Hire Purchase – Financial evaluation – underwriting –mutual funds. **CO4**

UNIT V INSURANCE AND OTHER FEE BASED FINANCIAL SERVICES **9**

Insurance Act, 1938– IRDA– Regulations– Products and services –Venture Capital Financing – Bill discounting –factoring – Merchant Banking – Role of SEBI **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2012.

REFERENCE BOOKS

1. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
2. Madura, Financial Institutions & Markets, 10th edition, Cengage, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand functions of banks and analyse the bank financial statement.

CO2 To evaluate the various risk associated with inflow and outflow of funds

CO3 To apply and analyse the risk associated with the modern e-banking

CO4 To evaluate financial service offered by banks and creating revenues from those services.

CO5 To understand the various aspects of insurance and financial services offered by Banks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	2	2	2	-
CO2	3	3	2	2	2	2	-	2	2	2	-
CO3	3	3	2	2	2	2	-	2	2	2	-
CO4	3	3	2	2	2	2	-	2	2	2	-
CO5	3	3	2	2	2	2	-	2	2	2	-

MB1011	FINANCIAL DERIVATIVES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic operational mechanisms in derivatives

UNIT I INTRODUCTION **9**

Derivatives – Definition – Types – Forward Contracts – Futures Contracts – Options – Swaps – Differences between Cash and Future Markets – Types of Traders – OTC and Exchange Traded Securities–Types of Settlement–Uses and Advantages of Derivatives –Risks in Derivatives. **CO1**

UNIT II FUTURES CONTRACT **9**

Specifications of Futures Contract - Margin Requirements – Marking to Market – Hedging usingFuturesTypesofFuturesContractsSecurities,StockIndexFutures,CurrenciesandCommodities – Delivery Options – Relationship between Future Prices, Forward Prices and Spot Prices. **CO2**

UNIT III OPTIONS **9**

Definition – Exchange Traded Options, OTC Options – Specifications of Options–Call and Put Options–American and European Options –Intrinsic Value and Time Value of Options–Option payoff, options on Securities, Stock Indices Currencies and Futures–Options pricing models– Differences between future and Option contracts. **CO3**

UNIT IV SWAPS **9**

Definition of SWAP – Interest Rate SWAP – Currency SWAP – Role of Financial Intermediary–Warehousing – Valuation of Interest rate SWAPs and Currency SWAPs Bonds and FRNs –Credit Risk **CO4**

UNIT V DERIVATIVES IN INDIA **9**

Evolution of Derivatives Market in India – Regulations -framework –Exchange Trading in Derivatives – Commodity Futures – Contract Terminology and Specifications for Stock Options and Index Options in NSE – Contract Terminology and specifications for stock futures and Index futures in NSE– Contract Terminology and Specifications for Interest Rate Derivatives. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. John.C.Hull, Options, Futures and other Derivative Securities‟, PHI Learning, 9th Edition,2012
2. S.L.Gupta, Financial Derivatives- Theory, Concepts and Practice, Prentice Hall Of India,2011.Websiteof NSE, BSE
3. David Dubofsky – „Option and Financial Futures – Valuation and Uses, McGraw Hill International Edition.

REFERENCE BOOKS

1. Keith Redhead, „Financial Derivatives – An Introduction to Futures, Forwards, Options and SWAPs‟,– PHI Learning, 2011.
2. Stulz, Risk Management and Derivatives, Cengage Learning, 2nd Edition, 2011.
3. Varma, Derivaties and Risk Management, 2ndt Edition, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To possess good skills in hedging risks using derivative
CO2 To understand about future contract and options
CO3 Learning in depth about options and swaps.
CO4 To knowing about the evolution of derivative markets.

CO5 To develop in depth knowledge about stock options and index futures in NSE

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	2	2	2	-
CO2	3	3	2	2	2	2	-	2	2	2	-
CO3	3	3	2	2	2	2	-	2	2	2	-
CO4	3	3	2	2	2	2	-	2	2	2	-
CO5	3	3	2	2	2	2	-	2	2	2	-

MB1012 FINANCIAL MODELLING L T P C
3 0 0 3

OBJECTIVES

- Making students to build financial models by including various fields of study viz financial Management and Derivatives.

UNIT I INTRODUCTION TO FINANCIAL MODELLING & BUILT INFUNCTIONS USING SPREAD SHEETS **9**

Introduction to Financial Modeling- Need for Financial Modeling- Steps for effective financial modeling-Introduction to Time value of money &Look up array functions FV,PV,PMT,RATE, NPER, V lookup, H lookup,if, count if etc - Time value of Money Models: EMI with Single& Two Interest rates–Loan amortization modeling-Debenture redemption modeling. **CO1**

UNIT II BOND& EQUITY SHARE VALUATION MODELLING **9**

Bond valuation – Yield to Maturity (YTM): Rate method Vs IRR method-Flexi Bond and Strip Bond YTM Modeling-Bond redemption modeling -Equity share valuation: Multiple growth rate valuation modeling with and without growth rates. **CO2**

UNIT III FINANCIAL MODELLING **9**

AltMan Z score Bankruptcy Modeling-Indifference point model in Financial Break-even modeling -Corporate valuation modeling (Two stage growth)- Business Modeling for capital budgeting evaluation: Payback period, NPV, IRR and MIRR. **CO3**

UNIT IV PORTFOLIO MODELLING **9**

Ris , Beta and Annualized Return –Security Market Line Modeling –Portfolio risk calculation (Equal Proportions)- Portfolio risk optimization(varying proportions)- Portfolio construction modeling. **CO4**

UNIT V DERIVATIVE MODELLING **9**

Option pay off modeling: Long and Short Call & Put options -Option pricing modeling (B-SModel)- Optimal Hedge Contract modeling. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Wayne L Winston," Microsoft Excel 2016-Data Analysis and Business Modelling", PHI publications, (Microsoft Press), NewDelhi,2017
2. Chandan Sen Gupta, "Financial analysis and Modelling –Using Excel and VBA" , WileyPublishingHouse,2014

REFERENCE BOOKS

1. Ruzhbeh J Bodanwala , "Financial management using excel spread sheet", Taxman Allied services Pvt Ltd, New Delhi,3rd Edition2015.
2. Craig W Holden, "Excel Modelling in Investments" Pearson Prentice Hall, Pearson Inc,New Jersey,5th Edition 2015

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To develop fast efficient and accurate excel skills.
CO2 To design and construct useful and robust financial modeling applications
CO3 To recognize efficient financial budgeting and forecasting techniques.
CO4 To familiarize the students with the valuation modeling of securities.
CO5 The course establishes the platform for students to develop various portfolio models

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	2	2	2	-
CO2	3	3	2	2	2	2	-	2	2	2	-
CO3	3	3	2	2	2	2	-	2	2	2	-
CO4	3	3	2	2	2	2	-	2	2	2	-
CO5	3	3	2	2	2	2	-	2	2	2	-

MB1013 INTERNATIONAL TRADE FINANCE **L T P C**
3 0 0 3

OBJECTIVES

- To understand export import finance and forex management.

UNIT I INTERNATIONAL TRADE **9**

International Trade – Meaning and Benefits – Basis of International Trade – Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade–WTO–Indian EXIM Policy. **CO1**

UNIT II EXPORT AND IMPORT FINACE **9**

Special need for Finance in International Trade – INCO Terms (FOB, CIF, etc.,) – Payment Terms–Letters of Credit – Pre-Shipment and Post Shipment Finance – Forfeiting – Deferred Payment Terms –EXIM Bank–ECG Candits schemes–Import Licensing– Financing methods for import of Capital goods CO2

UNIT III FOREX MANAGEMENT **9**

Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates. The effects of Exchange rates in Foreign Trade Tools for hedging against Exchange rate variations Forward, Futures and Currency options FEMA Determination of Foreign Exchange rate and Forecasting. **CO3**

UNIT IV DOCUMENTATION ININTERNATIONALTRADE **9**

Export Trade Documents: Financial Documents – Bill of Exchange- Type- Commercial Documents - Proforma, Commercial, Consular, Customs, Legalized Invoice, Certificate of Origin, Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents - Bill of Lading, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export Declaration Forms, GR Form, PP From, COD Form, Softer Forms, Export Certification, GSPS – UPCDC Norms. **CO4**

UNIT V EXPORT PROMOTION SCHEMES **9**

Government Organizations Promoting Exports – Export Incentives: Duty Exemption – IT Concession –Marketing Assistance – EPCG, DEPB– Advance License – Other efforts I Export Promotion– EPZ –EQU– SEZ and Export House. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Apte P.G., International Financial Management, Tata McGraw Hill,2011
2. JeffMadura, International Corporate Finance, Cengage Learning,9thEdition,2011

REFERENCE BOOKS

1. Website of Indian Government on EXIM policy.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concepts of international trade and role of WTO

CO2 To apply analyze and evaluate the methods and instruments of payment, pricing, incoterms, export import strategies.

CO3 To analyse the nature and functioning of foreign exchange markets,.

CO4 To evaluate international trade documentation

CO5 To apply the export promotion schemes

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	-	3	3	3	2
CO2	3	3	2	2	2	2	-	3	3	3	2
CO3	3	3	2	2	2	2	-	3	3	3	2
CO4	3	3	2	2	2	2	-	3	3	3	2
CO5	3	3	2	2	2	2	-	3	3	3	2

MB1014 BEHAVIORAL FINANCE **L T P C**

3 0 0 3

OBJECTIVES

- To identify and understand systematic behavioural factors that influences the investment behaviour.

UNIT I INTRODUCTION: WHY BEHAVIORAL FINANCE **9**

The role of security prices in the economy – EMH – Failing EMH – EMH in supply and demand framework – Equilibrium expected return models –Investment decision under uncertainty – Introduction to neo classical economics and expected utility theory – Return predictability in stock **CO1** market - Limitations to arbitrage.

UNIT II DECISION AND BEHAVIORAL THEORIES **9**

Nash Equilibrium: Keynesian Beauty Context and The Prisoner's Dilemma- The Monthly Hall Paradox- The St. Petersburg Paradox- The Allais Paradox- The Ellsberg Paradox – Prospects theory – CAPM - behavioral portfolio theory – SP/A theory – brief history on rational thought – Pascal– Fermat to Friedman - savage. **CO2**

UNIT III DECISION MAKING BIASES **9**

Information is screening bias - Heuristics and behavioral biases of investors – Bayesian decision making – cognitive biases – forecasting biases – emotion and neuroscience – group behavior – investing styles and behavioral finance. **CO3**

UNIT IV ARBITRAGEURS. **9**

Definition of arbitrageur - Long-short trades - Risk vs. Horizon - Transaction costs and short-selling costs-Fundamental risk -Noise-trader risk-Professional arbitrage –Destabilizing informed trading. **CO4**

UNIT V MANAGERIAL DECISIONS **9**

Supply of securities and firm investment characteristics (market timing, catering) by rational firms – Associate destitutions - Relative horizons and incentives - Biased managers. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Shleifer,Andrei(2000).InefficientMarkets:AnIntroductiontoBehavioralFinance.Oxford,UK: Oxford University Press

REFERENCE BOOKS

1. Daniel Kahneman, Paul Slovic, and Amos Tversky (eds.). (1982) Judgment under Uncertainty: Heuristics and biases, Oxford; New York: Oxford University Press.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understanding the need of behavioral finance
CO2 To knowing about various decision and behavioral theories.
CO3 To learn about heuristic and behavioral biases of investors.
CO4 To analyze arbitragers and managerial decision.
CO5 To make and evaluate managerial decisions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	3	3	3	2
CO2	3	3	2	2	2	1	1	3	3	3	2
CO3	3	3	2	2	2	1	1	3	3	3	2
CO4	3	3	2	2	2	1	1	3	3	3	2
CO5	3	3	2	2	2	1	1	3	3	3	2

HUMAN RESOURCE MANAGEMENT ELECTIVES

MB1015 STRATEGIC HUMAN RESOURCE MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

To help students understand the transformation in the role of HR functions from being a support function to strategic function.

UNIT I CONTEXT OF SHRM **9**

SHRM - SHRM models - strategic HRM vs Traditional HRM - Barriers to Strategic HR - Adopting an Investment Perspective –Understanding and Measuring Human capital-Human side (corporate strategies - strategic work redesign - Strategic Capability – Bench Marking. **CO1**

UNIT II HUMAN RESOURCE DEVELOPMENT **9**

Meaning–Strategic framework for HRM and HRD–Vision, Mission and Values– Importance – Challenges to Organisations – HRD Functions - Roles of HRD Professionals -HRD Needs Assessment - HRD practices – Measures of HRD performance – Links to HR, Strategy and Business Goals – HRD Program Implementation and Evaluation – Recent trends–HRD Audit. **CO2**

UNIT III E-HRM **9**

e-Employee profile – e- selection and recruitment - Virtual learning and Orientation – e –training and development – e-learning strategies - e- Performance management- and Compensation design - Use of mobile applications in HR functions – Development and Implementation of HRIS – Designing HR portals – Issues in employee privacy – Employee surveys online. **CO3**

UNIT IV CAREER & COMPETENCY DEVELOPMENT **9**

Career Concepts – Roles – Career stages – Career planning and Process –Career development Models – Career Motivation and Enrichment – Managing Career plateaus-Designing Effective Career Development Systems – Competencies and Career Management Competency Mapping Models–Equity and Competency based Compensation. **CO4**

UNIT V EMPLOYEE COACHING & COUNSELING **9**

Need for Coaching – Role of HR in coaching – Coaching and Performance – Skills for Effective Coaching–Coaching Effectiveness–Need for Counseling –Role of HR in Counseling - Components of Counseling Programs – Counseling Effectiveness – Employee Health and Welfare Programs. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Strategic Human Resource Management 1St Edition 2015 by Mathur, SP , New Age international (P) Ltd.
2. Randy L. Desimone, Jon M. Werner – David M. Mathis, Human Resource Development, Cengage Learning, 7th edition, 2016.

REFERENCE BOOKS

1. Jeffrey A Mello, Strategic Human Resource Management, Cengage Learning, 3rd edition, 2011.
2. PaulBoselie.StrategicHumanResourceManagement.TataMcGrawHill.2011
3. RobertL. Mathis and John H. Jackson, Human Resource Management, Cengage Learning, 2007.
4. Pulak Das. Strategic Human Resource Management- A Resource Driven Perspective- Cengage Learning 4thIndian Reprint-2013.
5. Terresa Torres Coronas & Mario Arias Olivia. e-Human Resource Management- Managing Knowledge People- Idea GroupPublishing,2005.
6. Randall S Schuler and Susan E Jackson. Strategic Human Resource Management. Wiley Publications-2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To analyse the barriers to Strategic HR, and; to create Strategic Capability

CO2 To measures HRD performance and to create HRD programs

CO3 To design, develop and implement HRIS; to create e-Employee profile– e- selection and recruitment - Virtual learning and Orientation – e –training and development–e-learning strategies -e-Performance management- and Compensation design

CO4 To design, develop and evaluate Career Development Systems, Competencies and Career Management

CO5 To design, develop and evaluate coaching, counseling and Employee Health and Welfare Programs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	3	3	3	-
CO2	3	3	3	2	-	-	-	3	3	3	-
CO3	3	3	3	2	-	-	-	3	3	3	-
CO4	3	3	3	2	-	-	2	3	3	3	2
CO5	3	3	3	2	-	-	2	3	3	3	2

MB1016 INDUSTRIAL RELATIONS AND LABOUR WELFARE

L	T	P	C
3	0	0	3

OBJECTIVES

To explore Contemporary knowledge and gain a conceptual understanding of industrial relations.

UNIT I INDUSTRIAL RELATIONS **7**

Concepts – Importance – Industrial Relations problems in the Public Sector– Growth of Trade Unions– Codes of conduct. **CO1**

UNIT II INDUSTRIAL CONFLICTS **12**

Disputes– Impact – Causes– Strikes– Prevention – Industrial Peace – Government Machinery– Conciliation – Arbitration – Adjudication. **CO2**

UNIT III LABOUR WELFARE **8**

Concept– Objectives– Scope– Need– Voluntary Welfare Measures– Statutory Welfare Measures– Labour– Welfare Funds– Education and Training Schemes. **CO3**

UNIT IV INDUSTRIAL SAFETY **9**

Causes of Accidents– Prevention–Safety Provisions– Industrial Health and Hygiene–Importance– Problems–Occupational Hazards– Diseases–Psychological problems– Counseling– Statutory Provisions. **CO4**

UNIT V WELFARE OF SPECIAL CATEGORIESOF LABOUR **9**

Child Labour–Female Labour – Contract Labour– Construction labour–Agricultural Labour - Differently abled Labour –BPO & KPO Labour – Social Assistance –Social Security Implications. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Labour and Industrial Law, H K Saharay ISBN **:** 9788131252673, edition **:** 7th**:** 2017
2. MamoriaC.B.,Sathish Mamoria, Gankar, Dynamics of Industrial Relations, Himalaya Publishing House, New Delhi, 2012.

REFERENCE BOOKS

1. Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. Industrial relations & Labour Laws. Tata McGraw Hill. 2012.
2. Ratna Sen, Industrial Relations in India, Shifting Paradigms, Macmillan India Ltd., NewDelhi, 2007.
3. C.S.Venkata Ratnam, Globalisation and Labour Management Relations, Response Books, 2007.
4. Srivastava, Industrial Relations and Labour laws, Vikas, 2007.
5. P.N.Singh, Neeraj Kumar. Employee relations Management. Pearson.2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concept of Industry relations , Analysis of industrial relation problem , evaluate Government rules and implication on code of conduct

CO2 To Remember the various disputes and evaluate the causes and impact of distputes and analyse the various methods to overcome this

CO3 To Analyse the various welfare measures, and evaluate the training schemes

CO4 To understand and analyze the causes of accidents and safety provisions

CO5 To Analyse the different types of labours and understand the ways to handle them

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	1	3	3	3	1
CO2	3	3	3	1	-	-	1	3	3	3	1
CO3	3	3	3	1	-	-	1	3	3	3	1
CO4	3	3	3	1	-	-	1	3	3	3	1
CO5	3	3	3	1	-	-	1	3	3	3	1

MB1017 SOCIAL PSYCHOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

To study how people view themselves and others, how people interact, influence and act when they are a part of a group.

UNIT I INTRODUCTION TO SOCIAL PSYCHOLOGY **6**

Social Psychology– Origin and development– Social behavior and social thought–Applications in society and business. **CO1**

UNIT II PERCEIVING AND UNDERSTANDING OTHERS **9**

Social perception – Nonverbal communication – Attribution – Impression formation and impression management **CO2**

UNIT III COGNITIONIN THE SOCIAL WORLD **10**

Self, Self Esteem & Social Comparison, self-efficacy, narcissism, Social cognition– Schemas–Heuristics – Errors – Attitudes & Behaviour –Persuasion –Cognitive dissonance **CO3**

UNIT IV INTERPERSONAL RELATIONS **10**

Social identity – Prejudice – Discrimination – Aggression – Interpersonal attraction and Relationships **CO4**

UNIT V APPLIED SOCIAL PSYCHOLOGY **10**

Social Influence – Conformity – Compliance – Social Influence - Prosocial behaviour – Groups–Social issues, Stress, personal beliefs and health. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Social Psychology Robert A Baron, Nyla R Branscombe 13th Edition – PEARSON: 2017
2. Rohallet al. Social Psychology. PHI Learning. 2nd edition
3. Attitudes, Personality and Behaviour. Ajzer. Tata Mc Graw Hill

REFERENCE BOOKS

1. Baron, Byrne and Brascombe, Social Psychology, 13th Edition, Pearson, 2014.
2. David G. Myers, Social Psychology, Tata Mc Graw Hill, 11th Edition,.
3. Baron and Byrne, Social Psychology, 8th Edition, PHI, 2006.
4. Howitt. Social Psychology. Tata Mc Graw Hill

COURSE OUTCOMES

Upon completion of the course, students will be able to learn about

CO1 To remember and understand social behavior and social thought.
CO2 To understand social perception and impression formation and impression management
CO3 To apply schemas–to reduce errors in cognitive dissonance
CO4 To analyse social identity , prejudice and discrimination in interpersonal attraction and relationships
CO5 To evaluate social issues - stress, personal beliefs and health

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	3	3	3	1
CO2	3	3	3	1	1	1	1	3	3	3	1
CO3	3	3	3	1	1	1	1	3	3	3	1
CO4	3	3	3	1	1	1	1	3	3	3	1
CO5	3	3	3	1	1	1	1	3	3	3	1

MB1018 ORGANIZATIONAL DESIGN, CHANGE AND DEVELOPMENT **L T P C**

3 0 0 3

OBJECTIVES

1. To help the students to gain knowledge about the concepts of change management and to acquire the skills required to manage any change effectively
2. To understand the concept and techniques of OD and to enable the skills for the application of OD in organizations

UNIT I ORGANIZATIONAL DESIGN		**9**
Organizational Design– Determinants– Components–Basic Challenges of design– Differentiation, Integration, Centralization, Decentralization, Standardization, Mutual adjustment -Mechanistic and Organic Structures- Technological and Environmental Impacts on Design-Importance of Design – Success and Failures in design.		**CO1**
UNIT II ORGANIZATIONAL CHANGE		**9**
Meaning, Nature, Forces for change- change agents- Change process-Types and forms of change –Models of change –Resistance to change –individual factors–organizational factors–techniques to overcome change-Change programs–job redesign.		**CO2**
UNIT III ORGANIZATIONAL DEVELOPMENT		**9**
Introduction- evolution- basic values and assumptions- foundations of OD- Process of OD- managing the phases of OD – Organizational diagnosis -Process- stages- Techniques- Questionnaire, interview, workshop, task-force - collecting, analyzing – feedback of diagnostic information.		**CO3**
UNIT IV OD INTERVENTION		**9**
Human process interventions-Individual, group and inter-group human relations- structure and technological interventions- strategy interventions–sensitivity training–survey feedback, process consultation–team building – inter-group development		**CO4**
UNIT V ORGANIZATIONAL EVOLUTION AND SUSTENANCE		**9**
Organizational life cycle – Models of transformation – Models of Organizational Decision making – Organizational Learning – Innovation, Intrapreneurship and Creativity-HR implications.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Wendell L. French, Cecil H. Bell, Jr, Veena Vohra - Organization Development : Behavioral Science Interventions for Organizational Improvement, Sixth Edition2017
2. S. Ramnarayan, T. Venkateswara Rao, Kuldeep Singh: Organization Development: Interventions And Strategies, Sage Publications 2015

REFERENCE BOOKS

1. French & Bell: Organisational Development, McGraw-Hill, 2005
2. Rajiv Shaw: Surviving Tomorrow: Turnaround Strategies in Organisational Design and Development, Vikas Publishing House.
3. Thomas G. Cummings, Christopher G. Worley: Organisation Development and Change, Thomson Learning.
4. Change & Knowledge Management-R.L. Nandeshwar, Bala Krishna Jayasimha, Excel Books, 1st Ed.
5. Management of Organizational Change – K Harigopal – Response BOOKS, 2^{nd} editon,2006
6. Organizational, Design, and Change-Gareth R. Jones, 5th Edition, PearsonEducation

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the fundamental components of organizational structure and design
CO2	To analyze the various dimensions of organizational change and techniques to overcome it

CO3 To remember the concepts of organizational development and apply it techniques
CO4 To apply the OD intervention techniques
CO5 To understand the evolution and reason the sustenance of the organization

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	-	3	3	3	1
CO2	3	3	3	1	-	-	-	3	3	3	1
CO3	3	3	3	1	-	-	3	3	3	3	1
CO4	3	3	3	1	-	-	2	3	3	3	1
CO5	3	3	3	1	-	-	-	3	3	3	1

MB1019	**MANAGERIAL BEHAVIOR AND EFFECTIVENESS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To examine managerial styles in terms of concern for production and concern for people.
- To assess different systems of management and relate these systems to organizational characteristics.

UNIT I DEFINING THE MANAGERIAL JOB **9**

Descriptive Dimensions of Managerial Jobs – Methods – Model – Time Dimensions in Managerial Jobs – Effective and Ineffective Job behavior – Functional and level differences in Managerial Job behavior. **CO1**

UNIT II DESIGNING THE MANAGERIAL JOB **9**

Identifying Managerial Talent – Selection and Recruitment – Managerial Skills Development – Pay and Rewards – Managerial Motivation – Effective Management Criteria – Performance Appraisal Measures – Balanced Scorecard - Feedback – Career Management – Current Practices. **CO2**

UNIT III THE CONCEPT OF MANAGERIAL EFFECTIVENESS **9**

Definition – The person, process, product approaches – Bridging the Gap – Measuring Managerial Effectiveness – Current Industrial and Government practices in the Management of Managerial Effectiveness- the Effective Manager as an Optimizer. **CO3**

UNIT IV ENVIRONMENTAL ISSUES IN MANAGERIAL EFFECTIVENESS **9**

Organizational Processes – Organizational Climate – Leader – Group Influences – Job Challenge – Competition – Managerial Styles. **CO4**

UNIT V DEVELOPING THE WINNING EDGE **9**

Organizational and Managerial Efforts – Self Development – Negotiation Skills – Development of the Competitive Spirit – Knowledge Management – Fostering Creativity and innovation . **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Managerial behavior and effectiveness ,Alejandro Serralde 2020 Kindle edition

REFERENCE BOOKS

1. Milkovich and Newman, Compensation, McGraw-Hill International, 2005.
2. Blanchard and Thacker, Effective Training Systems, Strategies and Practices

Pearson 2006.
3. Dubrin, Leadership, Research Findings, Practices & Skills, Biztantra, 2008.
4. Joe Tidd , John Bessant, Keith Pavitt , Managing Innovation ,Wiley 3rdedition,2006.
5. T.V.Rao, Appraising and Developing Managerial Performance, ExcelBooks,2002.
6. R.M.Omkar, Personality Development and Career Management, S.Chand,1^{sr} edition, 2008.
7. Richard L.Daft, Leadership, Cengage, 1st Indian Reprint2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand appropriate style of managerial behavior
CO2 To design and evaluate the managerial job.
CO3 To understand the managerial effectiveness
CO4 The analyse and solve environmental issues in managerial effectiveness
CO5 The design and develop a winning edge in creativity and innovation.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	3	3	3	1
CO2	3	3	3	1	1	1	1	3	3	3	1
CO3	3	3	3	1	1	1	1	3	3	3	1
CO4	3	3	3	1	1	1	1	3	3	3	1
CO5	3	3	3	1	1	1	1	3	3	3	1

MB1020 PERSONAL EFFECTIVENESS **L T P C**
3 0 0 3

OBJECTIVES

1. To enhance one's own self-awareness and understand others.
2. To explore one's own feelings and behavior.

UNIT I SELF AWARENESS AND MANAGEMENT **9**

Personal Effectiveness- Definition -Emotional Intelligence - Understanding oneself Importance self-knowledge - Stress and EI- Competence and Personal Competency - Personal Competency Models- Learning- Importance of Ongoing Learning- Learning and Unlearning- Personal Change- Impression Formation and Impression Management. **CO1**

UNIT II BUILDING TEAMS **9**

Team Building methods and strategies - Leadership and Team Building - Nature of Power Creating Effective work teams- Impact of Motivation and Delegation on Team Building - Participative Decision Making **CO2**

UNIT III COMMUNICATION **9**

Interpersonal Communication - Strategies and Issues - Culture, Diversity and Communication - Communicating Within Teams, Organizations -Communicating Outside Organizations - Assertiveness - Persuasion - Strategies. **CO3**

UNIT IV INFLUENCING OTHERS **9**

Influence- Objectives - Methods of Influence - Individual responses to Influence – Exerting Influence- Common Influencing Problems and Solutions- Aggression - Coping with **CO4**

Aggression- Negotiations- Convincing People - Developing and Using Contacts.

UNIT V TRANSCATIONAL ANALYSIS AND NLP **9**

Concept of Self- Feeling Self- Thinking Self- Believing Self- Transactions- Transactional Analysis - Structural Analysis -TA and Self Awareness- Concept of strokes- Making Sense of Life- Therapeutic Enquiry- Assessing suitability and Implementation of TA as therapy- NLP Basics - Managing Self with the power of NLP: Life Planning, Personal Vision and Mission. **CO5**

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TOTAL : 45 PERIODS

TEXT BOOKS

1. Brilliant Personal Effectiveness. Douglas Miller, 2015, Pearson Education.
2. The Seven Habits of highly effective people- Steven Covey, 2013, 25th Anniversary Edition, The Bath Press.

REFERENCE BOOKS

1. Personal Effectiveness. 3rd Edition- CMI- Alexander Murdock and Carol N. Scutt, Routledge Publishing, 2011
2. An Introduction to Transactional Analysis: Helping People to Change, Phil Lapworth and Charlotte Sills, 2011, Sage Publications.
3. NLP: The Essential Guide to Neuro-Linguistic Programming, Tom Hoobyar, Tom Dotz, Susan Sanders, Harper Collins Publishers. 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To remember and understand personal competency and importance of ongoing learning

CO2 To understand the impact of motivation and delegation on team building

CO3 To apply the interpersonal Communication Strategies and analyse the issues

CO4 To analyse the Individual responses to Influence others

CO5 To evaluate the suitability and Implementation of Transaction Analysis

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	3	3	3	1
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CO3	3	3	3	1	1	1	1	3	3	3	1
CO4	3	3	3	1	1	1	1	3	3	3	1
CO5	3	3	3	1	1	1	1	3	3	3	1

MB1021 **LABOUR LEGISLATION** **L T P C**
3 0 0 3

OBJECTIVES

1. To have a broad understanding of the legal principles governing the employment relationship at individual and collective level.
2. To familarise the students to the practical problems inherent in the implementation of labour statutes.

UNIT I FACTORY AND TRADE UNION **9**

1.TheFactories Act,1948
2.The Trade Unions Act 1926 **CO1**

UNIT II WAGES AND DIPUTE **9**

3.ThePayment of Wages Act, 1936
4.TheMinimumWagesAct, 1948 **CO2**
5.TheIndustrialDisputesAct,1947

UNIT III COMPENSATION **9**

6.TheWorkmen'sCompensationAct,1923
7.ThePaymentofGratuityAct, 1972 **CO3**
8.ThePaymentofBonusAct, 1965

UNIT IV EMPLOYEE WELFARE **9**

9.TheEmployee'sProvidentFund&Misc. Act,1952
10.TheEmployeesState InsuranceAct,1948 **CO4**
11.TheIndustrialEmployment(Standing Orders)Act,1946

UNIT V SPECIAL ACT **9**

12.TheApprenticesAct,1961
13.TheEqualRemuneration Act,1976
14.TheMaternityBenefitAct,1961 **CO5**
15.ContractLabourRegulations andAbolitionAct,1970
16.TheChildLabourPreventionandRegulationAct,1986

TOTAL : 45 PERIODS

TEXT BOOKS

1. Labour and Industrial Law: H K Saharay Edition **:** 7th, 2017, LEXISNEXIS
2. Kapoor N. D, Elements of Mercantile Law, Sultan Chand, 2015

REFERENCE BOOKS

1. Tax Mann, Labour Laws, 2017.
2. D. R. N. Sinha, Indu Balasinha & Semma Priyadarshini Shekar, Industrial Relation, Trade unions and Labour Legislation, 2014.
3. Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. Industrial relation labour Laws. Tata Mc Graw Hill. 2012
4. Srivastava, Industrial Relations and Labour laws, Vikas, 2015.
5. Respective Bare Acts.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and apply Factories Act and Trade union Act
CO2 To understand and apply Wages Act and Industrial Dispute Act
CO3 To understand and apply workmen compensation, Graduity and Bonus Act
CO4 To understand and apply employee welfare related Act

CO5 To understand and apply Apprentice, equal remuneration and women and Child labour related Act

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	-	-	1	3	3	3	1
CO2	3	3	3	1	-	-	1	3	3	3	1
CO3	3	3	3	1	-	-	1	3	3	3	1
CO4	3	3	3	1	-	-	1	3	3	3	1
CO5	3	3	3	1	-	-	1	3	3	3	1

MB1042 HUMAN RESOURCE ANALYTICS **L T P C**
3 0 0 3

OBJECTIVES

- To develop the ability of the learners to define and implement HR metrics that Sare aligned with the overall business strategy
- To know the different types of HR metrics and understand their respective impact and application
- To understand the impact and use of HR metrics and their connection with HR analytics
- To understand common workforce issues and resolving them using people analytics.

UNIT I INTRODUCTION TO HR ANALYTICS **9**

HR analytics - People Analytics: Definition- context -stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics –HR metrics and KPIs. **CO1**

UNIT II HR ANALYTICS I: RECRUITMENT **9**

Recruitment Metrics : Fill-up ratio - Time to hire - Cost per hire - Early turnover -Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire- Recruitment to HR cost-Recruitment analysis. **CO2**

UNIT III HR ANALYTICS II: TRAINING AND DEVELOPMENT **9**

Training & Development Metrics: Percentage of employee trained- Internally and externally trained -Training hours and cost per employee - ROI - Optimising the ROI of HR Programs - Training and Development analysis. **CO3**

UNIT IV HRANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION **9**

Employee Engagement Metrics: Talent Retention- Retention index- Voluntary and involuntary turnover-Turnover by department, grades, performance, and service tenure- Internal hired index-Engagement Survey Analysis. Career Progression Metrics: Promotion index- Rotation index-Career path index- Level wise succession readiness index. **CO4**

UNIT V HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT **9**

Workforce Diversity and Development Metrics : Employees per manager - Workforce age profiling -Workforce service profiling – Churn over index - Work force diversity index -Gender **CO5** mix - Differently abled index- Revenue per employee - Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance -Compensation to HR cost.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dipak Kumar Bhattacharyya, HR Analytics, Understanding Theories and Applications, SAGE Publications India, 2017.
2. Sesil, J. C., Applying advanced analytics to HR management decisions: Methods for selection, developing incentives, and improving collaboration. Upper Saddle River, New Jersey: Pearson Education, 2014.
3. Pease, G., & Beresford, B, Developing Human Capital: Using Analytics to Plan and Optimize Your Learning and Development Investments. Wiley, 2014.

REFERENCE BOOKS

1. JacFitzenz, The new HR Analytics, AMACOM, 2010.
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric. London: Kogan Page.2016.
3. Human Resources kit for Dummies–3rd edition–Max Messmer,2012
4. Phillips, J.,& Phillips, P.P, Making Human Capital Analytics Work: Measuring the ROI of Human Capital Processes and Outcomes.McGraw-Hill,2014.
5. HR Score card and Metrices, HBR, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To remember the basic concepts of HR Analytics

CO2 To understand , apply and analyse how the HR Analytics apply in Recruitment

CO3 To apply, and analyse how the HR Analytics apply in Training and Development

CO4 To apply and analyse how the HR analytics help in Employee engagement and Career progression

CO5 To evaluate the HR Analytics in Work force diversity and Development

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1	1	3	3	3	1
CO2	3	3	3	1	1	1	1	3	3	3	1
CO3	3	3	3	1	1	1	1	3	3	3	1
CO4	3	3	3	1	1	1	1	3	3	3	1
CO5	3	3	3	1	1	1	1	3	3	3	1

BUSINESS ANALYTICS ELECTIVES

MB1022 DATA MINING FOR BUSINESS INTELLIGENCE

L	T	P	C
3	0	0	3

OBJECTIVES

- To know how to derive meaning form huge volume of data and information
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION **9**

Data mining, Text mining, Web mining, Spatial mining, Process mining, Data warehouse and data marts. **CO1**

UNIT II DATA MINING PROCESS **9**

Data mining process–KDD,CRISP- DM, SEMMA and Domain-Specific, Classification and Prediction performance measures- RSME, MAD, MAP, MAPE, Confusion matrix, Receiver Operating Characteristic curve & AUC; Validation Techniques - hold-out, k-fold cross-validation, LOOCV, random sub sampling, and bootstrapping. **CO2**

UNIT III PREDICTION TECHNIQUES **9**

Data visualization, Time series– ARIMA, Winter Holts, Vector Autoregressive analysis, Multivariate regression analysis. **CO3**

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES **9**

Classification - Decision trees, k nearest neighbor, Logistic regression, Discriminant analysis; Clustering; Market basket analysis; **CO4**

UNIT V MACHINE LEARNING AND AI **9**

Genetic algorithms, Neural network, Fuzzy logic, Support Vector Machine, Optimization techniques– Ant Colony, Particle Swarm, DEA **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E.Aronson and David King, Business Intelligence, Prentice Hall, 2008.
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley Indiapvt.Ltd.2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 3rd edition, 2013.
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 2nd Edition,2011

REFERENCE BOOKS

1. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
2. G.K.Gupta, Introduction to Data mining with Case Studies, Prentice hall of India,2011
3. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley.2009
4. Elizabeth Vitt, Michael Luckevich Stacia Misner ,Business Intelligence,Microsoft,2011
5. 1MichalewiczZ.,SchmidtM.MichalewiczMandChiriacC, Adaptive Business Intelligence, Springer –Verlag, 2007
6. Galit Shmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To remember and understand the various data mining techniques used in different domains.

CO2 To understand how data mining process is used in business decision making.

CO3 To apply and analyze the various prediction techniques
CO4 To evaluate the kinds of patterns that can be discovered by association rule mining, classification and clustering.
CO5 To create and evaluate a basic trainable neural network (or) a fuzzy logic system to design and manufacturing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	-	3	3	3	-
CO2	3	2	3	2	-	-	-	3	3	3	-
CO3	3	2	3	2	-	-	-	3	3	3	-
CO4	3	2	3	2	-	-	-	3	3	3	-
CO5	3	2	3	2	-	-	-	3	3	3	-

MB1023	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the computational approaches to big data analytics
- To understand the various search methods and visualization techniques
- To learn to use various techniques for mining data stream
- To understand the applications using Map Reduce Concepts.

UNIT I INTRODUCTION TO BIG DATA **9**

Introduction to Big Data Platform– Challenges of Conventional Systems- Intelligent data analysis –Nature of Data- Analytic Processes and Tools - Analysis vs Reporting.. **CO1**

UNIT II MINING DATA STREAMS **9**

Introduction To Streams Concepts– Stream Data Model and Architecture- Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions. **CO2**

UNIT III HADOOP **9**

History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats-Map Reduce Features Hadoop environment. **CO3**

UNIT IV FRAMEWORKS **9**

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services –Hive QL – Querying Data in Hive - fundamentals of HBase and Zoo Keeper - IBM Info Sphere Big Insights and Streams. **CO4**

UNIT V VISUALIZATION TECHNIQUES **9**

Predictive Analytics- Simple linear regression- Multiple linear regression -Interpretations of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Frank J Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2013.
2. Colleen Mccue, "Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis", Elsevier, Second Edition, 2015.
3. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, Second Edition, 2007.
4. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.

REFERENCE BOOKS

1. BillFranks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", Wiley and SASBusinessSeries,2012.
2. Paul Zikopoulos,Chris Eaton "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw Hill, 2012.
3. Paul Zikopoulos, Dirk de Roos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, "Harness the Power of Big data - The big data platform", McGraw Hill, McGraw-Hills born e Media, 2012.
4. Glenn J. Myatt, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining", John Wiley & Sons, Second Edition, 2014.
5. Pete Warden, "Big Data Glossary", O"Reilly,2011.
6. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Elsevier, Third Edition, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To Understand the computational software's and techniques for handling big data and to analyze the various report formats.

CO2 To Remember the concepts, data model and architecture of streams and apply with various stream computing techniques

CO3 To Understand core technical concepts related to Business Intelligence, Big Data Analytics along with Hadoop Architecture and Analyze to data for analytics

CO4 To Understand and create the various application in Big Data

CO5 To Understand the visualization Techniques and analysis with various charts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

MB1024 **CLOUD COMPUTING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To know how to derive meaning form huge volume of data and information
- To understand how knowledge discovering process is used in business decision making.

UNIT I INTRODUCTION		**9**
History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.		**CO1**
UNIT II INTRODUCTION TO CLOUD COMPUTING		**9**
Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .		**CO2**
UNIT III CLOUD COMPUTING APPLICATIONS		**9**
Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Overview on Amazon AWS and Microsoft Azure – Overview on Google App Engine – Emerging Cloud software Environment.		**CO3**
UNIT IV CLOUD SECURITY		**9**
Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.		**CO4**
UNIT V GOVERNANCE AND THE FUTURE OF CLOUD		**9**
Organizational Readiness and Change Management in the Cloud Age, Legal Issues in Cloud Computing, Achieving Production Readiness for Cloud Services, How Cloud Will Change Operating Systems, Future of Cloud TV & Cloud-Based Smart Devices, Cloud and Mobile, Home-Based Cloud Computing.		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, Distributed and cloud computing from Parallel Processing to the Internet of Things, Morgan Kaufmann, Elsevier, 2012
2. RajkumarBuyya, James Broberg and Andrzej Goscinski, Cloud Computing – Principles and Paradigms, John Wiley & Sons, 2011
3. Kris Jamsa, Cloud Computing, Jones & Bartlett Learning, 2013
4. Kumar Saurahb, Cloud Computing – Insights into new era infrastructure, Wiley India, 2nd Edition, 2012
5. Barrie Sosinsky, " Cloud Computing Bible" John Wiley & Sons, 2011
6. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts of cloud computing.
CO2 To analyse the cloud issues and challenges.
CO3 To apply the appropriate cloud computing solutions.
CO4 To understand the core issues of cloud computing such as security, privacy.
CO5 To develop the cloud services and to apply the idea about the future of cloud computing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

MB1025	DEEP LEARNING AND ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To expose various algorithms related to Deep Learning and Artificial Intelligence.
- To prepare students to apply suitable algorithm for the specified applications.

UNIT I DEEP NETWORKS **9**

Deep Networks: Modern Practices: Deep Forward Networks: Example: Learning XOR - Gradient-Based Learning - Hidden Units - Architecture Design - Regularization for Deep Learning. **CO1**

UNIT II MODELS **9**

Optimization for Training Deep Models: How Learning Differs from Pure Optimization - Challenges in Neural Network Optimization - Basic Algorithms - Parameter Initialization Strategies - Algorithms with Adaptive Learning Rates - Approximate Second-Order Methods - Optimization Strategies and Meta Algorithms. **CO2**

UNIT III INTELLIGENT SYSTEMS **9**

Introduction to Artificial Intelligence: Intelligent Systems - Foundations of AI - Applications - Tic-Tac-Toe Game Playing - Problem Solving: State-Space Search and Control Strategies: Introduction - General Problem Solving - Exhaustive Searches - Heuristic Search Techniques. **CO3**

UNIT IV KNOWLEDGE REPRESENTATION **9**

Advanced Problem-Solving Paradigm: Planning: Introduction - Types of Planning Systems - Knowledge Representation: Introduction - Approaches to Knowledge Representation - Knowledge Representation using Semantic Network - Knowledge Representation using Frames. **CO4**

UNIT V APPLICATIONS **9**

Expert Systems and Applications: Blackboard Systems - Truth Maintenance Systems - Applications of Expert Systems - Machine-Learning Paradigms: Machine-Learning Systems - Supervised and Unsupervised Learnings. **CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Jared P.L., R for Everyone - Advanced Analytics and Graphics, Addison Wesley Data and Analytics series, 2015.
2. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the modern practices on deep forward networks, Architecture designs and analyse

	the regularization for deep learning.
CO2	To create the models to optimize and analyse the challenges in neural network optimization, approximate Second order models and Meta algorithms.
CO3	To understand the foundations of the AI applications, Tic-tac-toe Game playing, Problem solving: state-space search, Exhaustive searches and to apply the heuristic search techniques.
CO4	To understand the advanced problem solving paradigm, types of planning systems, knowledge representation using semantic network and frames.
CO5	To apply the expert systems and applications like Blackboard systems, machine learning Paradigms and to Understand the supervised and unsupervised learnings.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAMME OUTCOMES (POs)**								**PROGRAMME SPECIFIC OUTCOMES (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

MB1026 R PROGRAMMING L T P C

OBJECTIVES

- To study the fundamentals of R programming to apply in quantitative analysis.

UNIT I GETTING STARTED WITH R **9**

Installing R - The R environment - R packages - Basics of R - Data Structures - Reading data into R- Graphics in R **CO1**

UNIT II FUNCTIONS AND STATEMENTS **9**

Writing R functions - Control Statements (if and else, switch, if else, compound tests) -Loops in R (for, while, controlling loops) -Applications using the functions and loops **CO2**

UNIT III DATA MANIPULATION AND ANALYSIS **9**

Group manipulation - Data Reshaping - Manipulating Strings - Basic Statistics using R (Summaries, Correlation, t-tests, ANOVA) **CO3**

UNIT IV LINEAR MODELS USING R **9**

Linear Models - Simple and Multiple regression, GLM - Logit Regression, Model diagnostics- Residuals, Cross validation, Bootstrapping. **CO4**

UNIT V NON-LINEAR MODELS, TIME SERIES AND CLUSTERING USING R **9**

Nonlinear Models - Non-Linear least square, Splines, Generalised Additive Models, Decision trees, Random forests. Time Series - Autoregressive moving average, VAR, GARCH. Clustering –K means, PAM and Hierarchical Clustering **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jared P.L., R for Everyone - Advanced Analytics and Graphics, Addison Wesley Data and Analytics series, 2015.

REFERENCE BOOKS

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education,2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To install and understand the basics in R, data structures and graphics in R.

CO2 To apply the R functions, statements and loops in analyses.

CO3 To evaluate the basic statistical analytics like summary correlation, t-tests and ANOVA.

CO4 To create the linear models using R in solving the business programs.

CO5 To enhance the knowledge on Non-linear models in applying them to solve the organizational problems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

MB1027 MULTIVARIATE DATA ANALYSIS L T P C

OBJECTIVES

- To know various multivariate data analysis techniques for business research.

UNIT I INTRODUCTION **9**

Introduction – Basic concepts – Uni-variate, Bi-variate and Multi-variate techniques– Types of multivariate techniques– Classification of multivariate techniques– Guidelines for multivariate analysis and interpretation –Approaches to multivariate model building **CO1**

UNIT II PREPARING FOR MULTIVARIATE ANALYSIS **9**

Introduction– Conceptualization of research problem– Identification of technique- Examination of variables and data – Measurement of variables and collection of data –Measurement of errors – Statistical significance of errors. Missing data – Approaches for dealing with missing data– Testing the assumptions of multivariate analysis–Incorporating non-metric data with dummy variables. **CO2**

UNIT III MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS **9**

Multiple Linear Regression Analysis – Introduction – Basic concepts – Multiple linear regression model – Least square estimation – Inferences from the estimated regression function– Validation of the model. Factor Analysis: Definition– OBJECTIVE– Approaches to factor analysis – methods of estimation – Factor rotation – Factor scores -Sum of variance explained– interpretation of results **CO3**

UNIT IV LATENT VARIABLE TECHNIQUES **9**

Confirmatory Factor Analysis, Structural Equation modeling, Mediation models, Moderation models, Conditional processes, longitudinal studies, latent growth model, Bayesian inference **CO4**

UNIT V ADVANCED MULTIVARIATE TECHNIQUES **9**

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data Analysis, Pearson Education, New Delhi, 2005.
2. Barbara G. Tabachnick, Linda S. Fidell, Using Multivariate Statistics, 6th Edition, Pearson, 2012.

REFERENCE BOOKS

1. Richard A Johnson and Dean W. Wichern, Applied Multivariate Statistical Analysis, Prentice Hall, New Delhi, 2005.
2. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, Singapore, 2002

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the basic concepts and creating multivariate models using different models.
CO2 To collect data for variables by creating survey instruments and evaluating the relationships between variables.
CO3 To apply different multivariate analysis tools and techniques.
CO4 To select and apply the latent variable techniques at the requiered places.
CO5 To apply the advanced analyse techniques in organizational decision making

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

MB1040	SOCIAL MEDIA AND WEB ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the practices and technology involved in web marketing in real time business environment.

UNIT I INTRODUCTION TO WEB AND SOCIAL MEDIA **9**

Introduction - Web and social media - Website, Web apps - Social Media, Usability - User friendliness - Customer Experience - Web marketing, Competitive analysis - Web analytics framework - Analytics and outcomes, Competitive analysis. **CO1**

UNIT II BUSINESS ENVIRONMENT **9**

Data - Types of Data, primary data, secondary, Big Data - Data Analysis - tools used for analysis - descriptive statistics, comparing means, correlations, nonparametric tests **CO2**

UNIT III MEASURING USER EXPERIENCE **9**

Usability metrics - performance metrics, issues-based metrics, self-reported metrics - Planning and performing a usability study - study goals, user goals, metrics and evaluation methods, participants, data collection, data analysis, comparing alternative designs, comparing with competition, completing a task or transaction	**CO3**
UNIT IV WEB ANALYSIS AND METRICS	**9**
PULSE metrics on business and technical issues - Page views, Uptime, Latency, Seven-day active users HEART metrics - Happiness, Engagement, Adoption, Retention, and Task success on user behaviour issues - On-site web analytics, off-site web analytics, the goal-signal-metric process.	**CO4**
UNIT V SOCIAL MEDIA ANALYTICS	**9**
Social media analytics - Reasons for the growth - Social media KPIs - reach and engagement, Performing social media analytics - Business goal, KPIs, data gathering, analysis, measure and feedback	**CO5**

TOTAL :45 PERIODS

TEXT BOOKS

1. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, John Wiley & Sons
2. Tom Tullis, Bill Albert, Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, Morgan Kaufmann

REFERENCE BOOKS

1. Jim Sterne, Social Media Metrics: How to Measure and Optimize Your Marketing Investment, John Wiley & Sons.
2. Brian Clifton, Advanced Web Metrics with Google Analytics, John Wiley & Sons; 3rd Edition edition

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the web and social media and analyse.
CO2 To apply the analytical tools.
CO3 To analyse and evaluate the performance metrics.
CO4 To apply and analyse the issues of web analytics.
CO5 To create the KPI.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	3	2	-	-	1	3	2	3	-
CO2	2	2	3	2	-	-	1	3	2	3	-
CO3	2	2	3	2	-	-	1	3	2	3	-
CO4	2	2	3	2	-	-	1	3	2	3	-
CO5	2	2	3	2	-	-	1	3	2	3	-

OPERATIONS MANAGEMENT ELECTIVES

MB1028	LOGISTICS MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the need and importance of logistics in product flow.

UNIT I Introduction **9**

Definition and Scope of Logistics – Functions & Objectives – Customer Value Chain–Service Phases and attributes – Value added logistics services – Role of logistics in Competitive strategy– Customer Service. **CO1**

UNIT II DISTRIBUTION CHANNELSAND OUTSOURCINGLOGISTICS **9**

Distribution channel structure - channel members, channel strategy, role of logistics and support in distribution channels. Logistics requirements of channel members; Logistics outsourcing– catalysts, benefits, value proposition, 3PL, 4PL, 5PL, 6PL. **CO2**

UNIT III TRANSPORTATION AND PACKAGING **9**

Transportation System – Evolution, Infrastructure and Networks. Freight Management –Vehicle Routing – Containerization; Modal Characteristics - Inter-modal Operators and Transport Economies; International Logistics-objectives, importance in global economy, Characteristics of global supply chains, Incoterms. Selection of service provider; Packaging - Design considerations, Material and Cost. Packaging as Unitisation. Consumer and Industrial Packaging. **CO3**

UNIT IV PERFORMANCE MEASUREMENT AND COSTS **9**

Performance Measurement – Need, System, Levels and Dimensions. Internal and External Performance Measurement. Logistics Audit. Total Logistics Cost – Concept, Accounting Methods: Cost – Identification, Time Frame and Formatting. **CO4**

UNIT V CURRENT TRENDS **9**

Logistics Information Systems – Need, Characteristics and Design. E-Logistics – Structure and Operation. Logistics Resource Management eLRM. Automatic Identification Technologies; Reverse Logistics – Scope, design and as a competitive tool. Global Logistics –Operational and Strategic Issues, ocean and air transportation. Strategic logistics planning; Green Logistics. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process, Tata Mc GrawHill, 2010
2. RonaldH.Ballou,BusinessLogisticsandSupplyChainManagement,PearsonEducation,5th Edition, 2007

REFERENCE BOOKS

1. Sople Vinod V, Logistics Management: The Supply Chain Imperative, Pearson Education, 3rd Edition, 2012.
2. Coyleetal, The Management of Business Logistics, Thomson Learning, 7th Edition, 2004.
3. Ailawadi C Sathish & Rakesh Singh, Logistics Management,PHI,2005.
4. Bloomberg David Jetal., Logistics, Prentice Hall India, 2005.
5. Pierre David, International Logistics, Biztantra, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the concepts of logistics

CO2 Develop the skills in managing the distribution network and logistics partners to improve the supply chain practices

CO3 Analyse the impact of transportation on logistics operations including carrier selection, route optimization freight consolidation and understanding the role of packaging in efficient logistics management

CO4 Understanding the importance of performance management and cost management in logistics including the role of performance metrics and cost analysis in improving the supply chain efficiency

CO5 Evaluate the impact of new technologies or market trends on logistics management practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	1	3	3	2	1
CO2	3	2	3	2	2	-	1	3	3	2	1
CO3	3	2	3	2	2	-	1	3	3	2	1
CO4	3	2	3	2	2	-	1	3	3	2	1
CO5	3	2	3	2	2	-	1	3	3	2	1

MB1029 MATERIALS MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To understand why materials management should be considered for profit in operations

UNIT I INTRODUCTION **9**

Operating environment-aggregate planning-role, need, strategies, costs techniques, approaches master scheduling-manufacturing planning and control system-manufacturing resource planning enterprise resource planning-making the production plan. **CO1**

UNIT II MATERIALS PLANNING **9**

Materials requirements planning-bill of materials-resource requirement planning-manufacturing resource planning-capacity management-scheduling orders-production activity control-codification. **CO2**

UNIT III INVENTORY MANAGEMENT **9**

Policy Decisions–objectives-control -Retail Discounting Model, Newsvendor Model; EOQ and EBQ models for uniform and variable demand with and without shortages -Quantity discount models. Probabilistic inventory models **CO3**

UNIT IV PURCHASING MANAGEMENT **9**

Establishing specifications-selecting suppliers-price determination-forward buying-mixed buying strategy-price forecasting- buying seasonal commodities- purchasing under uncertainty-demand management-price forecasting- purchasing under uncertainty-purchasing of capital equipment international purchasing. **CO4**

UNIT V WAREHOUSE MANAGEMENT **9**

Warehousing functions – types - Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification-Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency productivity- cost effectiveness-performance measurement **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Chary, Production and Operations Management, Tata McGraw Hill , 2012
2. J.R.Tony Arnold, Stephen N. Chapman, Lloyd M. Clive, Materials Management, Pearson, 2012.
3.

REFERENCE BOOKS

1. P. Gopalakrishnan, Purchasing and Materials Management, Tata McGraw Hill, 2012
2. A.K. Chitale and R.C. Gupta, Materials Management, Text and Cases, PHI Learning, 2nd Edition, 2006.
3. A.K. Datla, Materials Management, Procedure, Text and Cases, PHI Learning, 2nd Edition, 2006
4. Ajay K Garg, Production and Operations Management, Tata McGraw Hill , 2012
5. Ronald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management, Pearson education, Fifth Edition.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the concepts and techniques in materials management
CO2	To understand the concept of materials planning and apply it for optimized ordering of materials
CO3	To understand and apply inventory management models for optimization of inventory
CO4	To understand and analyse purchase decisions during certainty and uncertainty scenarios
CO5	To remember and understand warehousing function and apply the concepts for efficient warehousing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	-	-	1	3	3	2	1
CO2	3	2	3	2	-	-	1	3	3	2	1
CO3	3	2	3	2	-	-	1	3	3	2	1
CO4	3	2	3	2	-	-	1	3	3	2	1
CO5	3	2	3	2	-	-	1	3	3	2	1

MB1030	**PRODUCT DESIGN**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To understand the application of structured methods to develop a product.

UNIT I PRODUCT DESIGN & DEVELOPMENT **9**

Product design & development - characteristics, duration and cost, challenges; Development Process - Generic Process, Concept development, Adapting to product types; Product Planning - Process, Understanding customer need, Product Specification; Concept Generation Evaluation - decay curve, cost expenditure curve; Technology Life Cycle; Disruptive Technologies. **CO1**

UNIT II PRODUCT CONCEPT **9**

Concept Selection – Importance, Methodology, concept Screening, Concept Scoring, Concept **CO2**

Testing; Product Architecture - Definition, Modularity, implication, Establishment, Delayed Differentiation, Platform Planning.

UNIT III PRODUCT DATA MANAGEMENT **9**

PDM - concept and benefits, functions, Product data and workflow, Product reliability, CIM data, Architecture of PDM systems, Product data interchange, Portal integration, PDM acquisition and implementation; Product Life Cycle management - strategy, Change management for PLM. **CO3**

UNIT IV DESIGN TOOLS **9**

Design Approaches - Industrial Design, Design for Manufacturing, Value Engineering, Ergonomics, Robust Design, Design for Excellence; Collaborative Product development-Prototyping, failure rate curve, product use testing-Product development economics, scoring model, financial analysis. **CO4**

UNIT V PATENTS **9**

Intellectual Property and Patents -Definitions, Patent Searches, Application, Patent Ownership and Transfer, Patent Infringement, New Developments and International Patents. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Karl T. Ulrich, Steven D. Eppinger, Anita Goyal Product Design and Development, Tata McGraw – Hill, Fourth Edition, reprint 2009.

REFERENCE BOOKS

1. Kenneth B. Kahn, New Product Planning, Sage, 2010.
2. A.K. Chitale and R.C. Gupta, Product Design and Manufacturing, PHI, 2008.
3. Deborah E. Bouchoux, Intellectual Property Rights, Delmar, Cengage Learning, 2005.
4. Michael Grieves, Product Life Cycle Management, Tata McGraw Hill, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the needs of the customers and thereby develop characteristics of product to be designed

CO2 To understand and analyze the methodology in the selection of product concept

CO3 To analyze and evaluate the product data management and its implementation

CO4 To apply the various tools available for design of product

CO5 To understand the concept of patenting for new products and its procedure

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	2	1	3	3	2	1
CO2	3	2	3	2	2	2	1	3	3	2	1
CO3	3	2	3	2	2	2	1	3	3	2	1
CO4	3	2	3	2	2	2	1	3	3	2	1
CO5	3	2	3	2	2	2	1	3	3	2	1

MB1031 **PROJECT MANAGEMENT** **L T P C**

3 0 0 3

OBJECTIVES

- To learn the fundamental principles and practices of managing projects.

UNIT I INTRODUCTION TO PROJECT MANAGEMENT **9**

Project Management – Definition –Goal - Lifecycles. Project Environments. Project Manager – Roles- Responsibilities and Selection. **CO1**

UNIT II PLANNING, BUDGETING AND RISK MANAGEMENT **9**

The Planning Process – Work Break down Structure. Cost Estimating and Budgeting - Process, Summaries, schedules and forecasts. Managing risks - concepts, identification, assessment and response planning. **CO2**

UNIT III SCHEDULING & RESOURCE ALLOCATION **9**

PERT & CPM Networks - Project durations and floats - Crashing – Resource loading and leveling. Simulation for resource allocation. Goldratt's Critical Chain **CO3**

UNIT IV PROJECT ORGANISATION & CONFLICT MANAGEMENT **9**

Formal Organization Structure – Organization Design – Types of project organizations. Conflict – Origin & Consequences. Project Teams. Managing conflict – Team methods for resolving conflict. **CO4**

UNIT V CONTROL AND COMPLETION **9**

Project Control – Process, Monitoring, Internal and External control, Performance analysis, Performance Index Monitoring. Project Evaluation, Reporting and Termination. Project success and failure - Lessons. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Clifford Gray and Erik Larson, Project Management, Tata McGraw Hill Edition, 2005.

REFERENCE BOOKS

1. John M. Nicholas, Project Management for Business and Technology - Principles and Practice, Second Edition, Pearson Education, 2006.
2. Gido and Clements, Successful Project Management, Second Edition, Thomson Learning, 2003.
3. Samuel J.M., Jack R.M., Scott M.S., Margaret M.S., and Gopalan M.R., Project Management, First Indian edition, Wiley-India, 2006.
4. Harvey Maylor, Project Management, Third Edition, Pearson Education, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the characteristics of project and teams and various stages of a project.

CO2 To create the work breakdown structure and understand the fundamentals of cost and budget estimation methods

CO3 To analyze the ways of completing projects on time and scheduling resources effectively

CO4 To understand the organization structure & critically analyze conflicts and ways of resolving conflicts

CO5 To understand reporting and control methods

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	3	3	3	-

CO2	3	3	3	2	2	-	-	3	3	3	-
CO3	3	3	3	2	2	-	-	3	3	3	-
CO4	3	3	3	2	2	-	-	3	3	3	-
CO5	3	3	3	2	2	-	-	3	3	3	-

MB1032 SERVICE OPERATIONS MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES

- To help understand how service performance can be improved by studying services operations management.

UNIT I INTRODUCTION **9**

Services – Importance, role in economy, service sector – nature, growth. Nature of services - distinctive characteristics, Service Package, Service classification, service-dominant logic, open systems view. Service Strategy –Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness. **CO1**

UNIT II SERVICE DESIGN **9**

New Service Development – Design elements – Service Blue-printing - process structure – generic approaches. Service Encounter – triad, creating service orientation, service profit chain; Front office Back-office Interface– service decoupling. Technology in services – self-service, automation, e-commerce, e-business, technology innovations. **CO2**

UNIT III SERVICE QUALITY **9**

Service Quality- Dimensions, Service Quality Gap Model; Measuring Service Quality – SERVQUAL, Walk-through Audit, Quality service by design , Service Recovery, Service Guarantees. Process Improvement –productivity improvement - DEA, quality tools, benchmarking, Quality improvement programs. **CO3**

UNIT IV SERVICE FACILITY **9**

Supporting facility -Service scape, Facility design – nature, objectives, process analysis, service facility layout. Service Facility Location – considerations, facility location techniques – metropolitan metric, Euclidean, centre of gravity, retail outlet location, location set covering problem. Vehicle routing and Scheduling. **CO4**

UNIT V MANAGING CAPACITY AND DEMAND **9**

Managing Demand – strategies; Managing capacity – basic strategies, supply management tactics, operations planning and control; Yield management; Inventory Management in Services– Retail Discounting Model, Newsvendor Model; Managing Waiting Lines –Queuing systems, psychology of waiting; Managing for growth- expansion strategies, franchising , globalization. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. James A. Fitzsimmons, Mona J, Fitzsimmons, Sanjeev Bordoloi, Service Management – Operations, Strategy, Information Technology, McGraw-Hill Education – 8th Edition 2018.

REFERENCE BOOKS

1. Richard D. Metters, Successful Service Operations Management, Cengage Learning, 2nd Edition, 2012.
2. Cengiz Haksever, Barry Render, Service Management, Pearson Education, 2013.
3. Robert Johnston, Graham Clark, Service Operations Management, Pearson Education, 2ndEdition, 2005.
4. Bill Hollins and Sadie Shinkins, Managing Service Operations, Sage, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the various concepts Services and apply the classification , strategy and role of information technology

CO2 To analyze the role of technological innovations with regards to business

CO3 To create service quality using models like SERVQUAL and analyze the process improvement and quality tools with respect to business standards

CO4 To apply and analyse various facility design , routing and scheduling

CO5 To analyse the real world applications and create automated models to be on par with the industry standards.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	3	3	3	-
CO2	3	3	3	2	2	2	-	3	3	3	-
CO3	3	3	3	2	2	2	-	3	3	3	-
CO4	3	3	3	2	2	2	-	3	3	3	-
CO5	3	3	3	2	2	2	-	3	3	3	-

MB1033 SUPPLY CHAIN MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To help understand the importance of and major decisions in supply chain management for gaining competitive advantage.

UNIT I INTRODUCTION **9**

Supply Chain – Fundamentals –Evolution- Role in Economy - Importance - Decision Phases - Supplier- Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance; Supply chain strategy - Supply Chain Performance Measures. **CO1**

UNIT II STRATEGIC SOURCING **9**

Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum -Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base- Supplier Development - World Wide Sourcing. **CO2**

UNIT III SUPPLY CHAIN NETWORK **9**

Distribution Network Design – Role - Factors Influencing Options, Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models - Supply Chain Network optimization models; Impact of uncertainty on Network Design - Network Design decisions using Decision trees. **CO3**

UNIT IV PLANNING DEMAND, INVENTORY AND SUPPLY **9**

Managing supply chain cycle inventory. Uncertainty in the supply chain –- Analyzing impact of supply chain redesign on the inventory - Risk Pooling - Managing inventory for short life – cycle products - multiple item -multiple location inventory management. Pricing and Revenue Management **CO4**

UNIT V CURRENT TRENDS **9**

Supply Chain Integration, SC process restructuring, IT in Supply Chain; Agile Supply Chains, Leagile supply chain, Green Supply Chain, Reverse Supply chain; Supply chain **CO5** technology trends – AI, Advanced analytics, Internet of Things, Intelligent things, conversational systems, robotic process automation, immersive technologies, Blockchain.

TOTAL : 45 PERIODS

TEXT BOOKS

2. Sunil Chopra, Peter Meindl and Dharam VirKalra, Supply Chain Management-Strategy Planning and Operation, Pearson Education, Sixth Edition, 2016.
3. Ballou Ronald H, Business Logistics and Supply Chain Management, Pearson Education, 5thEdition, 2007.

REFERENCE BOOKS

2. Janat Shah, Supply Chain Management – Text and Cases, Pearson Education, 2009
3. David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Cases, Tata McGraw-Hill, 2005.
4. Pierre David, International Logistics, Biztantra, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand and remember the concepts of Supply Chain and strategy formulation

CO2 To analyse the sourcing strategy for better decision making

CO3 To understand the different supply chain network models and evaluate the distribution network design using these optimization models

CO4 To analyse inventory decisions in supply chain

CO5 To understand the application of latest trends for better supply chain management practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	1	3	3	3	1
CO2	3	3	3	2	2	-	1	3	3	3	1
CO3	3	3	3	2	2	-	1	3	3	3	1
CO4	3	3	3	2	2	-	1	3	3	3	1
CO5	3	3	3	2	2	-	1	3	3	3	1

MB1034	**QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To learn the quality philosophies and tools in the managerial perspective.

UNIT I INTRODUCTION **9**

Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality. **CO1**

UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT **9**

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology. **CO2**

UNIT III STATISTICAL PROCESS CONTROL **9**

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations. **CO3**

UNIT IV TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE. **CO4**

UNIT V QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION 9

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre, Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, II Edition 2010

REFERENCE BOOKS

1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt. Limited, 2008.
2. James R. Evans and William M. Lindsay, The Management and Control of Quality,Sixth Edition, Thomson, 2005.
3. Poornima M.Charantimath, Total Quality Management, Pearson Education, Second Edition , 2011
4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the need for quality, evaluate the dimensions of quality and create quality products and services that delights the customers.

CO2 To understand the principles and philosophies contributed by quality gurus and apply in practice.

CO3 To evaluate the quality of process product and service using TQM tools and statisticals methods.

CO4 To analyse customer needs and create quality products and services that delights the customers by applying TQM tools.

CO5 To apply quality standards.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	-	-	3	3	3	-

CO2	3	2	3	2	2	-	-	3	3	3	-
CO3	3	2	3	2	2	-	-	3	3	3	-
CO4	3	2	3	2	2	-	-	3	3	3	-
CO5	3	2	3	2	2	-	-	3	3	3	-

SYSTEMS MANAGEMENT ELECTIVES

MB1035 **e–BUSINESS** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the practices and technology to start an online business.

UNIT I INTRODUCTION TO e-BUSINESS **8**

e-business, e-business Vs e-commerce, Economic forces - advantages - myths - e-business models, design, develop and manage business, Web2.0 and Social Networking, Mobile Commerce, S-commerce **CO1**

UNIT II TECHNOLOGY INFRASTRUCTURE **10**

Internet and World Wide Web, internet protocols - FTP, intranet and extranet, Information publishing technology - basics of web server hardware and software **CO2**

UNIT III BUSINESS APPLICATIONS **10**

Consumer oriented e-business - e-tailing and models - Marketing on web - advertising - e-mail marketing, affiliated programs - e-CRM; online services, Business oriented e-business, governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals - Social media marketing **CO3**

UNIT IV e-BUSINESS PAYMENTS AND SECURITY **9**

E-payments - Characteristics of payment of systems, protocols, e-cash, e cheque and Micro payment systems - internet security - cryptography - security protocols - network security **CO4**

UNIT V LEGAL AND PRIVACY ISSUES **8**

Legal, Ethics and privacy issues - Protection needs and methodology - consumer protection, cyberlaws, contract sand warranties, Taxation and encryption policies. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Harvey M.Deitel, Paul J.Deitel, Kate Steinbuhler, e – business and e – commerce for managers, Pearson, 2011.
2. Efraim Turban, Jae K.Lee, David King, Ting Peng Liang, Deborrah Turban, Electronic Commerce– A managerial perspective, Pearson Education Asia, 2010.
3. Parag Kulkarni, Sunita Jahirabadkao, Pradeep Chande, ebusiness, Oxford University Press,2012.

REFERENCE BOOKS

1. Hentry Channel, E-Commerce – fundamentals and Applications, Wiley India Pvt Ltd, 2007.
2. Gary P.Schneider, Electronic commerce, Thomson course technology, Fourth annual edition, 2007
3. Bharat Bhasker, Electronic Commerce Frame work technologies and Applications, 3rdEdition. Tata McGraw Hill Publications, 2009
4. Kamlesh K.Bajaj and Debjani Nag, Ecommerce - the cutting edge of Business,Tata McGraw Hill Publications, 7th reprint, 2009.
5. Kalakotaetal, Frontiers of Electronic Commerce, Addison Wesley, 2004
6. Micheal Papaloelon and Peter Robert, e-business, WileyIndia, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the various concepts of E-business and to create the designs and business models

CO2 To create different technology infrastructure and analyze basics of web server, hardware and software

CO3 To analyze various business applications and understand virtual communities and web portals

CO4 To analyze the tools for e-business and create cryptography and network security for payment systems

CO5 To analyse the legal and privacy issues and understand the cyber laws with regards to taxation and encryption policies.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	1	2	2	-
CO2	2	2	2	1	1	-	-	1	2	2	-
CO3	2	2	2	1	1	-	-	1	2	2	-
CO4	2	2	2	1	1	-	-	1	2	2	-
CO5	2	2	2	1	1	-	-	1	2	2	-

MB1036 ENTERPRISE RESOURCE PLANNING

L	T	P	C
3	0	0	3

OBJECTIVES

- To exhibit the theoretical aspects of Enterprise Resource Planning.
- To provide practical implication on ERP Suite implementation.

UNIT I INTRODUCTION **8**

Overview of enterprise systems – Evolution – Risks and benefits – Fundamental technology – warehouse management. **CO1**

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES **10**

Overview of ERP software solutions, BPR, Project management, Functional Modules - Organisational data, master data and document flow. **CO2**

UNIT III ERP IMPLEMENTATION **10**

Planning Evaluation and selection of ERP systems – Implementation lifecycle-ERP implementation, Methodology and Framework – Training – Data Migration. People Organization in implementation - Consultants, Vendors and Employees. **CO3**

UNIT IV POST IMPLEMENTATION **8**

Maintenance of ERP - Organizational and Industrial impact; Success and Failure factors of ERP Implementation. **CO4**

UNIT V EMERGING TRENDS ON ERP **9**

Extended ERP systems and ERP add-ons - CRM, SCM, Business analytics – Future trends in ERP systems – web enabled, Wireless technologies, cloud computing and Augmented reality. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Alexis Leon, ERP demystified, second Edition Tata McGraw - Hill, 2008.
2. Simha R.Magal, JeffreyWord, Integrated Business processes with ERP systems, John Wiley & Sons, 2012.
3. Jagan Nathan Vaman, ERP in Practice, Tata McGraw - Hill, 2008

REFERENCE BOOKS

1. Alexis Leon, Enterprise Resource Planning, second edition, Tata McGraw-Hill, 2008.
2. Mahadeo Jaiswal and Ganesh Vanapalli, ERP Macmillan India, 2009
3. Vinod Kumar Grag and N.K.Venkitakrishnan, ERP-Concepts and Practice, Prentice Hall of India, 2006.
4. Summer, ERP, Pearson Education, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand risk and benefits associated with Enterprise Resource Planning.
CO2 To design and develop ERP solutions and functional modules
CO3 To analyse and implement ERP
CO4 To analyse and evaluate the post implementation of ERP.
CO5 To have knowledge of emerging trends on ERP

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	1	2	2	-
CO2	2	2	2	1	1	-	-	1	2	2	-
CO3	2	2	2	1	1	-	-	1	2	2	-
CO4	2	2	2	1	1	-	-	1	2	2	-
CO5	2	2	2	1	1	-	-	1	2	2	-

MB1037 SOFTWARE PROJECT AND QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To create and understanding on methodologies, tools, techniques, metrics, quality and risk issues in software project management.
- To provide the knowledge and necessary skills for taking up quality related task in Software projects.

UNIT I SPM CONCEPTS **9**

Definition – components of SPM – challenges and opportunities – tools and techniques – managing human resource and technical resource – costing and pricing of projects – training and development–project management techniques. **CO1**

UNIT II SOFTWARE MEASUREMENTS **9**

Monitoring & measurement of SW development – cost, size and time metrics – methods and tools for metrics – issues of metrics in multiple projects. **CO2**

UNIT III SOFTWARE QUALITY AND RISK ISSUES **9**

Quality in SW development – quality assurance – quality standards and certifications. The risk issues in SW development and implementation – identification of risks – resolving and avoiding risks – tools and methods for identifying risk management. **CO3**

UNIT IV QUALITY PLANNING **9**

Planning Concepts - Integrating Business and Quality Planning - Prerequisites to Quality Planning **CO4**

-The Planning Process. Define, Build, Implement and Improve Processes: Process Management Concepts - Process Management Processes.

UNIT V QUALITY CONTROL PRACTICES **9**

Testing Concepts – Developing Testing Methodologies – Verification and Validation Methods - Software Change Control – Defect Management. Metrics and Measurement: Measurement Concepts - Measurement in Software - Variation and Process Capability - Risk Management - Implementing a Measurement Program. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Roger S. Pressman, Software Engineering A Practioners Approach, McGraw Hill International Edition, New Delhi, 7thEdition, 2010
2. Richard H. Thayer(Edited), Software Engineering Project Management, IEEE, John Wiley & Sons, 2nd edition, 2000

REFERENCE BOOKS

1. Bob Hughes, Mike Cotterell and Rajib Mall, Software Project Management, McGraw Hill Publishing Company, 6th Edition, 2017
2. Alan Gillies, Software Quality – Theory and Management, Thomson Learning, 3rd edition, 2011.
3. Stephen Kan, Metrics and Models in Software Quality Engineering, Pearson Education Asia, 8th Impression 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand and apply the project management concepts & techniques.
CO2 To analyse & evaluate the software development process.
CO3 Understand the risk issues in software development.
CO4 Apply the concepts in preparing the quality plan & documents.
CO5 Analyse and evaluate the quality of software product.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	1	2	2	-
CO2	2	2	2	1	1	-	-	1	2	2	-
CO3	2	2	2	1	1	-	-	1	2	2	-
CO4	2	2	2	1	1	-	-	1	2	2	-
CO5	2	2	2	1	1	-	-	1	2	2	-

MB1038 INTERNET OF THINGS **L T P C**
3 0 0 3

OBJECTIVES

- To experiment the technical aspects of Internet of Things.
- To expose the application of Internet of Things.

UNIT I INTRODUCTION **9**

Introduction to Internet of Things - Physical Design of IoT - Logical Design of IoT - IoT Enabling Technologies - IoT Levels and Deployment Templates - Domain Specific to IoTs. **CO1**

UNIT II IoT ARCHITECTURE **9**

ETSI, IETF, OGC architectures - IoT reference model - Domain model - information model - functional model – communication model - IoT reference architecture **CO2**

UNIT III BUILDING IoT **9**

IoT Systems - Logical Design using Python - IoT Physical Devices and Endpoints: What is an IoT Device - Basic building blocks of an IoT device - Exemplary Device: Raspberry Pi - Programming Rash berry Pi with Python - Other IoT Devices **CO3**

UNIT IV IoT DATA PLATFORM **9**

Data Analytics for IoT: Introduction - Apache Hadoop - Using Hadoop Map Reduce for Batch Data Analysis – Apache Oozie – Apache Spark – Tools for IoT- Introduction - Chef: Setting up Chef. **CO4**

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS **9**

IoT Physical Servers & Cloud Offerings - Case Studies Illustrating IoT Design: Introduction - Home Automation – Smart Cities – Environment – Agriculture – Productivity Applications. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti, - Internet of Things – A hands - on approach, University Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), - Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.

REFERENCE BOOKS

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefa Aves and David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, - The Internet of Things –Key applications and Protocols‖, Wiley, 2012
3. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley & Sons, 2013.
4. Cuno Pfister, “Getting Started with the Internet of Things: Connecting Sensors and Micro controllers to the Cloud”, Maker Media, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the various concepts of IOT used in different organisations and to provide the designs of IOT for various purposes.
CO2 To Create different IOT Models and analyse the business problems and give solution
CO3 To create Logical design using Python and building blocks of an IOT device
CO4 To analyze the tools for IOT and apply various data analytics tools for batch data analysis
CO5 To analyse the real world applications and create automated design to be on par with the industry standards.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	1	2	2	-

CO2	2	2	2	1	1	-	-	1	2	2	-
CO3	2	2	2	1	1	-	-	1	2	2	-
CO4	2	2	2	1	1	-	-	1	2	2	-
CO5	2	2	2	1	1	-	-	1	2	2	-

MB1039 ADVANCED DATABASE MANAGEMENT SYSTEM **L T P C**
3 0 0 3

OBJECTIVES

- To understand the various advanced databases used in the organization
- To be aware of recent trends in database management.

UNIT I SPM CONCEPTS **9**

DBMS Models - Multimedia Databases, Parallel Databases, embedded, web, spatial, temporal databases, Virtualization, Active Databases - Embedded databases - Web databases. **CO1**

UNIT II SOFTWARE MEASUREMENTS **9**

Query Processing basics and optimization – Heuristic Optimization – Transactions Models – Concurrency Control – Recovery – Security and Authorization – Storage – Indexing and Hashing – ISAM – B-Trees –Kd Trees –X Trees – Dynamic Hashing. **CO2**

UNIT III DISTRIBUTED DATABASES **9**

Distributed Databases – Queries – Optimization Access Strategies – Distributed Transactions Management – Concurrency Control – Reliability **CO3**

UNIT IV OBJECT ORIENTED DATABASES **9**

Object Oriented Concepts – Data Object Models – Object Oriented Databases – Issues in OODBMS – Object Oriented Relational Databases – Object Definition Languages – Object Query Languages **CO4**

UNIT V EMERGING TRENDS **9**

Data Mining – Data warehousing – Star, Snowflake, Fact Constellation; open source database systems, Scripting Language, JDBC, ODBC **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Peter Rob, Carlos Coronel, Database System and Design, Implementation and Management, 8th edition, Cengage,
2. Ramez Elmasri and Shamkant B. Navethe, Fundamentals of Database Systems,7th edition, Pearson Education, 2015.
3. Jeffrey A Hofferetal, Modern Database Management,12th Edition, PearsonEducation,2016,
4. Abraham Silberchatz, Henry F. Korth and S.Sudarsan, Database System Concepts, 6th Edition, McGraw-Hill, 2015.

REFERENCE BOOKS

1. Thomas M. Connolly and Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation and Management, 6th edition, Pearson Education, 2015.
2. Jefrey D. Ullman and Jenifer Widom, A First Course in Database Systems, 3rd edition, Pearson Education Asia, 2013.
3. Stefano Ceri and Giuseppe Pelagatti, Distributed Databases Principles and Systems, McGraw-Hill International Editions, 2008.
4. Rajesh Narang, Object Oriented Interfaces and Databases, 1st edition, Prentice Hall of India ,2004.
5. Mark L.Gillenson & el, Introduction to database management, 2ndedition, Wiley India Pvt. Ltd,2012

6. Charkrabarti, Advanced Database Management Systems, WileyIndiaPvtLtd,2011

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To apply different databases for various purposes.

CO2 To apply the steps in database query processing with the objective of accessing the data from the database.

CO3 To analyze the concepts of databases used in different locations with the intricacies of data access and providing data security in various networks.

CO4 To analyze the insights in Object Oriented Database structure with different models to store and retrieve the data from different models in an organisation.

CO5 To evaluate the data mining and data ware housing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	1	1	-	-	1	2	2	-
CO2	2	2	2	1	1	-	-	1	2	2	-
CO3	2	2	2	1	1	-	-	1	2	2	-
CO4	2	2	2	1	1	-	-	1	2	2	-
CO5	2	2	2	1	1	-	-	1	2	2	-

NON – FUNCTIONAL ELECTIVES

MB1211 ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

OBJECTIVES

- To equip and develop the learners' entrepreneurial skills and qualities essential to undertake business.
- To impart the learners' entrepreneurial competencies needed for managing business efficiently and effectively.

UNIT I ENTREPRENEURAL COMPETENCE **9**

Entrepreneurship concept–Entrepreneurship as a Career–Entrepreneurial Personality-Characteristics of Successful Entrepreneurs–Knowledge and Skills of an Entrepreneur. **CO1**

UNIT II ENTREPRENEURAL ENVIRONMENT **9**

Business Environment-Role of Family and Society-Entrepreneurship Development Training and Other Support Organisational Services-Central and State Government Industrial Policies and Regulations. **CO2**

UNIT III BUSINESS PLAN PREPARATION **9**

Sources of Product for Business-Prefeasibility Study-Criteria for Selection of Product-Ownership-Capital Budgeting- Project Profile Preparation-Matching Entrepreneur with the Project-Feasibility Report Preparation and Evaluation Criteria. **CO3**

UNIT IV LAUNCHING OF SMALL BUSINESS **9**

Finance and Human Resource Mobilisation - Operations Planning - Market and Channel **CO4**

Selection-Growth Strategies -Product Launching–Incubation, Venture capital, Start-ups.

UNIT V MANAGEMENT OF SMALL BUSINESS **9**

Monitoring and Evaluation of Business - Business Sickness - Prevention and Rehabilitation of Business Units -Effective Management of small Business-Case Studies. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2016.
2. R.D. Hisrich, Entrepreneurship, Tata Mc Graw Hill, NewDelhi, 2018.
3. Rajeev Roy, Entrepreneurship, OxfordUniversityPress, 2nd Edition,2011.
4. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning, 2012.

REFERENCE BOOKS

1. Dr. Vasant Desai, "Small Scale Industries and Entrepreneurship", HPH, 2006.
2. Arya Kumar. Entrepreneurship, Pearson, 2012.
3. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 8th edition, 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand the concepts of entrepreneurial competence to run the business efficiently.

CO2 To apply the various entrepreneurial policies and regulations based on the entrepreneurial environment.

CO3 To analyse the capable of preparing business plan and undertake feasible projects.

CO4 To create and develop their business ventures successfully.

CO5 To evaluate and monitor the business effectively towards growth and development.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	2	1	3	3	2	-
CO2	3	2	2	2	1	2	1	3	3	2	-
CO3	3	2	2	2	1	2	1	3	3	2	-
CO4	3	2	2	2	1	2	1	3	3	2	-
CO5	3	2	2	2	1	2	1	3	3	2	-

MB1212 BUSINESS ETHICS AND CORPORATE GOVERNANCE **L T P C**
3 0 0 3

OBJECTIVES

- To have grounding on theory through the understanding of real-life situations and cases.

UNIT I INTRODUCTION **9**

Definition & nature Business ethics, Characteristics, Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good. **CO1**

UNIT II ETHICS THEORY AND BEYOND		**9**
Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice - ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation. Business and ecological / environmental issues in the Indian context and case studies.		**CO2**
UNIT III LEGAL ASPECTS OF ETHICS		**9**
Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.		**CO3**
UNIT IV ENVIRONMENTAL ETHICS		**9**
Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.		**CO4**
UNIT V CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE		**9**
Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance- innovative practices; Case studies with lessons learnt.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, Sage Publications Inc., 2011
3. Robert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.

REFERENCE BOOKS

1. W.H. Shaw, Business Ethics, Cengage Learning, 2007.
2. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.
3. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley, 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand ethical issues in workplace and be able to find solution.
CO2 To understand ethical issues and the behavior to be followed in the corporate.
CO3 To understand ethical issues in legal and social environment.
CO4 To analyse ethical issues in economic and political environment.
CO5 To evaluate ethical issues and practices in CSR.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	1	3	3	2	3
CO2	3	2	2	1	-	-	1	3	3	2	3
CO3	3	2	2	1	-	-	1	3	3	2	3
CO4	3	2	2	1	-	-	1	3	3	2	3
CO5	3	2	2	1	-	-	1	3	3	2	3

MB1213	**EVENT MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- This course is designed to provide an introduction to the principles of event management. The course aims to impart knowledge on the various events and how these events can be organized successfully.

UNIT I EVENT CONTEXT **9**

History& Evolution–Types of events–MICE Types of Meeting, Trade Shows, Conventions, Exhibitions- Structure of event industry – Event Management as a profession –Perspectives on event: Government, Corporate & Community – Code of Ethics. **CO1**

UNIT II EVENT PLANNING & LEGAL ISSUES **9**

Conceptualizing the event – Host, sponsor, Media, Guest, Participants, Spectators – Crew – Design of concept – Theme and content development – Visualization – Event objectives –Initial planning – Budgeting – Event design and budget checklist – Preparation of functionalsheets– Timing–ContractsandAgreements–Insurance, Regulation,Licence and Permits-–Negotiation. **CO2**

UNIT III EVENT MARKETING **9**

Role of StrategicMarketingPlanning-Pricing–MarketingCommunicationMethods& budget – Elements of marketing communication – Managing Marketing Communication –Role of Internet – Sponsorship – Event sponsorship – Strategy – Managing Sponsorships –Measuring& Evaluating sponsorship. **CO3**

UNIT IV EVENT OPERATION **9**

Site Selection–Types of location–Venue Requirements–Room, Stage, Audi- Visual, Lighting, Performers, Decors, Caterer, Photography & Videography – Protocols – Guest list –Guest demographics – Children at event – Invitation – Media – Freelance Event Operation –Road show - Food & Beverage – Entertainment – Event Logistics – Supply of facilities –Onsite logistics– Control of event logistics– Evaluation & Logistics. **CO4**

UNIT V SAFETY & EVENT EVALUATION **9**

Risk assessment–Safety officer, Medical Manager –Venue, Structural safety –Food safety –Occupational safety–Fire Prevention–Sanitary facilities–Vehicle traffic Waste Management.EventImpact–EventEvaluationProcess–ServiceQuality-CustomerSatisfaction. **CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Lynn Van Der Wagen, Event Management for Tourism, Cultural Business & SportingEvents,4th Edition, Pearson Publications, 2014.
2. Lynn Van Der Wagen, & Brenda R. Carlos, Successful Event Management.

3. Judy Allen, Event Planning2nd Edition, Wiley &Sons, Canada, 2014.
4. G.A.J. Bowdin, Event Management, Elseiver Butterworth
5. JohnBeech, Sebastian Kaiser & Robert Kaspar, The Business of Events Management, Pearson Publication, 2014.

REFERENCE BOOKS

1. Judy, Event Planning Ethics and Etiquette: A Principled Approach to the Business of Special Event Management, 2014.
2. Shannon Kilkenny, The complete guide to successful event planning.
3. Julia Ruther ford Silvers, Professional Event Coordination, The Wiley Event Management Series. Allison, The Event Marketing Handbook: Beyond Logistics& Planning

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the evolution of event management and their types.
CO2	To create event plans and analyse various activities relating to implementation of events and create budgets.
CO3	To apply marketing mix for various types of events and analyse the various sponsorship requirements for an event.
CO4	To analyse the various event operations requirements for the conduct of an event.
CO5	To evaluate the various risk and safety issues associated with event industry.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	3	3	2	1
CO2	3	2	2	1	1	1	1	3	3	2	1
CO3	3	2	2	1	1	1	1	3	3	2	1
CO4	3	2	2	1	1	1	1	3	3	2	1
CO5	3	2	2	1	1	1	1	3	3	2	1

MB1214	**SUSTAINABILITY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To providestudentswithfundamentalknowledgeofthenotionofcorporatesustainabily.
- To determine how organizations impacts on the environment and socio technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY **9**

Management of sustainability -rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies. **CO1**

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY **9**

Corporate sustainability perimeter, corporate sustainability institutional framework, integration of **CO2** sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES **10**

Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement. **CO3**

UNIT IV SUSTAINABILITY AND INNOVATION **8**

Socio technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations. **CO4**

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS **9**

Energy management, Water management, Waste management. **CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Daddi, T., Iraldo, F., Testa, Environmental Certification for Organizations and Products: Management, 2015
2. Christian N.Madu, Handbook of Sustainability Management 2012
3. Petra Molthan-Hill, The Business Student's Guide to Sustainable Management: Principles and Practice, 2014.

REFERENCE BOOKS

1.Margaret Robertson, Sustainability Principles and Practice, 2014
2.Peter Rogers**,** An Introduction to Sustainable Development, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To understand sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact
CO2 To apply sustainability into strategic planning and regular business practices
CO3 To apply and evaluate sustainability management strategies
CO4 Knowledge of innovative practices in sustainable business and community management
CO5 Deep understanding of sustainable management of resources and commodities

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	3	3	2	-
CO2	3	2	2	1	-	-	-	3	3	2	-
CO3	3	2	2	1	-	-	-	3	3	2	-
CO4	3	2	2	1	-	-	-	3	3	2	-
CO5	3	2	2	1	-	-	-	3	3	2	-

AUDIT COURSES

AX1001 ENGLISH FOR RESEARCH PAPER WRITING

L	T	P	C
2	0	0	0

OBJECTIVES

- Teach how to improve writing skills and level of reading ability
- Tell about what to write in each section
- Summarise the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTIONTORESEARCHPAPERWRITING		**6**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness		**CO1**
UNIT II PRESENTATIONSKILLS		**6**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction		**CO2**
UNIT III TITLE WRITING SKILLS		**6**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check		**CO3**
UNIT IV RESULT WRITINGSKILLS		**6**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions		**CO4**
UNIT V VERIFICATIONSKILLS		**6**
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission		**CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,2011
2. Day R How to Write and Publish a Scientific Paper, CambridgeUniversityPress2006

REFERENCE BOOKS

1. Gold bort R Writing for Science, Yale University Press (available on Google Books)2006
2. High man N, Handbook of Writing for the Mathematical Sciences, SIAM. High man's book 1998.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand how to improve writing skills and level of reading ability
CO2 Learn about what to write in each section
CO3 Understand the skills needed when writing a Title
CO4 Understand the skills needed when writing the Conclusion
CO5 Ensure the good quality of paper at very first-time submission

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	-	1	-	1	-	-	-	1	1	-	-
CO2	-	1	-	1	-	-	-	1	1	-	-
CO3	-	1	-	1	-	-	-	1	1	-	-
CO4	-	1	-	1	-	-	-	1	1	-	-
CO5	-	1	-	1	-	-	-	1	1	-	-

AX1002 DISASTER MANAGEMENT

L	P	T	C
2	0	0	0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude **CO1**

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS **6**

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts. **CO2**

UNIT III DISASTER PRONE AREAS IN INDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics **CO3**

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness. **CO4**

UNIT V RISK ASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival **CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

s

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.

REFERENCE BOOKS

1. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company, 2007.
2. Sahni, Pardeep .A. ," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi,2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to summarize basics of disaster

CO2 Abilitytoexplaincriticalunderstandingofkeyconceptsindisasterriskreductionandhumanitarianr esponse.

CO3 Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4 Ability to describe understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5 Abilitytodevelopthestrengthsandweaknessesofdisastermanagementapproaches

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	-	1	-	1	-	-	-	1	1	-	-
CO2	-	1	-	1	-	-	-	1	1	-	-
CO3	-	1	-	1	-	-	-	1	1	-	-
CO4	-	1	-	1	-	-	-	1	1	-	-
CO5	-	1	-	1	-	-	-	1	1	-	-

AX1003	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand value of education and self-development
- Imbibe good moral and social values
- Understand the importance of character

UNIT I **6**

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements **CO1**

UNIT II **6**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline **CO2**

UNIT III **6**

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free fro manger, Dignity of labour. **CO3**

UNIT IV **6**

Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature **CO4**

UNIT V **6**

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively. **CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. N. Venkataiah Value Education APH Publishing, 1998

REFERENCE BOOKS

1. Chakroborty,S.K."ValuesandEthicsfororganizationsTheoryandpractice",Oxford University Press, New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the importance of self-development
CO2 Learn the importance of Human values
CO3 Develop the overall personality
CO4 Imbibe good values
CO5 Develop the concentration skill by understanding mind control strategies

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	1
CO2	-	-	-	-	-	-	1	1	-	-	1
CO3	-	-	-	-	-	-	1	1	-	-	1
CO4	-	-	-	-	-	-	1	1	-	-	1
CO5	-	-	-	-	-	-	1	1	-	-	1

AX1004 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I **HISTORY OF MAKING OF THE INDIAN CONSTITUTION** **6**

History, Drafting Committee,(Composition Working), Preamble, Salient features **CO1**

UNIT II **CONTOURSOFCONSTITUTIONALRIGHTSANDDUTIES** **6**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. **CO2**

UNIT III ORGANS OF GOVERNANCE **6**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions. **CO3**

UNIT IV LOCAL ADMINISTRATION **6**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. **CO4**

UNIT V ELECTION COMMISSION **6**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners- Institute and Bodies for the welfare of SC/ST/OB Candwomen. **CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. The Constitution of India,1950 (Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution 1stEdition,2015.

REFERENCE BOOKS

1. M.P.Jain, Indian Constitution Law, 7th Edn., LexisNexis, 2014.
2. D.D.Basu, Introduction to the Constitution India, Lexis Nexis, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indian before the arrival of Gandhi in Indian politics.

CO2 Discuss the intellectual origins of the frame work of argument that in formed the conceptualization of social reforms leading to revolution in India.

CO3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4 DiscussthepassageoftheHinduCodeBillof1956.

CO5 Discuss the role of Election Commission and institutions for welfare of women.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	1	-	-
CO2	-	-	-	-	-	-	-	1	1	-	-
CO3	-	-	-	-	-	-	-	1	1	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	1	1	-	-

AX1006	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

UNIT I STRESS MANAGEMENT **6**

Meaning of stress – body reaction to stress-sources of stress-problem solving and time management. **CO1**

UNIT II STRESS MASNAGEMENT PRACTICES **6**

Psychological and Spiritual Relaxation Methods- Physical Methods of Stress Reduction - Preparing for the Future: College and Occupational Stress. **CO2**

UNIT III YOGA PRACTICES **6**

Definitions of Eight parts of yoga.(Ashtanga). **CO3**

UNIT IV DO'S AND DON'T'S IN YOGA PRACTICES **6**

Yam and Niyam - Do`s and Don't's in life - i) Ahimsa, satya, astheya, bramhacharya and aparigraha. **CO4**

UNIT V PRANAYAM PRACTICES **6**

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathingtechniquesand its effects-Types of pranayam **CO5**

TOTAL : 30 PERIODS

TEXT BOOKS

1. Yogic Asanas for Group Training - Part- I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. Stress Management Paperback – 1 January 2016 by Pratibha Goyal Alok Chakrawal, Studera Press.

REFERENCE BOOKS

1. "Raja yoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To create awareness about stress and its outcome
CO2 To understand the various stress management practices
CO3 To develop healthy mind in a healthy body thus improving socialhealth also
CO4 To educate the importance of various asanas
CO5 To Improve efficiency in breathing practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	1	-	-
CO2	-	-	-	-	-	-	-	1	1	-	-
CO3	-	-	-	-	-	-	-	1	1	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	1	1	-	-

OPEN ELECTIVES
(Offered To Other Department)

OMB101	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I: INTRODUCTION		**9**
Introduction - Need for quality - Evolution of quality - Definitions of quality- Dimensions of product and service quality - Basic concepts of TQM - TQM Framework – Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, customer retention.		**CO1**
UNIT II: TQM PRINCIPLES		**9**
Leadership - Quality Statements, Strategic quality planning, Quality Councils – Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement –PDCA cycle, 5S,Kaizen-Supplierpartnership-Partnering, Supplier selection, Supplier Rating.		**CO2**
UNIT III: TQM TOOLS AND TECHNIQUES I		**9**
The seven traditional tools of quality- New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking – Reason to benchmark, Bench marking process- FMEA - Stages, Types.		**CO3**
UNIT IV: TQM TOOLS AND TECHNIQUES II		**9**
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function -TPM-Concepts, improvement needs-Performance measures.		**CO4**
UNIT V: QUALITY MANAGEMENT SYSTEM		**9**
Introduction—Benefits of ISO Registration — ISO 9000 Series of Standards—Sector-Specific Standards — AS9100, TS 16949 and TL9000—ISO 9001 Requirements — Implementation — Documentation — Internal Audits — Registration—ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction — ISO 14000 Series Standards — Concepts of ISO 14001— Requirements of ISO14001—Benefits of EMS.		**CO5**
	TOTAL PERIODS:	**45**

TEXT BOOKS:

Dale H. Besterfiled, CarolB. Michna, Glen H. Besterfield, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, First Indian Edition, CengageLearning,2012.
2. Janakiraman. Band Gopal.R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.Ltd., 2006.
4. ISO 9001-2015standards

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO3	Students can understand the organisational, communication and teamwork requirements for effective quality management
CO4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans
CO5	The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	3	-	3	-	-	-	-	1	3	1	-
CO2	3	-	3	-	-	-	-	1	3	1	-
CO3	3	-	3	-	-	-	-	1	3	1	-
CO4	3	-	3	-	-	-	-	1	3	1	-
CO5	3	-	3	-	-	-	-	1	3	1	-

OMB102	LOGISTICS AND SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	2	0	4

OBJECTIVES:

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I: INTRODUCTION **9**

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Supply chain and competitive Strategies – Drivers of Supply Chain Performance and Obstacles. **CO1**

UNIT II: SOURCING AND NETWORK DESIGN **9**

Role of sourcing supply chain - Outsourcing – Make Vs buy -Sourcing strategy - Supplier Selection and Contract Negotiation. Building strategic partnerships and trust within a supply chain - Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions. **CO2**

UNIT III: LOGISTICS IN SUPPLY CHAIN **9**

Introduction to logistics – Role of logistics in Competitive strategy– Value added logistics services – Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation **CO3**

UNIT IV: TRANSPORTATON AND PACKAGING

Transportation System – Evolution, Infrastructure and Networks. Freight Management– Containerization; Modal Characteristics - Inter-modal Operators and Transport Economies; International Logistics-objectives, importance in global economy, Characteristics of global supply chains; Packaging - Design considerations – Logistics outsourcing.	**CO4**

UNIT V: IT IN SUPPLY CHAIN **9**

The role IT in supply chain- Supply Chain Integration – Agile Supply chain – Green Supply chain – Reverse Supply chain – E-logistics – future of IT in supply chain – E-Business in supply chain – Supply chain analytics - Blockchain	**CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.

REFERENCES:

1. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

COURSE OUTCOMES

Upon completion of the course, the students will be able

CO1	To understand the basics of Supply chain, the strategic role of SCM and the drivers of supply chain performance.
CO2	To understand the different distribution networks in Supply chain, the factors influencing design of these networks and to develop a framework of network for distribution.
CO3	To understand about the logistic part of supply chain management and the methods to identify the optimized route for transportation.
CO4	To understand about sourcing, selection of suppliers and supply chain coordination
CO5	To understand the role of IT in Supply chain management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	2	2	2	2	2	-	2	2	3	1	-
CO2	2	2	2	2	2	-	2	2	3	1	-
CO3	2	2	2	2	2	-	2	2	3	1	-
CO4	2	2	2	2	2	-	2	2	3	1	-
CO5	2	2	2	2	2	-	2	2	3	1	-

OMB103	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

Objectives

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT – I INTRODUCTION TO COSTING CONCEPTS **9**

Objectives of a Costing System; Cost concepts in decision–making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control. CO1

UNIT – II INTRODUCTION TO PROJECT MANAGEMENT **9**

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts. CO2

UNIT – III PROJECT EXECUTION AND COSTING CONCEPTS **9**

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break–even Analysis, Cost–Volume–Profit Analysis, Various decision–making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing. CO3

UNIT – IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL **9**

Just–in–time approach, Material Requirement Planning, Enterprise Resource Planning, Activity– Based Cost Management, Bench Marking; Balanced Score Card and Value–Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero–based budgets. CO4

UNIT – V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT **9**

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory. CO5

Total Periods: 45

Reference Books:

1. Ashish K. Bhattacharya, ‘Principles & Practices of Cost Accounting’ A. H. Wheeler publisher, 1991.
2. Charles T. Horngren and George Foster, ‘Advanced Management Accounting’, Pearson Prentice Hall, 1988.
3. Charles T. Horngren et. Al. ‘Cost Accounting A Managerial Emphasis’, Prentice Hall of India, New Delhi, 2011.
4. Robert S Kaplan and Anthony A. Alkinson, ‘Management & Cost Accounting’, Pearson Prentice Hall, 2003.
5. N. D. Vohra, ‘Quantitative Techniques in Management’, Tata McGraw Hill Book Co. Ltd, 2007.

Course Outcomes (CO)

CO1 Understand the costing concepts and their role in decision making
CO2 Understand the project management concepts and their various aspects in selection
CO3 Interpret costing concepts with project execution
CO4 Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 Become familiar with quantitative techniques in cost management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO 1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	2	3	1	-
CO2	2	2	2	2	-	-	-	2	3	1	-
CO3	2	2	2	2	-	-	-	2	3	1	-
CO4	2	2	2	2	-	-	-	2	3	1	-
CO5	2	2	2	2	-	-	-	2	3	1	-

PROFESSIONAL ELECTIVES
(Offered to Other Departments)

MG1001	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Objectives

- To enable the students to study the evolution of Management.
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

UNIT – I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur – Types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management. CO1

UNIT – II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process. CO2

UNIT – III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – CO3

Delegation of authority – Centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT – IV DIRECTING **9**

Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT. CO4

UNIT – V CONTROLLING **9**

System and process of controlling – Budgetary and non–budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting. CO5

Total Periods: 45

Text Books:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

Reference Books:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 6th Edition 2017.

Course Outcomes (CO)

CO1 Ability to understand the various terms and definitions related to management and organization.

CO2 Ability to acquire the skill of planning and various strategies of management in an organization.

CO3 Ability to understand the types of organization and also get an insight into HR planning, recruitment, selection and career planning and management.

CO4 Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.

CO5 Ability to understand the concept of budget and budgetary control and acquire the skill of controlling technique.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	2	3	1	-
CO2	2	2	2	2	-	-	-	2	3	1	-

CO3	2	2	2	2	-	-	-	2	3	1	-
CO4	2	2	2	2	-	-	-	2	3	1	-
CO5	2	2	2	2	-	-	-	2	3	1	-

MG1002 OPERATIONS RESEARCH **L T P C**
3 0 0 3

Objectives

- To classify and formulate real-life problem for modelling, solving and applying for decision making.
- To study the formulation and various methods of solutions for linear programming, transportation, assignment , CPM and PERT problems
- To solve problems using dynamic programming method

UNIT – I LINEAR MODELS **9**

Introduction to operations research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method-Primal Dual problems - Dual theory and Sensitivity analysis CO1

UNIT – II TRANSPORTATION MODELS **9**

Transportation and assignment problems-Applications (Emphasis should be more on problems than theory) CO2

UNIT – III NETWORK MODELS **9**

Shortest path problem: Dijkstra's algorithms, Floyd's algorithm, systematic method – CPM / PERT–Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations-example-Sequencing problems. CO3

UNIT – IV DECISION MODELS AND INVENTORY MODELS **9**

Replacement problems-Capital equipment-Discounting costs-Group replacement. Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models-Single period inventory models with shortage cost. CO4

UNIT – V QUEUING MODELS **9**

Characteristics of Queuing Models – Single and multi server models -Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models. CO5

Total Periods: 45

Text Books:

1. H. A. Taha, operational research-An introduction, Macmillan, 1976
2. F. S. Hiller and G. J. Liebermann, Introduction to operational research (7^{th} edition)
3. B. E. Gillet, Introduction to operational research-A computer oriented algorithmic approach, McGraw Hill, 1989
4. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975

Reference Books:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley,

2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.
6. J. C. Pant, 'Introduction to Optimisation: Operations Research', Jain Brothers, Delhi, 2008.
7. Pannerselvam, 'Operations Research', Prentice Hall of India 2010.

Course Outcomes (CO)

CO1 To analyze the problems in engineering, management or business environment, focusing on important details

CO2 To formulate real problems in terms of input-output parameters relationships and identify the solution procedure

CO3 To understand the concept of network and project planning

CO4 To understand the inventory management in manufacturing context

CO5 To understand the application of queuing theory in real world

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	2	2	3	1	-
CO2	2	2	2	2	-	-	2	2	3	1	-
CO3	2	2	2	2	-	-	2	2	3	1	-
CO4	2	2	2	2	-	-	2	2	3	1	-
CO5	2	2	2	2	-	-	2	2	3	1	-

		L	T	P	C
MG 1003	**APPLIED OPERATIONS RESEARCH**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To provide the concept and an understanding of basic concepts in Operations Research Techniques for Analysis and Modeling in Computer Applications.
- To understand , develop and solve mathematical model of linear programming problems
- To understand , develop and solve mathematical model of Transport and assignment problems
- To Understand network modeling for planning and scheduling the project activities**.**

UNIT I LINEAR PROGRAMMING MODELS 9

Mathematical Formulation - Graphical Solution of linear programming models – Simplex method – Artificial variable Techniques.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 9

Mathematical formulation of transportation problem- Methods for finding initial basic feasible solution – optimum solution - degeneracy –Mathematical formulation of assignment models – Hungarian Algorithm.

UNIT III INVENTORY MODELS 9

Inventory Models – Economic order Quantity Models- Quantity Discount Models- Stochastic Inventory Models- Multi Product Model- Inventory Control Models in Practice

UNIT IV SCHEDULING FOR PROJECT ACTIVITIES 9

Network Construction – Critical Path Method – Project Evaluation and Review Technique – Resource Analysis in Network Scheduling

UNIT V QUEUEING MODELS 9

Characteristics of Queuing Models – Single and multi server models
Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞),
(M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.

TOTAL : 45 PERIODS

Text Books:

1. H. A. Taha, operational research-An introduction, Macmillan, 1976
2. F. S. Hiller and G. J. Liebermann, Introduction to operational research (7^{th} edition)
3. B. E. Gillet, Introduction to operational research-A computer oriented algorithmic approach, McGraw Hill, 1989
4. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975

Reference Books:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.
6. J. C. Pant, 'Introduction to Optimisation: Operations Research', Jain Brothers, Delhi, 2008.
7. Pannerselvam, 'Operations Research', Prentice Hall of India 2010.

Course Outcomes (CO)

CO1 To analyze the problems in engineering, management or business environment, focusing on important details
CO2 To understand the transportation and assignment in logistics and job allocation scenarios
CO3 To understand the inventory management in manufacturing context
CO4 To understand the concept of network and project planning
CO5 To understand the applications of queuing theory in real world

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAMME OUTCOMES (POs)								PROGRAMME SPECIFIC OUTCOMES (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	2	2	3	1	-
CO2	2	2	2	2	-	-	2	2	3	1	-
CO3	2	2	2	2	-	-	2	2	3	1	-
CO4	2	2	2	2	-	-	2	2	3	1	-
CO5	2	2	2	2	-	-	2	2	3	1	-

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DEPARTMENT OF MECHANICAL ENGINEERING

M.E. MANUFACTURING ENGINEERING

REGULATIONS – 2021
(CHOICE BASED CREDIT SYSTEM)

PROPOSED CURRICULA AND SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES

Engineering graduates will be able to:

PEO1: Profession –Practice manufacturing engineering in a broad range of industries both core engineering and non-engineering fields such as medicine, space, law or business.

PEO2: Continuing Education–Pursue advanced education, research and development, and other creative and innovative efforts in science, engineering, and technology, as well as other professional careers.

PEO3: Technophile– Conduct them in a responsible, professional, and ethical manner and attain professional maturity with deep understanding of the impact of the technological solutions in a societal and global context and a need for sustainable development.

PEO4: Service–Participate as leaders in their fields of expertise and in activities that support service and economic development nationally and throughout the world.

2. PROGRAMME OUTCOMES

Engineering graduates will be able to:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solution for complex engineering problems and design systems components or process that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environmental and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-Long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

3. PROGRAMME SPECIFIC OUTCOMES

PSO 1: The students graduating in Manufacturing Engineering will have profound foundation in mathematical, scientific and engineering domains necessary to achieve professional and productive excellence in technical and non-technical problem solving and analyzing engineering problems.

PSO 2: The students graduating in Manufacturing Engineering will have the ability to synthesize the engineering data and apply scientific principles for applications involving manufacturing engineering using high end CAD/CAM/CAE computational packages such as CATIA, ANSYS and MATLAB.

PSO 3: The students graduating in Manufacturing Engineering will have the ability to pursue advanced careers and discharge his/her duties entrusted with high degree of commitment to address professional and ethical responsibilities, including a respect for diversity and provide cost effective engineering solutions.

4. PEO / PO MAPPING

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PEO2	✓	✓	✓	✓	✓		✓		✓		✓	✓
PEO3	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
PEO4	✓		✓	✓	✓	✓		✓		✓		

5. SEMESTER, COURSE WISE PO, PSO MAPPING

YEAR	SEM	COURSE TITLE	PO												PSO		
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR 1	SEMESTER1	Applied Probability and Statistics	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
		Advanced in Manufacturing Technology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Computer Integrated Manufacturing Systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Advances in Materials Technology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Research Methodology and IPR	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Course – I															
		Audit Course *															
		CAD/CAM Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEMESTER 2	Optimization Techniques	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
		Advances in Metrology and Inspection	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Tooling for manufacturing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Professional Elective Course – II															
		Professional Elective Course – III															
		Modelling and Simulation Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Automation and Metal Forming Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Mini Project with Seminar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
YEAR 2	SEM3	Professional Elective Course – IV															
		Professional Elective Course – V															
		Open Elective Course															
		Project Work Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEM4	Project Work Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

You Choose, We Do It
St. JOSEPH'S COLLEGE OF ENGINEERING
(An Autonomous Institution)
St. Joseph's Group of Institutions
Jeppiaar Educational Trust
OMR, Chennai - 119.

DEPARTMENT OF MECHANICAL ENGINEERING

M.E. MANUFACTURING ENGINEERING

REGULATIONS – 2021
(CHOICE BASED CREDIT SYSTEM)

CURRICULA AND SYLLABI

SEMESTER I

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
		THEORY						
1	MA1154	Applied Probability and Statistics	FC	4	3	1	0	4
2	MF1101	Advanced in Manufacturing Technology	PCC	3	3	0	0	3
3	MF1102	Computer Integrated Manufacturing Systems	PCC	3	3	0	0	3
4	MF1103	Advances in Materials Technology	PCC	4	4	0	0	4
5		Professional Elective Course – I	PEC	3	3	0	0	3
6	RM 1101	Research Methodology and IPR	RMC	2	2	0	0	2
		PRACTICALS						
7	MF1111	CAD/CAM Laboratory	PCC	4	0	0	4	2
			Total	**25**	**20**	**1**	**4**	**21**
8		Audit Course * **(*Audit Course is optional)**	AC	**Registration of any one of the Audit Courses is optional**				

SEMESTER II

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
		THEORY						
1	MF1201	Optimization Techniques	PCC	4	3	1	0	4
2	MF1202	Advances in Metrology and Inspection	PCC	3	3	0	0	3
3	MF1203	Tooling for manufacturing	PCC	4	4	0	0	4
4		Professional Elective Course – II	PEC	3	3	0	0	3
5		Professional Elective Course – III	PEC	3	3	0	0	3
		PRACTICALS						
6	MF1211	Modelling and Simulation Laboratory	PCC	4	0	0	4	2
7	MF1212	Automation and Metal Forming Laboratory	PCC	4	0	0	4	2
8	MF1213	Mini Project with Seminar	EEC	2	0	0	2	1
			Total	**27**	**16**	**1**	**10**	**22**

SEMESTER III

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
THEORY								
1		Professional Elective Course – IV	PEC	3	3	0	0	3
2		Professional Elective Course – V	PEC	3	3	0	0	3
3		Open Elective	OEC	3	3	0	0	3
PRACTICALS								
4	MF1311	Project Work Phase I	EEC	12	0	0	12	6
			Total	**21**	**9**	**0**	**12**	**15**

SEMESTER IV

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
PRACTICALS								
1	MF1411	Project Work Phase II	EEC	24	0	0	24	12
			Total	**24**	**0**	**0**	**24**	**12**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 70

FOUNDATION COURSES (FC)

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MA1154	Applied Probability and Statistics	FC	4	3	1	0	4

PROFESSIONAL CORE COURSES(PCC)

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1101	Advanced in Manufacturing Technology	PCC	3	3	0	0	3
2	MF1102	Computer Integrated Manufacturing Systems	PCC	3	3	0	0	3
3	MF1103	Advances in Materials Technology	PCC	4	4	0	0	4
4	MF1111	CAD/CAM Laboratory	PCC	4	0	0	4	2
5	MF1201	Optimization Techniques	PCC	4	3	1	0	4
6	MF1202	Advances in Metrology and Inspection	PCC	3	3	0	0	3
7	MF1203	Tooling for manufacturing	PCC	4	4	0	0	4
8	MF1211	Modelling and Simulation Laboratory	PCC	4	0	0	4	2
9	MF1212	Automation and Metal Forming Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVECOURSES (PEC)

SEMESTER I

PROFESSIONALELECTIVE COURSES – I

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1001	Design of Manufacturing Tools, Jigs and Fixtures	PEC	3	3	0	0	3
2	MF1002	Non-Destructive Testing and Evaluation	PEC	3	3	0	0	3
3	MF1003	Metal Cutting Theory and Practice	PEC	3	3	0	0	3
4	MF1004	Operations Management	PEC	3	3	0	0	3

SEMESTER II

PROFESSIONAL ELECTIVE COURSES – II

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1005	Advances in Casting and Welding	PEC	3	3	0	0	3
2	MF1006	Finite Element Methods for Manufacturing Engineering	PEC	3	3	0	0	3
3	MF1007	Manufacturing of Automotive Components	PEC	3	3	0	0	3
4	MF1008	Computer Aided Product Design	PEC	3	3	0	0	3

PROFESSIONALELECTIVE COURSES – III

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1009	Robotics and Industrial Automation	PEC	3	3	0	0	3
2	MF1010	Theory of Metal Forming	PEC	3	3	0	0	3
3	MF1011	Lean and Agile Manufacturing	PEC	3	3	0	0	3
4	MF1012	Surface Engineered Materials Technology	PEC	3	3	0	0	3

SEMESTER III

PROFESSIONAL ELECTIVE COURSES – IV

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1013	Industrial Design and Ergonomics	PEC	3	3	0	0	3
2	MF1014	MEMS and Nanotechnology	PEC	3	3	0	0	3
3	MF1015	Material Testing and Characterization	PEC	3	3	0	0	3
4	MF1016	Mechatronics in Manufacturing	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE COURSES – V

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1017	Micro Manufacturing	PEC	3	3	0	0	3
2	MF1018	Additive Manufacturing	PEC	3	3	0	0	3
3	MF1019	Design and Analysis of Experiments	PEC	3	3	0	0	3
4	MF1020	Product Design and Life Cycle Management	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

(Out of 6 Courses one Course must be selected)

SEMESTER III

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	OCP101	Business Data Analytics	OEC	3	3	0	0	3
2	OMF101	Industrial Safety	OEC	3	3	0	0	3
3	OPE101	Renewable sources of Electrical Energy	OEC	3	3	0	0	3
4	OMB103	Cost Management of Engineering Projects	OEC	3	3	0	0	3
5	OMF102	Composite Materials	OEC	3	3	0	0	3
6	OCH105	Waste to Energy	OEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	MF1213	Mini Project with Seminar	EEC	2	0	0	2	1
2	MF1311	Project Work Phase I	EEC	12	0	0	12	6
3	MF1411	Project Work Phase II	EEC	24	0	0	24	12

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

SEMESTER I

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	RM1101	Research Methodology and IPR	RMC	2	2	0	0	2

AUDIT COURSES (AC)

SEMESTER I

Registration for any of these courses is optional to students

Sl. No.	Subject Code	Subject Name	Category	Contact Periods	L	T	P	C
1	AX1001	English for Research Paper Writing	AC	2	2	0	0	0
2	AX1002	Disaster Management	AC	2	2	0	0	0
3	AX1003	Sanskrit for Technical Knowledge	AC	2	2	0	0	0
4	AX1004	Value Education	AC	2	2	0	0	0
5	AX1005	Constitution of India	AC	2	2	0	0	0
6	AX1006	Pedagogy Studies	AC	2	2	0	0	0
7	AX1007	Stress Management by Yoga	AC	2	2	0	0	0
8	AX1008	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0

Credits Distribution

Sl. No.	Subject Area	CreditsPer Semester				Credits Total	Percentage %
		I	II	III	IV		
1	FC	04	-	-	-	04	5.7
2	PCC	12	15	-	-	27	38.6
3	PEC	03	06	06	-	15	21.4
4	RMC	02	-	-	-	02	2.9
5	OEC	-	-	03	-	03	4.3
6	EEC	-	01	06	12	19	27.1
7	AC	✓	-	-	-	-	
Total		**21**	**22**	**15**	**12**	**70**	**100**

FC – Foundation Courses
PCC – Professional Core Courses
PEC – Professional Elective Courses
RMC – Research Methodology and IPR Courses
OEC – Open Elective Courses
EEC – Employability Enhancement Courses
AC – Audit Courses / Non - Credit Courses(Optional).

Semester Wise Course Details

Sl. No.	Semester	Theory	Laboratory	Mini Project With Seminar	Project Work		Total
					Phase I	Phase II	
1	I	6 + 1 (*AC)	1	-	-	-	8
2	II	5	2	1	-	-	8
3	III	3	-	-	1	-	4
4	IV	-	-	-	-	1	1
Total		**15**	**3**	**1**	**1**	**1**	**21**

***AC – Audit Courses / Non – Credit Courses (Optional)**

FOUNDATION COURSES (FC)

MA1154	APPLIED PROBABILITY AND STATISTICS TECHNIQUES	L	T	P	C
		4	0	0	4

OBJECTIVES

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

COURSE OUTCOMES (CO)

CO1 The course gives exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.

CO2 The course paves ideas to handle situations involving more than one random variable and functions of random variables.

CO3 Students will gain fundamentals of estimation theory and regression

CO4 Students will gain the knowledge on testing of hypotheses on data. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.

CO5 Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

UNIT - I PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye’s theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT - II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT - III ESTIMATION THEORY 12

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT - IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT - V MULTIVARIATE ANALYSIS 12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL PERIODS: 60

REFERENCE BOOKS:

1. Dallas E. Johnson, "Applied Multivariate Methods for Data Analysis", Thomson and Duxbury press, 1998.
2. Devore, J. L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
3. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", Sultan and Sons, New Delhi, 2001.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 5th Edition, Pearson Education, Asia, 2002.

PROFESSIONAL CORE COURSES (PCC)

MF1101	ADVANCED IN MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce to fundamentals of special machining processes.
- To understand unconventional machining processes.
- To introduce the micro machining process.
- To learn the nano fabrication processes and rapid prototyping

COURSE OUTCOMES (CO)

CO1 Discuss on fundamentals of unconventional machining processes
CO2 To produce useful research output in machining of various materials
CO3 Use this knowledge to develop hybrid machining techniques
CO4 Application of this knowledge to manage shop floor problems
CO5 To design of nano fabrication and rapid prototyping

UNIT – I UNCONVENTIONAL MACHINING 10

Introduction-Bulk processes - surface processes- Plasma Arc Machining- Laser Beam Machining-Electron Beam Machining-Electrical Discharge Machining – Electro chemical Machining-Ultrasonic Machining- Water Jet Machining-Electro Gel Machining-Anisotropic machining-Isotropic machining-Elastic Emission machining – Ion Beam Machining.

UNIT – II PRECISION MACHINING 10

Ultra-Precision turning and grinding: Chemical Mechanical Polishing (CMP) - ELID process – Partial ductile mode grinding-Ultra precision grinding- Binderless wheel – Free form optics. Aspherical surface generation Grinding wheel- Design and selection of grinding wheel-High-speed grinding-High-speed milling- Diamond turning.

UNIT – III ADVANCES IN METAL FORMING 7

Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques –Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming-micro blanking –Powder rolling – Tooling and process parameters.

UNIT – IV MICRO MACHINING AND NANO FABRICATION 10

Theory of micromachining-Chip formation-size effect in micromachining-microturning, micromilling, microdrilling- Micromachining tool design-Micro EDM-Microwire EDM-Nano fabrication:LIGA, Ion beam etching, Molecular manufacturing techniques –Atomic machining- Nano machining techniques – Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum dot fabrication techniques – MOCVD – Epitaxy techniques.

UNIT – V RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES 10

Introduction – Classification – Principle advantages limitations and applications- Stereo lithography – Selective laser sintering –FDM, SGC, LOM, 3D Printing-Surface modification Techniques: Sputtering-CVD-PVD-Diamond like carbon coating-Plasma Spraying Technique.-Diffusion coatings-Pulsed layer deposition.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Narayanaswamy, R., Theory of Metal Forming Plasticity, Narosa Publishers,1989.
2. Pandey, P.S. and Shah.N., “Modern Manufacturing Processes”, Tata McGraw Hill, 1980.
3. Serope Kalpakjian., “Manufacturing Engineering and Technology” Pearson Education,2001

REFERENCE BOOKS:

1. Benedict,G.F.,"Non Traditional manufacturing Processes",CRC press,2011
2. Madou, M.J., Fundamentals of Micro fabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267), 2006.
3. McGeough,J.A.,"Advanced methods of Machining",Springer,2011

		L	T	P	C
MF1102	**COMPUTER INTEGRATED MANUFACTURING SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES

- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

COURSE OUTCOMES (CO)

CO1 The students will be able to explain about various components of computer aided design and the fundamentals of parametric curves, surfaces and Solids.

CO2 The students will be able to explain about various components of computer integrated manufacturing and its applications.

CO3 The students will be able to explain about the features of group technology and computer aided process planning.

CO4 The students will be able to explain about the features of shop floor control and flexible manufacturing systems.

CO5 The students will be able to explain about various components of computer aided planning and control and computer monitoring.

UNIT - I COMPUTER AIDED DESIGN 9

Product cycle- Sequential and concurrent engineering- CAD system architecture- Computer graphics – Co-ordinate systems- 2D and 3D transformations - Line drawing -Clipping- viewing transformation, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

UNIT - II COMPONENTS OF CIM 9

CIM as a concept and a technology, CASA/SME model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM.

UNIT - III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING 9

History Of Group Technology – role of G.T in CAD/CAM Integration – part families- classification and coding – DCLASS and MCLASS and OPTIZ coding systems – facility design using G.T – benefits of G.T – cellular manufacturing. Process planning - role of process planning in CAD/CAM Integration – approaches to computer aided process planning – variant approach and generative approaches – CAPP and CMPP systems.

UNIT - IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS 9

Shop floor control – phases – factory data collection system – automatic identification methods – Bar code technology – automated data collection system.
FMS – components of FMS – types – FMS workstation – material handling and storage system –FMS layout- computer control systems – applications and benefits.

UNIT - V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING 9

Production planning and control – cost planning and control – inventory management – material requirements planning (MRP) – shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems – structure model of manufacturing – process control and strategies – direct digital control.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Chris McMahon and Jimmie Browne, “CAD CAM Principles, Practice and Manufacturing Management”, Pearson Education second edition, 2005.Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd.,2005.
2. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
3. James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Education second edition, 2005.

REFERENCE BOOKS:

1. Mikell. P. Groover and Emory Zimmers Jr.,CAD/CAM”, Prentice hall of India Pvt.Ltd., 1998.
2. P N Rao, “CAD/CAM Principles and Applications”, TMH Publications, 2007.
3. Yorem Koren, “Computer Integrated Manufacturing”, McGraw Hill, 2005.

MF1103	ADVANCES IN MATERIALS TECHNOLOGY	L	T	P	C
		4	0	0	4

OBJECTIVES

- To understand the elastic and plastic behaviour of materials.
- To impart knowledge on fracture analysis.
- To familiarize on modern metallic materials.

- To review on polymeric and ceramics materials and their applications.
- To enable student to select material for specific applications.

COURSE OUTCOMES (CO)

CO1 Get knowledge of mechanism of failure of materials and methods.
CO2 Fully appreciate modification of material property to suit the specific requirements.
CO3 Express and appreciate the existing materials and development of upcoming new materials.
CO4 Have the knowledge to select the various non-metallic materials to suit required applications
CO5 Identify and select suitable material for relevant application.

UNIT - I ELASTIC AND PLASTIC BEHAVIOR 10

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre, dispersion and texture strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of polymeric, ceramic and non-crystalline materials.

UNIT - II FRACTURE BEHAVIOUR 10

Griffith‘s theory, stress intensity factor, J-Integral and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture in ceramics and polymers – Failure analysis, sources of failure, procedure of failure analysis.

UNIT - III MODERN METALLIC MATERIALS 8

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel, Super alloys –Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT - IV NON METALLIC MATERIALS 7

Polymeric materials – Formation of polymer structure – Production techniques of fibres, foams, adhesives and coating – structure, properties and applications of Commodity and engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, applications as abrasives and cutting tool- Properties and applications of CNT – Graphene based Material

UNIT - V SELECTION OF MATERIALS 10

Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for Atmospheric, water, Soil and chemical, corrosion Selection for adhesive and abrasive wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery, chemical and nuclear applications.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ashby M.F., Material Selection in Mechanical Design, 5thEdition, Butter Worth 2017.
2. ASM Hand book, Vol.11, Failure Analysis and Prevention, 10thEdition, ASM, 2002.
3. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, 3rd edition, Butterworth-Heiremann, 2001.
4. Thomas H. Courtney, Mechanical Behaviour of Materials, 2ndedition, McGraw Hill, 2000.

REFERENCE BOOKS:

1. Marc Andre, Meyers and Krishan Kumar Chawla, Mechanical Behaviour of Materials, 2ndEdition, Cambridge University Press, 2009.
2. George E.Dieter, Mechanical Metallurgy, 3rd Edition,McGraw Hill, 2014.10. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
3. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010.

MF1111	CAD/CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

 To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines

 To train them to use the various sensors

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.

CAD LABORATORY

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course the students are expected to

CO1 Draw complex geometries of machine components in sketcher mode.

CO2 Ability to Develop 2D and 3D Part Models using Modeling Software.

CO3 Create complex engineering assemblies using appropriate assembly constraints.

CO4 Ability to Understand the CNC Control in Modern Manufacturing System.

CO5 Ability to Prepare CNC Part Programming and Perform Manufacturing.

LIST OF EQUIPMENTS

S.NO	EQUIPMENT	QUANTITY
1.	Computer Server	1
2.	Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server	30
3.	A3 size plotter	1
4.	Laser Printer	1
5.	CNC Lathe	1
6.	CNC milling machine	1
	SOFTWARE	
7.	Any High end integrated modeling and manufacturing CAD / CAM software	15 licenses
8.	CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller)	15 licenses
9.	Licensed operating system	adequate
10.	Support for CAPP	adequate

MF1201 OPTIMIZATION TECHNIQUES

L	T	P	C
3	1	0	4

OBJECTIVES

- To introduce the various optimization techniques and their advancements.
- To make use of the above techniques while modeling and solving the engineering problems of different fields

COURSE OUTCOMES (CO)

CO1 The student has the basic knowledge about historical development of optimization problems, formulation of the problem, classification and application to various engineering domain.

CO2 Ability to approach and solve the linear equations of operational research problems which relates to the real engineering business problem.

CO3 Ability to approach and solve the Non-linear equations of operational research problems which relates to the real engineering business problem.

CO4 Ability to use the various optimization techniques for solving the various experimental studies to obtain the optimum objective function value.

CO5 The student has the knowledge about various simulation techniques and knows to relate these techniques to various experimental studies to obtain the optimum objective function value.

UNIT - I INTRODUCTION 5

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems

UNIT - II CLASSIC OPTIMIZATION TECHNIQUES 10

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT - III NON-LINEAR PROGRAMMING 9

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT - IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES 12

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem

UNIT - V ADVANCES IN SIMULATION 9

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL PERIODS: 60

TEXT BOOKS:

1. Singiresu S. Rao , "Engineering Optimization: Theory and Practice", Fourth Edition ,John Wiley & Sons, Inc., 2009
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 – 2005

REFERENCE BOOKS:

1. Hamdy A. Taha, Operations Research – An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research – Theory and Applications – Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research – Sultan chand & Sons, 1994
4. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

MF1202	ADVANCES IN METROLOGY AND INSPECTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries.
- To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.

COURSE OUTCOMES (CO)

C111.1 Ability to understand the concepts of metrology and errors in measurement
C111.2 Ability to understand the applications of measurement of surface roughness
C111.3 Ability to understand the basic study of interferometry and its importance
C111.4 Ability to understand measuring machines and laser metrology .
C111.5 Ability to apply image processing for metrology

UNIT - I CONCEPTS OF METROLOGY 8

Terminologies – Standards of measurement – Errors in measurement – Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments – Basics of Dimensional metrology and Form metrology

UNIT - II MEASUREMENT OF SURFACE ROUGHNESS 9

Definitions – Types of Surface Texture: Surface Roughness Measurement Methods- Comparison, Contact and Non Contact type roughness measuring devices, 3D Surface Roughness Measurement, Nano Level Surface Roughness Measurement – Instruments

UNIT - III INTERFEROMETRY 8

Introduction, Principles of light interference – Interferometers – Measurement and Calibration – Laser Interferometry.

UNIT - IV MEASURING MACHINES AND LASER METROLOGY 10

Tool Makers Microscope – Microhite – Coordinate Measuring Machines – Applications – Laser Micrometer, Laser Scanning gauge, Computer Aided Inspection techniques - In-process inspection, Machine Vision system-Applications.

UNIT - V IMAGE PROCESSING FOR METROLOGY 10

Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms - Examples.

TOTAL PERIODS: 45

TEXT BOOKS:

1.Jain ,R.K.,“Engineering Metrology”, Khanna Publishers, 2008.
2. Rajput,R.K., “Engineering Metrology and Instrumentations”, Kataria & Sons Publishers, 2001.

REFERENCE BOOKS:

1. “ASTE Handbook of Industries Metrology”, Prentice Hall of India Ltd., 1992.
2. Bewoor, A.K. and Kulkarni,V.A.,”Metrology and Measurement”, Tata Mc Graw-Hill, 2009.
3. Galyer, F.W. and Shotbolt, C.R., “Metrology for engineers”, ELBS, 1990.
4. Gupta, I.C., “A Text Book of engineering metrology”, Dhanpat Rai and Sons, 1996.
5. Smith,G.T., “Industrial Metrology”, Springer, 2002
6. Sonka,M., Hlavac,V. and Boyle.R., “Image Processing, Analysis, and Machine Vision”, Cengage Engineering, 2007.
7. Whitehouse,D.J., "Surface and their measurement", Hermes Penton Ltd, 2004.

MF1203	TOOLING FOR MANUFACTURING	L	T	P	C
		4	0	0	4

OBJECTIVES

- To study the various design considerations for tooling.
- Develop knowledge in tooling and work holding devices.

COURSE OUTCOMES (CO)

CO1	Explain the fundamental concepts of tooling, tool engineering procedures, control and maintenance.
CO2	Discuss the mechanism in metal removal, tooling of automats, tooling in Non-traditional material removal processes
CO3	Explain the concept of tooling in metal forming processes.
CO4	Explain the concept of tooling in metal casting and metal joining processes
CO5	Explain the concept of inspection and gauging

UNIT - I INTRODUCTION 12

Manufacturing Processes-objectives of manufacturing processes-classification of manufacturing process-Objectives of Tool design-tool design process-Nature and scope of Tool engineering-principles of economy for tooling-problems of economy in tooling-planning and tooling for economy-Manufacturing principles applicable to process and tool planning-tool control-tool maintenance-tool materials and its selection

UNIT - II TOOLING FOR METAL REMOVAL PROCESSES 12

Traditional machining processes -work and tool holding devices-tool nomenclatures-Mechanism of machining-force temperature and tool life of single point tool-multipoint tools -tool design-tool wear-special processes-capstan and turret lathe-tooling layout of automats-tooling in NC and CNC machines-tooling for machining centres-CAD in tool design-Jigs and fixtures-design-Non-traditional material removal processes-mechanical, electrical thermal and chemical energy processes-principles-operation-equipment-tooling parameters and limitations.

UNIT - III TOOLING FOR METAL FORMING PROCESSES 12

Classification of Forming Processes-Types of presses-design of -blanking and piercing dies-simple, compound, combination and progressive dies-Drawing Dies-Bending dies-forging dies-plastic moulding dies

UNIT - IV TOOLING FOR METAL CASTING AND METAL JOINING PROCESSES 12

Tools and Equipment for moulding-patterns –pattern allowances – pattern construction-die casting tools- mechanization of foundries. Tooling for Physical joining processes Design of welding fixtures – Arc welding, Gas welding, Resistance welding, laser welding fixtures-Tooling for Soldering and Brazing Tooling for Mechanical joining processes

UNIT - V TOOLING FOR INSPECTION AND GAUGING 12

Survey of linear and angular measurements-standards of measurement-design and manufacturing of gauges- measurement of form-Inspection bench centre-co-ordinate measuring machine-tooling in CMM.

TOTAL PERIODS: 60

REFERENCE BOOKS:

1. Cyril Donaldson Tool Design, Tata McGraw Hill, 1976
2. Hoffman E.G Fundamentals of tool design SME 1984.
3. Kalpak Jian S., Manufacturing Engineering and Technology Addison Wesley 1995.
4. L E Doyle Tool Engineering Prentice Hall 1950
5. Wellar, J Non-Traditional Machining Processes, SME, 1984

MF1211	MODELLING AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To study the fundamentals of finite element analysis from classical method to nodal approximation method in various fields of manufacturing applications.
- To make the students to design an element by Finite element analysis.
- To develop the knowledge related to modelling and simulation in field of manufacturing.

LIST OF EXERCISES

1. One Dimensional FEA Problem like beam, Truss etc.
2. Two Dimensional FEA Problems like plane stress, plane strain, axisymmetric and vibration.
3. Three Dimensional FEA Problems like shell and contact.
4. FEA Application in metal forming like superplastic forming, deep drawing etc
5. FEA Application in Metal cutting

6. FEA Application in Casting process
7. 3D Modelling and Assemble of Engine
8. Modelling of Crack Shaft
9. Modelling of Connecting Rod
10. Modelling of Cotter Joint
11. Modelling of Plummer Block and Coupling

(Any 10 for Conduct of end semester examination)

COURSE OUTCOMES (CO)

Students will be able to

CO1 : Apply the principles of Finite Element Analysis to solve problems in the field of production engineering.

CO2 : design and analyse various problems in field of manufacturing

CO3 : identify the problems and simulate using Finite element analysis

CO4 : Relate to Finite element analysis in various manufacturing applications.

CO5 : Develop skills in field of design and simulation using FEA.

MF1212	AUTOMATION & METAL FORMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To train the students to have an hands on having the basic concepts of metal forming processes and to determine some metal forming parameters for a given shape

COURSE OUTCOMES (CO)

CO1 Ability to Design pneumatic circuits with trainer kits and execute

CO2 Ability to understand the metal forming techniques and evaluate the related parameters.

CO3 Ability to design and execute pnuemo-hydraulic circuits using hydro-pneumatic Software.(case studies)

CO4 Ability to understand the strain hardening of material and evaluate.

CO5 Ability to understand the formability of sheet metal and forming methods.

EXPERIMENTS

1. Determination of strain hardening exponent
2. Determination of strain rate sensitivity index
3. Construction of formability limit diagram
4. Determination of efficiency in water hammer forming
5. Determination of interface friction factor
6. Determination of extrusion load
7. Study on two high rolling process

AUTOMATION LAB

1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits
6. Software simulation of fluid power circuits using Automation studio

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Universal testing machine.
2. Hydraulic press.
3. Pipe surge and Water hammer apparatus.
4. Extrusion machine.
5. Two high mill roll apparatus.
6. Force sensor and motion sensor.

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

		L	T	P	C
MF1213	**MINI PROJECT WITH SEMINAR**	0	0	2	1

OBJECTIVES

- To prepare students to identify a problem for study.
- To do literature review of a problem.
- To enable to comprehend information in form of presentation both written and oral, to develop technical communication skills.
- To carry out modelling/ conduct experiments beyond regular laboratory exercises in developing solution to the identified problem.
- To cultivate spirit of team work in working as a group.

COURSE OUTCOMES (CO)

CO1 To critically observe the world around and identify a problem that can be solved.
CO2 To develop skills of read and comprehensively analysing the facts.
CO3 To exhibit skill of presentation both orally and in written form.
CO4 To get hands on experience to doing experimental/ theoretical analysis in synthesis of solution to the problem
CO5 Able to appreciate the importance of team work

TOTAL PERIODS: 30

		L	T	P	C
MF1311	**PROJECT WORK PHASE-I**	0	0	12	6

OBJECTIVES

- To enable students to select and define a problem/need for analysis in the field of manufacturing engineering.
- To review and analyse literature/ data of selected problem for study and propose objective and scope of dissertation work.
- To develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem
- To design, model and experiment/develop optimal solution for problem being investigated
- To analysis and interpretation of data, and synthesis of the information to provide valid conclusions and submit dissertation.

COURSE OUTCOMES (CO)

CO1 Identify a topic in advanced areas of Manufacturing Engineering. Identify methods and materials to carry out experiments
CO2 Review literature to identify gaps and define objectives & scope of the work

CO3	Generate and implement innovative ideas for social benefit
CO4	Analyze and discuss the results to draw valid conclusions
CO5	Reorganize the procedures with a concern for society, environment and ethics

EVALUATION

- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report
- Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes.

OUTCOMES

- The students' would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

TOTAL PERIODS: 24

MF1411	PROJECT WORK PHASE-II	L	T	P	C
		0	0	24	12

OBJECTIVES

- Based on practical experience in project work phase I, the students will be able to propose and define a problem/need for analysis in the field of manufacturing engineering.
- To comprehensively review and analyse literature/ data to develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem
- To design experiments, develop model and conduct experiments/ simulations for development of sustainable and economical solution for problem being investigated
- To analyse and interpret data, and synthesize of the factual information's to arrive at valid conclusions
- To enable students to communicate technical information in form of oral presentation and technical report in form of dissertation.

COURSE OUTCOMES (CO)

CO1	Identify a topic in advanced areas of Manufacturing Engineering.Identify methods and materials to carry out experiments
CO2	Review literature to identify gaps and define objectives & scope of the work
CO3	Reorganize the procedures with a concern for society, environment and ethics
CO4	Generate and implement innovative ideas for social benefit
CO5	Analyze and discuss the results to draw valid conclusions

EVALUATION

- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report
- Project work evaluation is based on the Regulations of the Credit system for Post graduate

programmes.

OUTCOMES

- The students' would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

TOTAL PERIODS: 24

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER I

PROFESSIONAL ELECTIVE COURSES – I

		L	T	P	C
MF1001	**DESIGN OF MANUFACTURING TOOLS, JIGS AND FIXTURES**	3	0	0	3

OBJECTIVES

- To introduce to fundamentals of Jigs and Fixtures and tool materials.
- To understand geometrical features and design of cutting tools.
- To introduce the design steps of tools for metal forming operation.
- To learn the design process of clamping, locator and fixtures
- To familiarize the design process of Jigs and tool guides

COURSE OUTCOMES (CO)

CO1 Discuss on fundamentals Jigs and Fixtures and tool materials
CO2 Brief on geometrical features and design of cutting tools.
CO3 Understand the design steps of tools for metal forming operation.
CO4 Carryout design process for clamping, locator and fixtures.
CO5 To design of Jigs and tool guides

UNIT - I INTRODUCTION 9

Introduction, The design procedure, Drafting and design techniques in tooling drawing. Tooling Materials and Heat Treatment: Introduction, Properties of materials, Ferrous tooling materials, Non-ferrous tooling materials, Non-metallic tooling materials, Heat treatment and tool design. Introduction to Jigs and Fixtures: Definition, Differences between Jigs and Fixtures, principles of Jigs and Fixtures.

UNIT - II DESIGN OF CUTTING AND METROLOGY TOOLS 9

Introduction to metal cutting process and tools, Revision of metal cutting tools-Single point cutting tools, Milling cutters, Drills and Drilling, Reamers, Taps. Selection of carbide tools, determining the insert thickness for carbide tools. Introduction to Design of Tools for Inspection and Gauging, Geometrical Dimensioning and Tolerance, Work piece quality criteria, Principles of gauging, Types of gages and their applications, Amplification and magnification of error, Gage Tolerances, Indicating gages, Automatic gages, Gauging positional tolerance parts, problems.

UNIT - III DESIGN OF PRESS TOOLS 9

Design of Press-working Tools: Power presses, Cutting operations, Types of die-cutting operations - and their design, Evolution of blanking and progressive blanking. Design of Sheet Metal Bending, Forming and Drawing Dies: Introduction, Bending dies, Forming dies, and Drawing dies. Evolution of a draw die, Progressive dies. Strip development for progressive dies, Examples of progressive dies. Extrusion dies, Drop forging dies and auxiliary tools

UNIT - IV DESIGN OF CLAMPS LOCATING METHODS AND FIXTURES 9

Locating and Clamping Methods: Introduction, Basic principle of location, Locating methods and devices, Basic principle of clamping. Principles of Location: Six degrees of freedom, Duty of the location system, Choice of location system, redundant location, 3-2-1 Location, Types and methods of location. Principles of Clamping: Requirements of the clamping system, Position of the clamps, Design of clamps, Types of clamps: Cam clamp, Toggle clamp. General Principles Of Milling, Lathe, Boring, Broaching And Grinding Fixtures – Assembly, Inspection And Welding Fixtures – Modular Fixturing Systems- Quick Change Fixtures.

UNIT - V DESIGN OF JIGS AND TOOL GUIDES 9

Types Of Jigs –plate Jig, Box Jig, Leaf Jig, Channel Jig, Post, Turnover, Channel, Latch, Pot, Angular Post Jigs – Indexing Jigs – Design of Drill Jigs: Introduction, Types of drill jigs, General considerations in the design of drill jigs, Drill bushings, Methods of construction. Guiding Elements: Introduction, Guiding the tools, Types of drill bushes.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Cyril Donaldson, Lecain, G.H. and Goold, V.C. Tool Design , 4th editions, TMH Publishing Co Ltd., New Delhi, 2012.
2. Donaldson, Lecain And Goold “Tool Design”, 3rdEdition, Tata McGraw Hill, 2000.
3. Hoffman “Jigs And Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
4. Joshi, P.H. “Jigs And Fixtures”, 2ndEdition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Kempster, “Jigs And Fixture Design”, 3rd Edition, Hoddes And Stoughton, 1974.
2. Nagpal, G.R., “Tool Engineering and Design”, 6th edition, Khanna Publishers, , 2009.
3. Venkataraman. K., “Design Of Jigs Fixtures and Press Tools”, Tata McGraw Hill, New Delhi, 2005

MF1002	NON-DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To stress the importance of NDT in engineering.

COURSE OUTCOMES (CO)

CO1	To introduce the basic principles, techniques, equipment, applications and limitations of NDT methods such as Visual inspection and liquid penetrant testing.
CO2	To learn the eddy current testing and acoustic emission NDT methods.
CO3	To know the magnetic particle and thermography testing methods.
CO4	To identify the defects by ultrasonic testing methods.
CO5	To make aware the developments and future trends in Radiography.

UNIT - I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications.

UNIT - II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT - III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.
Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT - IV ULTRASONIC TESTING 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT - V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.
Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002.
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, New York, 1996.

REFERENCE BOOKS:

1. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker, Inc., New York, 2002.
2. www.ndt.net.

MF1003	METAL CUTTING THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

OBJECTIVES

To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.
To find the tool life in various machining operations by different machining condition.

COURSE OUTCOMES (CO)

CO1	To study the basic mechanism of chip formation, types of chips and other theories proposed by different scientists.
CO2	Have the detailed knowledge of single and multipoint cutting tool nomenclature.
CO3	Have the complete idea of heat distribution in cutting tool, influence of cutting fluid on tool.
CO4	To study the tool life calculation, machinability index.
CO5	To have the concept of tool wear mechanism, types of chatter and its mechanism.

UNIT – I INTRODUCTION 12

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT - II SYSTEM OF TOOL NOMENCLATURE 12

Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

UNIT - III THERMAL ASPECTS OF MACHINING 12

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids

UNIT - IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 12

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index-economics of machining.

UNIT - V WEAR MECHANISMS AND CHATTER IN MACHINING 12

Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter

TOTAL PERIODS: 60

TEXT BOOKS:

1. Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India, 1984.

REFERENCE BOOKS:

1. Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 1989.
2. Shaw.M.C.Metal cutting principles, oxford Clare don press, 1984

MF1004	OPERATIONS MANAGEMENT	L	T	P	C
		3	0	0	0

OBJECTIVES

- To familiarize with various forecasting models.
- To impress upon the importance of sequencing problem in industries.
- To design and develop inventory control models for a given industry.
- To familiarize with project management techniques such as CPM and PERT.
- To train on plant engineering techniques such as plant location, plant layout, materials

handling and work study

COURSE OUTCOMES (CO)

CO1 Select an appropriate forecasting method for a given industry.
CO2 Obtain optimal solutions for sequencing problem in industry.
CO3 Design a suitable inventory system for any particular industry.
CO4 Use the project management techniques to minimize the project time.
CO5 Design plant layout and materials handling systems and can make use of the concepts of work study for work design.

UNIT - I FORECASTING 9

Forecasts-Types-Purpose- opinion and judgmental method-Time series methods – moving average - weighted moving average – method of least squares – Exponential smoothing method- Regression and correlation methods – simple and multiple regression – Linear and Nonlinear regression

UNIT - II SCHEDULING AND SEQUENCING 9

Scheduling – Single Criterion rules –Sequencing –n job 2 machine problem – Johnson's algorithm – 3 machine problem – M machine problem – Graphical method for 2 jobs M machine problems – Heuristic methods.

UNIT - III INVENTORY 9

Inventory – purpose of inventory – Basic EOQ Model –Quantity discount model – Reorder level – Fixed order quantity inventory system – Periodic review system – ABC analysis – Materials requirement planning – EOQ models under constraints – Purchasing management – Stores management – Just In Time inventory system – Vendor evaluation - Inventory pricing –Supply chain Management – Aggregate planning.

UNIT - IV PROJECT MANAGEMENT 9

Project network analysis – Activities – Events- critical path method – Method based on time estimates – Programme Evaluation Review Technique –Optimistic, pessimistic time, most likely time - Probability of completion of projects – Time crashing of Projects –Optimum duration and cost

UNIT - V PLANT ENGINEERING AND WORK STUD 9

Plant location – Factors affecting plant location – Break even analysis- Factors weighted rating method – Plant layout- Types- Selection – Plant layout Techniques – Travel chart method – Line balancing method– Work study – method study – Principles of Motion economy – steps in methods study - Charts – Micromotion study-memo motion study – multiple activity charts- therbligs – work measurement – stop watch time study – Production studies – PMTS – Work sampling – Materials handling – Principles – Selection

TOTAL PERIODS: 45

TEXT BOOKS:

1. Chary S.N Production and Operations Management, Tata McGraw Hill, 3rd Edition 2012.
2. Kanishka Bedi, Production and Operations Management, Oxford University Press,3rdEdition 2016.
3. Norma Gaither and Gregory Frazier, Operations Management, Cengage Learning, 9thEdition,2016.

REFERENCE BOOKS:

1. Pannerselvam R, Production and Operations Management, Prentice Hall of India, 2ndEdition, 2008.
2. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, McGraw Hill,14th edition, 2017.
3. William J Stevenson, Operations Management, McGraw Hill, 11th edition, 2012

SEMESTER II

PROFESSIONAL ELECTIVE COURSES – II

MF1005	**ADVANCES IN CASTING AND WELDING**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of welding process.

COURSE OUTCOMES (CO)

CO1 Ability to understand the concepts of casting design and casting principles

CO2 Ability to understand the concepts of casting metallurgy, casting effects and Castability

CO3 Ability to understand the basic study of foundry and the different technologies involved in casting

CO4 Ability to understand welding technique and technological aspects over welding design.

CO5 Ability to understand the unique characteristics of welding

UNIT - I CASTING DESIGN 8

Heat transfer between metal and mould –– Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT - II CASTING METALLURGY 8

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification –– Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys, Babbit alloy and Cu alloy.

UNIT - III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8

Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry –– Computer aided design of casting.

UNIT - IV WELDING METALLURGY AND DESIGN 10

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment

UNIT - V RECENT TRENDS IN WELDING 11

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electroslag welding- narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water

TOTAL PERIODS: 45

TEXT BOOKS:

1. Jain. P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
2. Parmer R.S., Welding Engineering and Technology, Khanna Publishers,2002

REFERENCE BOOKS:

1. ASM Handbook vol.6, welding Brazing & Soldering, 2003
2. ASM Handbook, Vol 15, Casting, 2004
3. Cary B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
4. Cornu.J. Advanced welding systems – Volumes I, II and III, JAICO Publishers, 1994.
5. Heineloper &Rosenthal, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. Iotrowski – Robotic welding – A guide to selection and application – Society of mechanical Engineers, 1987.
7. Lancaster.J.F. – Metallurgy of welding – George Alien & Unwin Publishers, 1980
8. Schwariz, M.M. – Source book on innovative welding processes – American Society for Metals (OHIO), 1981
9. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002

MF1006	FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the fundamentals of one dimensional and two dimensional problems, higher order elements using FEA in manufacturing.
- Finite element methods and its application in manufacturing.

COURSE OUTCOMES (CO)

CO1 To understand the fundamentals of FEA and functional approximation method used to find the solution of engineering problems

CO2 To study the fundamentals of one dimensional problems using FEA in manufacturing.

CO3 To study the shape function of 1D, 2D finite elements and concepts of higher order elements which are useful for FEA in manufacturing.

CO4 To be familiar in utilization of analysis software and to get solution for manufacturing process

CO5 To understand and interpret the solutions obtained by software with respect to different types of manufacturing areas.

UNIT - I INTRODUCTION 6

Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT - II ONE DIMENSIONAL ANALYSIS 10

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT - III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 10

Shape functions for one and two dimensional elements- Three noded triangular and four nodded quadrilateral element Global and natural co-ordinates—Non linear analysis – Isoparametric elements

– Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT - IV COMPUTER IMPLEMENTATION 9

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

UNIT - V ANALYSIS OF PRODUCTION PROCESSES 10

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bathe, K.J., Finite Element procedures in Engineering Analysis, 1990 , Latest Edition
2. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill,2017, Latest Edition

REFERENCE BOOKS:

1. Kobayashi,S, Soo-ik-Oh and Altan,T, Metal Forming and the Finite Element Methods, Oxford University Press, 1989.
2. Lewis R.W. Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.
3. Rao, S.S., Finite Element method in engineering, Pergamon press, 2005.
4. Seshu P., Textbook of Finite Element Analysis, PHI Learning Pvt. Ltd, 2004.
5. www.pollockeng.com
6. www.tbook.com

MF1007	MANUFACTURING OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students about the requirement of materials for automobile components
- To familiarize students on typical materials used in manufacturing of automobile components
- To impart knowledge on material and manufacturing techniques of piston, valves and battery parts
- To impart knowledge on material and manufacturing techniques of engine blocks, cables and locks in automobile.
- To impart knowledge on material and manufacturing techniques of general transmission parts of automobile

COURSE OUTCOMES (CO)

CO1 Have the knowledge about material requirements, its recycling and life cycle aspects.
CO2 Gain an insight over the latest materials adopted in automobile manufacture.
CO3 Have the knowledge of methods adopted in manufacture of piston, valves and battery parts.
CO4 Know the methods of manufacturing engine block, cables and locks in automobile.
CO5 Have the idea of various manufacturing methods of automobile structure, transmission parts.

UNIT - I MATERIAL NEEDS IN AUTOMOBILE 9

Requirements of materials in automotive tests – recycling and life cycle consideration. Current materials in use and their future. Advanced in manufacturing and joining techniques. Technical problems and solutions for use of magnesium alloys in automotive industry. Most commonly used composite moulding processes. Renewable materials, barriers and incentives in use of bio-composites - composite materials and their automotive applications.

UNIT - II MATERIALS AND TECHNOLOGIES FOR AUTOMOBILE 8

Introduction – steel sheets – high strength steel sheet – "Nano-Hilen" – "BHT" – high strength galvannealed steel sheets – development of inorganic type high lubrication galvannealed steel sheets – organic solid lubricant technology – uses of aluminium in automobiles – uses of plastics in automobiles.

UNIT – III MANUFACTURING OF PISTON, VALVES AND BATTERY PARTS 10

Introduction – manufacturing of auto piston – manufacturing of pins for automobiles – manufacturing of piston rings – manufacturing of lead storage battery. Manufacturing of valve and valve set – manufacturing of automobile silencer.

UNIT - IV MANUFACTURING OF ENGINE BLOCK, CABLES AND LOCKS 8

Manufacturing of automobile chain – manufacturing of cylindrical block. Manufacturing of cylinder liner – manufacturing of automobile control cable – manufacturing of engine moulding pad – manufacturing of auto locks.

UNIT - V MANUFACTURING OF TRANSMISSION PARTS 10

Manufacturing of automobile chassis and other technologies. Manufacturing of automobile body – Manufacturing of disc brake – Manufacturing of brake drum – Manufacturing of gear blank – Manufacturing of gear – casting method – forming method – powder metallurgy – Manufacturing of gear box housing – Manufacturing process of leaf spring – Manufacturing process of automotive tyres – Manufacturing of auto tubes and flaps. Heat treatment of automobile components – forging technologies of automobile parts – Manufacturing of Torque Converters- painting technology of automobiles - Role of Nanotechnology in Automotive Industries.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Gupta K.M, Automobile Engineering Vol.I and II, Umesh Publishers, 2000.
2. Kirpal Singh, Automobile Engineering, Vol.I and II, Standard Publishers, New Delhi, 1997.
3. Ramalingam K K, Automobile Engineering: Theory and Practice, 2nd Edition, Scitech Publications (India), 2001.

REFERENCE BOOKS:

1. Joao Paulo Carmo, New Advances in Vehicular Technology and Automotive Engineering, JanezaTrdine publisher, 2012.
2. Ahmed Elmarkkbi, Advanced Composite Materials for Automotive Applications, Wiley publications, 2014.
3. Brian Cartor, Patric Grant, Automotive Engineering Light Weight, Functional and Novel materials, Taylor and Francis, CRC Press, 2008.

MF1008 COMPUTER AIDED PRODUCT DESIGN

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To review the basics of Computer aided design
- To familiarize students on use of modelling tools of CAD software.
- To apply the various design concepts and design tools and techniques while designing a product.
- To understand the product modelling method and its relationship with computer graphics.
- To create awareness on product life cycle management.

COURSE OUTCOMES(CO):

Students will be able to

1. Understand the design phases and various design hardware and software.
2. Relating basics of various geometrical feature creation.
3. Systematically work on each stages in the development of a new product and its management.
4. Predicting on various factors for various design applications.
5. Mixing the techniques in the design of new product.

UNIT I INTRODUCTION 8

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – CAD/CAM hardware and Softwares – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC 8

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves - Geometric Modelling – types – Wire frame surface and solid modelling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modelling – use of software packages

UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT 10

Understanding customer needs – Product function modelling – Function trees and function structures – Product tear down methods – Bench marking – Product portfolio – concept generation and selection – Product Data Management – concepts – Collaborative product design– manufacturing planning factor – Customization factor – Product life cycle management.

UNIT IV PRODUCT DESIGN TOOLS AND TECHNIQUES 10

Product modelling – types of product models; product development process tools – TRIZ – Altshuller‘s inventive principles – Modelling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment

UNIT V PRODUCT DESIGN TECHNIQUES 9

FMEA – QFD – Poka Yoke - DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

TOTALPERIODS: 45

REFERENCES:

1. Biren Prasad, ―Concurrent Engineering Fundamentals Vol.II, Prentice Hall,1st Edition, 1996..
2. David F.,Rogers.J, Alan Adams, Mathematical Elements for Computer Graphics, McGraw Hill, 2ndEdition,2002.
3. Ibrahim Zeid, Sivasubramanian R, CAD/CAM theory and Practice, McGraw Hill, 2ndEdition, 2009.
4. James G.Bralla, Handbook of Product Design for Manufacturing, McGraw Hill, 1998
5. Kevin Otto, Kristin Wood, Product Design, Pearson Education, 2004.

PROFESSIONAL ELECTIVE COURSES – III

		L	T	P	C
MF1009	**ROBOTICS AND INDUSTRIAL AUTOMATION**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES:

To make the student to be familiar with
- Classification and construction of robots
- Serial and parallel Manipulators
- Programming method of robots
- Understand various control systems

COURSE OUTCOMES (CO):

Students will be able to
CO1 Understand the basics of robotics.
CO2 Relating basics of robot arm kinematics and dynamics.
CO3 Understand the basics of robot programming methods.
CO4 Understanding the basics of sensing elements.
CO5 Understand the control system and components.

Unit I INTRODUCTION TO ROBOTICS 9

Introduction to Robotics: Definitions, historical development, classification, work volume, Control systems and dynamic performance. – Grippers

Unit II ROBOT ARM KINEMATICS AND DYNAMICS 9

Robot Arm Kinematics and Dynamics: Frame transformation, D-H parameters, Forward kinematics, Inverse kinematics, - Rotation matrix - Homogeneous coordinates and transformation matrix

Unit III ROBOT PROGRAMMING METHODS 9

Robot Programming Methods: Manual teaching, Lead-through teaching, VAL programming. – Introduction to trajectory Planning - Introduction to Automation.

Unit IV SENSING 9

Sensing: Range sensing, proximity sensing, touch sensors, force and torque sensing, Robot Vision: System: Sensing & Digitizing, Image processing & Analysis, Application.

Unit VCONTROL SYSTEM AND COMPONENTS 9

Control system and components: Control system concepts and models, controllers, Control system analysis, Robot Activation and Feedback componens – position control - velocity control – Actuation.

TOTALPERIODS: 45

REFERENCES:

1.Mikell P. Groover, “Industrial Robots”, McGraw Hill, 2005
2.S.K. Saha, Introductions to Robotics, McGraw Hill, 2009
3.L.K. Huat, Industrial Robotics: Programming, Simulation and Applications, Tata McGraw Hill, 2003.
4.Ganesh Hegde, A textbook of Industrial Robotics, Lakshmi Publication, 2006.

MF1010	THEORY OF METAL FORMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming

COURSE OUTCOMES (CO):

Students will be able to
CO1 Understand the basics of theory of plasticity.
CO2 Relate the theory and practicing methods of Bulk Forming Processes
CO3 Understand the basics of sheet metal forming.
CO4 Understanding the basics of powder metallurgy and special forming processes.
CO5 Understand the surface treatment and metal forming applications.

UNIT I THEORY OF PLASTICITY 9

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress-strain relation – Mohr’s circle representation of a state of stress – cylindrical and spherical co-ordinate system – upper and lower bound solution methods – Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 8

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III SHEET METAL FORMING 8

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling – Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9

Experiment techniques of evaluation of friction in metal forming selection – influence of temperature and gliding velocity – Friction heat generation – Friction between metallic layers – Lubrication carrier layer – Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation – Formability of welded blank sheet – Laser structured steel sheet - Formability of laminated sheet.

TOTALPERIODS: 45

REFERENCES:

1. Altan T., Metal forming – Fundamentals and applications – American Society of Metals, Metals park, 2003
2. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1995.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol – 14, 2003
4. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 1988
5. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press, 2012.
6. Marciniak,Z., Duncan J.L., Hu S.J., 'Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elesevier, 2006
7. Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.
8. Proc. Of National Seminar on "Advances in Metal Forming" MIT, March 2000
9. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007
10. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T,Metal forming and Finite Element Method, Oxford University Press, 2001.
11. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010.

MF1011	LEAN AND AGILE MANUFACTURING	L	T	P	C
		3	0	0	0

OBJECTIVES

- To provide basic understanding on the concepts of Lean and Agile Manufacturing.

COURSE OUTCOMES (CO)

CO1	The student will be able to practice the principles of lean manufacturing
CO2	The student will be able to practice the principles of lean manufacturing like customer focus, reduction of MUDA.
CO3	The student will be able to practice the principles of lean manufacturing and lean tools,
CO4	The students will obtain knowledge to try the relevant technique for manufacturing.
CO5	The student will be able to practice the principles of new organisation culture.

UNIT - I INTRODUCTION 9

Origins and objectives of lean manufacturing-Lean process,3M concept, key principles and implications of lean manufacturing-traditional vs lean manufacturing characteristics–roadmap for lean implementation and lean benefits. Study of Ford and Toyota production system, JIT manufacturing, Lean building blocks.

UNIT - II LEAN TOOLS I 9

Value creation and waste elimination – seven types of waste- pull production - different models of pull production -The Kanban system - continuous flow-The continuous improvement process / Kaizen, Worker involvement. Design of Kanban quantities, levelled production, tools for continuous improvement.

UNIT - III LEAN TOOLS II 9

The value stream – benefits, mapping process. The current state map–mapping icons, mapping steps. VSM exercises, Takt time calculations Standardized work – standard work sequence, timing and working progress. Quality at source - Automation/Jidoka, Visual management system, Mistake proofing/Poka-Yoke. 5S technique – Elements and waste elimination thro 5S, advantages and benefits, 5S audit. Visual control aids for improvement, Flexible work force

UNIT - IV AGILE PRODUCTION SYSTEM AND PRACTICES 9

Agile production system – the task aligned organization – agile manufacturing production system – production planning and control, quality assurance, purchasing, maintenance, overview of production support, business operation, engineering, human resource, finance and accounting. Agile practices – Agile practice for product development – manufacturing agile practice – understanding the value of investing in people, removing inappropriate fear from the shop floor – not scarifying agility for perfectionism

UNIT - V MANAGEMENT IN THE AGILE ORGANIZATION 9

Old management styles, role of manager in an agile organization – vision champion, team leader, coach, business analyzer, supporting the new culture – performance appraisal systems, selection systems, reward and recognition systems, organizational measurement, organizational learning processes

TOTAL PERIODS: 45

TEXT BOOKS:

1. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing, 2002.
2. William M Feld, "Lean Manufacturing: Tools, Techniques and How to Use Them", APICS, 2001.
3. S.R.Devadasan, V.Mohan Sivakumar, V.Murugesh, P.R.Shalij, 'Lean and Agile Manufacturing', Prentice Hall India, 2012.

REFERENCE BOOKS:

1. Taiichi Ohno, "Toyoto Production Systems: Beyond Large Scale Production", Productivity Press,1988.
2. Askin RG and GoldbergJB, "Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003.
3. Goldman S L, Nagal R N and Preiss K, "Agile Competitors and Virtual Organization", Van Nostrand Reinhold, 1995.

MF1012	SURFACE ENGINEERED MATERIALS TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To teach students the basic concepts of surface engineering and its development
- To provide students the knowledge of coatings and the formation of technological surface layers
- To enable the students, understand the basic principles of Laser Technology and Plasma Coating Technology

COURSE OUTCOMES (CO)

CO1 Able to understand the basic concepts in surface coating, wear and corrosion

CO2 Explain the concepts of coating in metallic and non- metallic materials. Measurement of roughness

CO3 Explain the concepts on formation of Surface Layers in coating techniques

CO4 Ability to understand the laser techniques and tribological properties

CO5 Explain the concept of coating by using Plasma coating technology

UNIT - I DEVELOPMENT OF SURFACE ENGINEERING 12

Development of surface Engineering – Solid surface – Geometrical and mechanical concepts- Wear-Abrasive wear- Erosion wear – Erosion – Corrosion- Surface roughness-Metallographic structure – Need for surface coatings- Enhancement of wear and prevention of corrosion.

UNIT - II CONCEPTS OF COATING 12

Coatings- Concepts of coatings – Metallic and non- metallic coatings- Galvanizing – Spray and cladded coatings- Principles parameters of coatings – Thickness measurement – Physico and chemical parameters of coatings – Surface characterization – GIXRD - microstructure - SIMS – Roughness measurement – Profilometer.

UNIT - III FORMATION OF TECHNOLOGICAL SURFACE LAYERS 12

Formation of technological surface layers – Techniques – Physical vapor deposition –Chemical vapor deposition - electron beam technology – Principles underlying the electron beam impingement – Acceleration of electrons – Electron guns – Interaction of electron beam with treated material – Applications of electron beam coating in surface engineering

UNIT - IV LASER TECHNOLOGY 12

Laser technology – CO2 and Nd: YAG lasers - processing parameters – Continuos and pulsed operations – Properties of laser – Temperature distribution in laser treated material – Depth of penetration of photons – Hard coatings – Applications of laser in surface engineering - Ion implantation techniques – Physical principal of ion beam implantation – Pulsed and continuos ion beam implantation – Tribological properties of ion implanted materials – Strength –Hardness and adhesion of implanted materials- Advantages and disadvantages

UNIT - V PLASMA COATING TECHNOLOGY 12

Plasma coating technology – Processing parameters- Plasma nitriding – Oxy nitriding – Nitro carburizing - boriding- Characterization of Cr –N coatings – Plasma nitrided steels and titanium alloys – Corrosion and wear behavior – Super hard biocompatible coating for medical implants – Carbon like diamond coating- -Nano surface coatings- Comparative study of various coating process in industry

TOTAL PERIODS: 60

TEXT BOOKS:

1. Plasma surface engineering, (2004), Proceedings of DAE-BRNS workshop

REFERENCE BOOKS:

1.D.Setas , A.Tacton, Mercel –Dekker, (2001), Coatings technology handbook I Editors: Bharat Bhushan, (2000), Principles and application of tribology, John Wiley Sons

2. Surface Modification Technologies Vol. XI and XII, Ed: T. Sudarshan et al – TMS Conference Proceedings

SEMESTER III

PROFESSIONAL ELECTIVE COURSES – IV

		L	T	P	C
MF1013	**INDUSTRIAL DESIGN AND ERGONOMICS**	3	0	0	3

OBJECTIVES

- To introduce to industrial design based on ergonomics.
- To consider ergonomics concept in manufacturing
- To apply ergonomics in design of controls and display.
- To apply environmental factors in ergonomics design
- To understand aesthetics applicable to manufacturing and product

COURSE OUTCOMES (CO)

CO1 Appreciate ergonomics need in the industrial design.
CO2 Apply ergonomics in creation of manufacturing system
CO3 Discuss on design of controls and display.
CO4 Consider environmental factors in ergonomics design.
CO5 Report on importance of aesthetics to manufacturing system and product

UNIT - I INTRODUCTION 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT - II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT - III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT - IV ENVIRONMENTAL FACTORS 9

Colour: Colourand light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation,reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style

UNIT - V AESTHETIC CONCEPTS 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout softwares

TOTAL PERIODS: 45

TEXT BOOKS:

1. Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002
2. Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.

REFERENCE BOOKS:

1. Brain Shakel,"Applied Ergonomics Hand Book", Butterworth Scientific London 1988
2. Mayall W.H. "Industrial design for Engineers", London Hiffee books Ltd., 1988.

MF1014	MEMS AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nano scale.

COURSE OUTCOMES (CO)

CO1 Understand MEMS and Microsystems working principle and applications
CO2 Understand MEMS manufacturing and micro system packaging
CO3 Ability to select and use micro devices in various applications.
CO4 Understand the science and synthesis of Nano materials
CO5 Ability to characterize nano materials

UNIT - I OVER VIEW OF MEMS AND MICROSYSTEMS 6

Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT - II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 10

Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam ,Ion beam processes – Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

UNIT - III MICRO DEVICES 8

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer , chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

UNIT - IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 10

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNIT - V CHARACTERIZATION OF NANO MATERIALS 11

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunnelling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
2. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
3. Mark Madou , Fundamentals of Micro fabrication, CRC Press, New York, 1997.
4. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
5. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
6. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
7. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
8. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013, ISBN : 978-93-82291-39-8

MF1015	MATERIAL TESTING AND CHARACTERIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide understanding of techniques of microstructure and crystal structure evaluation of materials.
- To introduce tools for analysis of microstructure and surface topography of materials.
- To understand the techniques of chemical and thermal analysis of materials.
- To gain knowledge in various static mechanical testing methods.
- To gain knowledge in various dynamic mechanical testing methods.

COURSE OUTCOMES (CO)

CO1 To characterize the engineering materials.
CO2 Know the fundamental principle of Top-notch characterization tools.
CO3 Choose appropriate mechanical static testing methods.
CO4 Choose appropriate mechanical dynamic testing methods.
CO5 Identify the crystal structure and analysis can be made.

UNIT - I MICRO AND CRYSTAL STRUCTURE ANALYSIS 9

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg‘s law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction – Estimation of residual stress and grain size.

UNIT - II ELECTRON MICROSCOPY 9

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF and DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction and working of SEM and FESEM Back scattered and Secondary Electron Imaging Techniques – Applications- Atomic Force Microscopy- Construction and working of AFM - Contact and Non-Contact modes Applications.

UNIT - III CHEMICAL AND THERMAL ANALYSIS 9

Basic Principles, Practice and Applications of X-Ray Spectrometry, Energy dispersive and Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravity metric Analysis (TGA) - Dynamic Mechanical Analysis (DMA).

UNIT - IV MECHANICAL TESTING – STATIC TESTS 9

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test, Rebound hardness and Indendation – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy and Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT - V MECHANICAL TESTING – DYNAMIC TESTS 9

Fatigue – Low and High Cycle Fatigues – Rotating Beam and Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests – Fatigue life estimation.

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. Angelo P C, Material characterization, Cengage Learning India, 2016.
2. Cullity B.D., Stock S.R and Stock S., Elements of X ray Diffraction, 3rdEdition. Prentice Hall, 2018.
3. Skoog, Holler and Nieman, Principles of Instrumental Analysis, 7thedition, Cengage Learning, 2017.
4. Suryanarayana A. V. K., Testing of metallic materialism's publications, 2ndEdition, 2007.
5. Suryanarayana C, Experimental Techniques in materials and Mechanics, CRC Press, 1stEdition,2011.
6. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Hong Kong University of Science and Technology, John Wiley and Sons (Asia) Pvt. Ltd., 2ndEdition, 2013.

MF1016	MECHATRONICS IN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

•To provide overview of various electrical and electronic control techniques used in modern manufacturing systems.

• To know the basic working principle of sensors and transducers of use for manufacturing systems

• To know the basic working principle of drives and actuators of use for manufacturing systems

• To know the features, modules and interfaces of microcontrollers and microprocessors

• To gain the knowledge of integration of mechatronic systems in automation of modern manufacturing systems

COURSE OUTCOMES (CO)

CO1 Imply the knowledge to study the mechatronics in modern manufacturing systems.

CO2 Identify and select the sensors and transducers based on the application.

CO3 Identify the principles and functions of drives and actuators.

CO4 Get knowledge of microprocessor and microcontrollers and its functions.

CO5 Apply the knowledge about integration of mechatronic systems in manufacturing.

UNIT - I INTRODUCTION TO MECHATRONICS IN MODERN MANUFACTURING 12

Introduction to Process Parameters in Conventional Manufacturing – Assembly – Inspection – Transportation - Introduction to Systems - Subsystems of Mechatronics - Identification of Mechatronics' Entities in Modern Manufacturing - Mechanical, Fluid, Thermal, Electrical, Electronics, Communication, Control systems and Software Integration for Manufacturing - Classification of Manufacturing based on Mechatronics – CNC based Subtractive Manufacturing – Rapid Prototyping based Additive Manufacturing- Automated Assembly Stations – Modern Quality Inspection and Transportation Systems.

UNIT - II SENSORS AND TRANSDUCERS 8

Introduction – Performance Terminology – Resistive Transducers – Inductive Transducers - Capacitance Transducers – Optical Sensors – Contact and Non-Contact Temperature Sensors – Eddy Current Sensor – Hall Effect Sensor – Piezo Electric Sensor - Ultrasonic Sensors – Proximity Sensors – Chemical and Gas Sensors - Signal Conditioning - Condition Monitoring

UNIT - III DRIVES AND ACTUATORS 8

Role of Linear and Rotary Actuators - Electrical Actuators- Servo Concepts and Stepper Motors - Fluid Power – Piezo Actuators – Solenoids - Function of Drives - Mechanical Switching Devices – Solid State drives for various actuators.

UNIT - IV MICROPROCESSORS AND MICROCONTROLLERS 8

Requirement for Processor – Comparison of 8085 Microprocessor and 8051 Microcontrollers– 8051 Microcontrollers Architecture -Assembly Language Programming- Instruction Set, Addressing Modes, Basic Programming – Interfacing - Sensors, Keyboard, LED, LCD, A/D and D/A Converters, Actuators – Embedded Systems.

UNIT - V RADIOGRAPHY(RT) 9

Design Process - Stages of Design Process – Skeletal Structure and Block Diagram of CNC Based - Vertical Machining Centre, turning centre, Water Jet Machine, Electrical Discharge Machine, Serial Manipulator, hydraulic press, 3 D printers– Coordinate Measuring Machine –Automated conveyors - Extended Transportation System – Total Integration of Manufacturing Systems for Production Automation

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. Beno Benhabib, Manufacturing, design, production, automation and integration, Marcel Dekker, 2003
2. Bolton W, ― Mechatronics: Electronic control systems in mechanical and electrical engineering, 6thedition, Pearson Education Limited, 2015.
3. Devadas shetty, Richard A. Kolk, Mechatronics System Design, Cengage Learning, 2011.
4. Mazidi M A and Mazidi J G, 8051 Microcontroller and Embedded Systems, 2002.
5. Vijayaraghavan G.K., Balasundaram M S, Ramachandran K P, Mechatronics: Integrated Mechanical Electronic Systems, Wiley, 2008.

PROFESSIONAL ELECTIVE COURSES – V

MF1017	MICRO MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVE:

 The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

COURSE OUTCOMES (CO)

CO1 Understanding the various aspects of mechanical, ultrasonic, abrasive, chemical and electrical micromachining.
CO2 Understanding the various advanced methods in micromachining and grinding.
CO3 Understanding the basic principles of nano polishing and its techniques.
CO4 Understanding the basics of micro forming and welding.
CO5 Understanding the various applications of micro machining.

UNIT I MICRO MACHINING I 10

Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

UNIT II MICRO MACHINING II 10

Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Hybrid Micro machining – Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.

UNIT III NANO POLISHING 9

Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemo-mechanical Polishining.

UNIT IV MICRO FORMING AND WELDING 9

Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.

UNIT V RECENT TRENDS AND APPLICATIONS 7

Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications

TOTALPERIODS: 45

REFERENCES:

1. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Jain V.K., ‘Introduction to Micro machining’ Narosa Publishing House, 2011

4. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002
5. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012
6. Janocha H., Actuators – Basics and applications, Springer publishers – 2012
7. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.
8. www.cmxr.com/industrial/
9. www.sciencemag.org.handbook

MF1018	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.

COURSE OUTCOMES (CO)

CO1 The students will be able to know about the evolution, classification of various techniques in additive manufacturing.
CO2 The students will be able to know about the reverse engineering and cad modeling techniques in additive manufacturing.
CO3 The students will be able to know about liquid based and solid based additive manufacturing systems.
CO4 The students will be able to know about the powder based additive manufacturing systems.
CO5 The students will be able to know about the recent research techniques in additive manufactured systems.

UNIT - I INTRODUCTION 8

Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Benefits-Applications.

UNIT - II REVERSE ENGINEERING AND CAD MODELING 10

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT - III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.
Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT - IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 10

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case

Studies.

UNIT - V OTHER ADDITIVE MANUFACTURING SYSTEMS 7

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010
2. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
3. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

REFERENCE BOOKS:

1. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
2. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.

MF1019	DESIGN AND ANALYSIS OF EXPERIMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

The objective of this course is to introduce experimental design techniques and familiarize with all of the best design techniques and study the objectives, similarities, differences, advantages, and disadvantages of each.

COURSE OUTCOMES (CO)

CO1 Ability to understand the Basic principle of DOEs and ANOVA.
CO2 Ability to understand the various Single Factor Experiments.
CO3 Ability to Learn Full and Fraction Factorial Experiment Design.
CO4 Ability to understand the Robust Design.
CO5 Ability to understand the Orthogonal Experiments.

UNIT - I INTRODUCTION 9

Basic principle of DOEs, Guide lines for Designing Experiments, Terminology, ANOVA, Computation of sum of squares and Basics of quality by design, Experiments with single factor, Model Adegnacy checking, Test on means.

UNIT - II SINGLE FACTOR EXPERIMENTS 9

Randomized complete block design, Latin square design, Graeco-Latin square design, Balanced Incomplete block design.

UNIT - III FACTORIAL DESIGN 9

Two-Factor factorial design, General factorial design, 2k Factorial design, 3k Factorial design, Blocking and confounding, Fractional replication and Factors with mixed levels.

UNIT - IV ROBUST DESIGN PROCESS 9

Comparison of classical and Taguchi's approach, variability due to noise factors, principle or robustization, classification of quality characteristics and parameters, objective functions in robust design, S/N ratios.

UNIT - V ORTHOGONAL EXPERIMENTS 9

Selection and application of orthogonal arrays for design, Conduct of experiments, collection of data and analysis of simple experiments, Modifying orthogonal arrays, Inner and outer OA experiments, Optimization using S/N ratios, attribute data analysis, a critique of robust design.

TOTAL PERIODS: 45

TEXT BOOKS:

1. K. Krishnaiah, P. Shahabudeen. "Applied Design of Experiments and Taguchi Methods" PHI (11 March 2012).
2. R. Panneerselvam, "Design and Analysis of Experiments" PHI Learning, 2012.

REFERENCE BOOKS:

1. Montgomery, D.C., "Design and Analysis of Experiments", John Wiley and Sons, 1997.
2. Philip J. Rose, "Taguchi Techniques for Quality Engineering", Prentice Hall, 1989.
3. Nicolo Belavendram, "Quality by Design: Taguchi Techniques for Industrial Experimentation", Prentice Hall, 1995.

MF1020	PRODUCT DESIGN AND LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- The new product management process
- Product lifecycle management stages
- The DFx concepts from the conception to recovery or disposal
- Applying analytic methods for all stages of product planning, development and control.

COURSE OUTCOMES (CO)

CO1	Understanding the concept of product design and development
CO2	Understanding & Analysing the model based study on costing and Accounting of the manufactured product.
CO3	Understanding the best practise followed for design and evaluation of prototype building and performing the decision analysis on new product development
CO4	The DFx concepts from the conception to recovery or disposal with standards and Failure mode effective analysis.
CO5	Assessing and improving product development and management performance in the context of a case study.

UNIT – I INTRODUCTION 9

Product development – Trends affecting product development – Best practices for product development – Product development process and organizations – Collaborative product development – concurrent engineering – risk management - Stages of Product development

UNIT – II PRODUCT DEVELOPMENT LIFE CYCLE – I 9

Early design – Requirement Definition and Conceptual design - Trade-off Analysis – Optimization using cost and utility metrics – Trade-off analysis models and parameters- design to cost – Design to

Life cycle cost – Design for warranties.

UNIT – III PRODUCT DEVELOPMENT LIFE CYCLE – II 9

Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies.

UNIT – IV PRODUCT DEVELOPMENT LIFE CYCLE – III 9

Supply chain – Logistics, packaging, supply chain and the environment – ISO 14000/210 – Design for people – Ergonomics, Repairability, maintainability, safety and product liability – Task analysis and failure mode analysis.

UNIT – V PRODUCIBILITY AND RELIABILITY 9

Reducibility – strategies in design for manufacturing – requirements for optimizing design and manufacturing decisions – Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functional analysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Karl T. Ulrich, Ateven D. Eppinger "Product Design and Development" Tata McGraw-Hill, 2003.

REFERENCE BOOKS:

1. John W. Priest and Jose M. Sanchez, "Product development and design for manufacturing- A
2. 2. Collaborative approach to produciability and reliability", Marcel Dekker Publications, 2001.
3. 3. Stephen C. Armstrong, "Engineering and product development management – the holistic approach", Cambridge university press, 2001.
4. 4. Thomas A. Sabomone, "What every engineer should know about concurrent engineering", Marcel Dekker Publications, 1995.

OPEN ELECTIVECOURSES (OEC)

SEMESTER III

OCP 101	BUSINESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks

COURSE OUTCOMES (CO)

CO1 Identify the real world business problems and model with analytical solutions.

CO2 Solve analytical problem with relevant mathematics background knowledge.

CO3 Convert any real world decision making problem to hypothesis and apply suitable statistical testing.

CO4 Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce

CO5 Use open source frameworks for modeling and storing data and apply suitable visualization technique using R for visualizing voluminous data.

UNIT - I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

UNIT - II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

UNIT - III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

UNIT - IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop– RDBMS versus Hadoop–Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop– Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

UNIT - V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. VigneshPrajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, UmeshaNayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

OMF 101	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0

OBJECTIVES

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion

- Illustrate fault tracing
- Identify preventive and periodic maintenance

COURSE OUTCOMES (CO)

CO1 Ability to summarize basics of industrial safety
CO2 Ability to describe fundamentals of maintenance engineering
CO3 Ability to explain wear and corrosion
CO4 Ability to illustrate fault tracing
CO5 Ability to identify preventive and periodic maintenance

UNIT - I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment

UNIT - III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment’s like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. Audels, Pump-hydraulic Compressors, Mcgraw Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn , Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition, 2008

OPE101 RENEWABLE SOURCES OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

OBJECTIVES

- ❖ To understand the energy scenario and various energy sources.
- ❖ To learn the solar photovoltaic and solar thermal systems.
- ❖ To impart knowledge on wind energy and bio-mass energy conversion systems.
- ❖ To provide knowledge about the Geothermal and Ocean energy conversion system.
- ❖ To design and implement hybrid energy conversion system.

COURSE OUTCOMES (CO)

CO1 Understand the energy scenario and the various sources of non-conventional energy sources.

CO2 Learn the physics of solar energy and to understand the solar photovoltaic, solar-thermal energy conversion system.

CO3 Acquire knowledge in wind and bio-mass energy conversion system.

CO4 Acquire knowledge in Geothermal and Ocean energy conversion system.

CO5 Design and implement hybrid energy systems.

UNIT I INTRODUCTION **9**

Renewable energy sources and its energy scenario - global and Indian; Environmental aspects and impacts of renewable energy generation on environment; Types of Renewable energy sources: solar - wind - Biomass - Ocean - Tidal - Geothermal and Fuel cell.

UNIT II SOLAR ENERGY SYSTEMS **9**

Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - Introduction to Solar photo-voltaic (PV) system and Solar - thermal system; Equivalent circuit of a solar cell, solar array and its sizing. Solar thermal collectors: flat plate collectors - concentrating collectors; solar thermal applications - heating, cooling, desalination, drying, cooking - solar thermal electric power plant.

UNIT III WIND ENERGY AND BIO-MASS ENERGY **9**

Wind Sources: horizontal and vertical axis wind turbine - performance characteristics - types of wind turbine generators - Betz criteria; Bio-mass: Principles of Bio-Conversion - Anaerobic/aerobic digestion - types of Bio-gas digesters - gas yield - combustion characteristics of bio-gas - utilization for cooking.

UNIT IV GEOTHERMAL AND OCEAN ENERGY **9**

Geothermal: Resources - types of wells - methods of harnessing the energy. Ocean Energy: OTEC- Principles, utilization - setting of OTEC plants - thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques - mini-hydro power plants and their economics.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems - Types of Hybrid systems - Case studies of solar and Wind.

`TOTAL PERIODS : 45

TEXT BOOKS

1. S. P. Sukhatme, Solar Energy Principle of Thermal Collection and Storage‟, Tata McGraw Hill, 1990.
2. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 2011.

REFERENCE BOOKS

1. G. L. Johnson, Wind energy systems, Prentice Hall Inc. New Jersey.
2. J. M. Kriender, Principles of Solar Engineering‟, McGraw Hill, 1987.
3. Twidell&Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011
4. V. S. Mangal, Solar Engineering‟, Tata McGraw Hill, 1992.
5. N. K. Bansal, Renewable Energy Source and Conversion Technology‟, Tata McGraw Hill, 1989.
6. P. J. Lunde, Solar Thermal Engineering‟, John Willey & Sons, New York, 1988.
7. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes‟, Wiley & Sons, 1990.

OMB 103	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

COURSE OUTCOMES (CO)

CO1 Understand the costing concepts and their role in decision making
CO2 Understand the project management concepts and their various aspects in selection
CO3 Interpret costing concepts with project execution
CO4 Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 Become familiar with quantitative techniques in cost management

UNIT - I INTRODUCTION TO COSTING CONCEPTS 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT - II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT - III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle

Costing.

UNIT - IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity- Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT - V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL PERIODS: 45

REFERENCE BOOKS:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OMF 102	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

COURSE OUTCOMES (CO)

CO1 Know the characteristics of composite materials and effect of reinforcement in composite materials.
CO2 Know the various reinforcements used in composite materials.
CO3 Understand the manufacturing processes of metal matrix composites.
CO4 Understand the manufacturing processes of polymer matrix composites.
CO5 Analyze the strength of composite materials.

UNIT - I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT - II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT - III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT - IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT – V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL PERIODS: 45

Text Books:

1. Chawla K.K., 'Composite Materials' Science and Engineering, Springer Publications,Second Edition, 2013.

Reference Books:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Lubin.G, Hand Book of Composite Materials, 2013.

OCH 105	**WASTE TO ENERGY**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

COURSE OUTCOMES (CO)

CO1 To understand the various types of wastes from which energy can be generated
CO2 To Gain knowledge on biomass pyrolysis process and its applications
CO3 To develop knowledge on various types of biomass gasifiers and their operations
CO4 To gain knowledge on biomass combustors and its applications on generating energy
CO5 To understand the principles of bio-energy systems and their features

UNIT - I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT - II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT - IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT - V BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

REFERENCE BOOKS:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

SEMESTER I

RM 1101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

OBJECTIVES

To impart knowledge and skills required for research and IPR

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

COURSE OUTCOMES (CO)

CO1	Ability to formulate research problem
CO2	Ability to carry out research analysis
CO3	Ability to follow research ethics
CO4	Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
CO5	Ability to understand about IPR and filing patents in R & D

UNIT - I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT - II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT - III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT - IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL PERIODS: 30

REFERENCE BOOKS:

1. Asimov, “Introduction to Design”, Prentice Hall, 1962.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners” 2010

AUDIT COURSES (AC)

SEMESTER I

AX 1001	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		3	0	0	0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

COURSE OUTCOMES (CO)

CO1 Understand that how to improve your writing skills and level of readability
CO2 Learn about what to write in each section
CO3 Understand the skills needed when writing a Title

CO4 Understand the skills needed when writing the Conclusion
CO5 Ensure the good quality of paper at very first-time submission

UNIT - I INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT - II PRESENTATION SKILLS 6
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT - III TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT - IV RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT - V VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL PERIODS: 30

REFERENCE BOOKS:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman’s book 1998.

AX 1002	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

COURSE OUTCOMES (CO)

CO1 Ability to summarize basics of disaster
CO2 Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3 Ability to illustrate disaster risk reduction and humanitarian response policy and practice

from multiple perspectives.

CO4 Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5 Ability to develop the strengths and weaknesses of disaster management approaches

UNIT - I INTRODUCTION 6

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT - II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT - III DISASTER PRONE AREAS IN INDIA 6

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT - IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness

UNIT - V RISK ASSESSMENT 6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL PERIODS: 30

REFERENCE BOOKS:

1. Goel S. L., Disaster Administration And Management Text And Case Studies”,Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’NewRoyal book Company,2007.
3. Sahni, Pardeep et. al.,” Disaster Mitigation Experiences And Reflections”, Prentice Hall OfIndia, New Delhi,2001.

AX 1003	**SANSKRIT FOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
		2	0	0	0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

COURSE OUTCOMES (CO)

CO1 Understanding basic Sanskrit language.
CO2 Write sentences.
CO3 Know the order and roots of Sanskrit.
CO4 Know about technical information about Sanskrit literature.
CO5 Understand the technical concepts of Engineering

UNIT - I ALPHABETS **6**
Alphabets in Sanskrit

UNIT - II TENSES AND SENTENCES **6**
Past/Present/Future Tense - Simple Sentences

UNIT - III ORDER AND ROOTS **6**
Order - Introduction of roots

UNIT - IV SANSKRIT LITERATURE **6**
Technical information about Sanskrit Literature

UNIT - V TECHNICAL CONCEPTS OF ENGINEERING **6**
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL PERIODS: 30

REFERENCE BOOKS:

1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX 1004	VALUE EDUCATION	L	T	P	C
		3	0	0	0

OBJECTIVES

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

COURSE OUTCOMES (CO)

CO1 Knowledge of self-development.
CO2 Learn the importance of Human values.
CO3 Developing the overall personality

UNIT - I **6**
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT - II **6**
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT - III **6**
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and

discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT - IV **6**

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL PERIODS: 24

SUGGESTED READING

1. Chakroborty, S.K."Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

AX 1005 **CONSTITUTION OF INDIA**

L	T	P	C
2	0	0	0

OBJECTIVES

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

COURSE OUTCOMES (CO)

C107E.1 To understand the history of making and philosophy of the Indian constitution
C107E.2 To understand the constitutional rights and duties
C107E.3 To understand the organs of governance
C107E.4 To understand the Local administration concepts
C107E.5 To understand the role and function election commission

UNIT - I HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION **10**

History, Drafting Committee, (Composition & Working), Preamble, Salient Features

UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES **5**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT – III ORGANS OF GOVERNANCE **5**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT - IV LOCAL ADMINISTRATION **5**

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational

Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT - V ELECTION COMMISSION 5

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL PERIODS: 30

TEXT BOOKS:

1. The Constitution of India,1950 (Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.

REFERENCE BOOKS:

1. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
2. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX 1006	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Review existing evidence on their view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.

COURSE OUTCOMES (CO)

CO1 What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2 What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3 How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

CO4 To Review existing evidence on their view topic to inform programme design and policy.

CO5 To Identify critical evidence gaps to guide the development.

UNIT - I INTRODUCTION AND METHODOLOGY: 6

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT - II THEMATIC OVERVIEW 6

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT - III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 6

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT - IV PROFESSIONAL DEVELOPMENT 6

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT - V RESEARCH GAPS AND FUTURE DIRECTIONS 6

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL PERIODS: 30

REFERENCE BOOKS:

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf

AX 1007	STRESS MANAGEMENT BY YOGA	L	T	P	C
		3	0	0	0

OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

COURSE OUTCOMES (CO)

CO1 Develop healthy mind in a healthy body thus improving social health also
CO2 Improve efficiency

UNIT - I 10

Definitions of Eight parts of yoga.(Ashtanga)

UNIT - II 10

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT - III 10

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL PERIODS: 30

SUGGESTED READING

1. Yogic Asanas for Group Training-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur

2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX 1008	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

COURSE OUTCOMES (CO)

CO1 To understand the holistic development of personality – I
CO2 To understand the holistic development of personality – II
CO3 To understand the day-to-day work and duties in Shrimad Bhagwad Geeta
CO4 To understand the statements of basic knowledge in Shrimad Bhagwad Geeta
CO5 To understand the personality of role model in Shrimad Bhagwad Geeta

UNIT - I HOLISTIC DEVELOPMENT OF PERSONALITY - I 6
Neetisatakam - holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism)

UNIT - II HOLISTIC DEVELOPMENT OF PERSONALITY - II 6
Neetisatakam-holistic development of personality – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT - III DAY-TO-DAY WORK AND DUTIES 6
Approach to day-to-day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35

UNIT - IV STATEMENTS OF BASIC KNOWLEDGE 6
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68 Chapter 12 - Verses 13, 14, 15, 16,17, 18 - Chapter 18-Verses 45, 46, 48.

UNIT - V PERSONALITY OF ROLE MODEL 6
Personality of role model - shrimad bhagwad geeta – Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL PERIODS: 30

TEXT BOOKS:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi,2010

REFERENCE BOOKS:

1. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

You Choose, We Do It

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OMR, Chennai - 119.

B.TECH INFORMATION TECHNOLOGY

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

B.Tech INFORMATION TECHNOLOGY

REGULATION 2021

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULAM AND SYLLABUS

For the candidate Admitted in the Academic Year 2021-2025

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Intellectual progress
To ensure graduates will be proficient in utilizing the fundamental knowledge of basic sciences, mathematics and Information Technology for the applications relevant to various streams of Engineering and Technology.

PEO2: Skill augmentation
To enrich graduates with the core competencies necessary for applying knowledge of computers and telecommunications equipment to store, retrieve, transmit, manipulate and analyze data in the context of business enterprise.

PEO3: Continuing education
To enable graduates to think logically, pursue lifelong learning and will have the capacity to understand technical issues related to computing systems and to design optimal solutions.

PEO4: Nurture Technocrat
To enable graduates to develop hardware and software systems by understanding the importance of social, business and environmental needs in the human context.

PEO5: Career development
To enable graduates to gain employment in organizations and establish themselves as professionals by applying their technical skills to solve real world problems and meet the diversified needs of industry, academia and research.

PROGRAM OUTCOMES POs:

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs):

PSO1: To analyse and design an efficient information management system which uses the concepts of Information technology to deliver technological solutions and to analyse its impact in the societal and human context.

PSO2: To identify the resources needed for building complex IT projects with an understanding of risk management processes, operational and policy implications considering human, financial and ecological factors.

PSO3: To develop and test software projects by applying IT tools and techniques for the development of computational systems to serve the needs of the community at large.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

Abroad relation between the Programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMMEOUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	3										
2	2		2	1	3							
3												3
4						2	3	3	2		1	
5			2	2	2	1				2	1	

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

Abroad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAM SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	2			3				2	2		
2				3			3	3			3	
3	1		2		3	2						

Contribution 1: Reasonable **2: Significant** **3: Strong**

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

A broad relation between the Course Outcomes and Program Outcomes (POs) and Program Specific Outcomes (PSOs) are given in the following table

Sem	Course Title	Program Outcomes (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Communicative English		√		√					√	√		√	√	√	√
	Engineering Mathematics-I	√	√	√	√	√	√			√		√	√	√	√	√
	Engineering Physics	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Engineering Chemistry	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Problem Solving and Python Programming	√	√	√		√			√	√	√		√	√	√	√
	Engineering Graphics	√	√	√	√	√	√			√	√	√	√	√	√	√
	Python Programming Laboratory	√	√	√		√			√	√	√		√	√		
	Physics and Chemistry Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
II	Professional English		√		√	√				√	√	√	√	√		√
	Engineering Mathematics-II	√	√	√	√	√	√	√					√	√	√	√
	Physics for Information Science	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Environmental Science and Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Basic Electrical, Electronics and Measurement Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Programming in C	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Engineering Practice Laboratory	√	√	√			√					√	√	√	√	√
	Programming in C Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
III	Probability and Statistics	√	√	√	√	√	√				√	√	√	√	√	√
	Java Programming	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Digital Principles & Logic Design (Lab Integrated)	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

	Data Structures	√	√	√	√	√	√				√	√	√	√	√	√
	Computer Architecture	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Software Engineering	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Data Structures Laboratory using C	√	√	√	√	√			√	√	√	√	√	√	√	√
	Java Programming Laboratory	√	√	√	√	√			√	√	√	√	√	√	√	√
	Professional Skills Laboratory		√		√	√				√	√			√	√	√
IV	Discrete Mathematics	√	√	√	√	√	√				√	√	√	√	√	√
	Design and Analysis of Algorithm	√	√	√	√	√				√		√	√	√	√	√
	Operating Systems	√	√	√	√							√	√	√	√	√
	Database Design and Management (Lab Integrated)	√	√	√	√	√	√	√			√	√	√	√	√	√
	Computer Communication	√	√	√	√	√				√	√	√	√	√	√	√
	Foundations of Machine Learning	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Operating Systems Laboratory	√	√	√	√	√				√	√	√	√	√	√	√
	Machine Learning Laboratory	√	√	√	√	√					√	√	√	√	√	√
V	Algebra and Number Theory	√	√	√		√			√	√			√	√	√	√
	Object Oriented Analysis and Design	√	√	√	√	√					√	√	√	√	√	√
	Web Technology			√		√				√	√	√	√	√	√	√
	Computational Intelligence (Lab Integrated)	√	√	√	√	√	√			√	√	√	√	√	√	√
	Web Technology Laboratory	√		√		√				√	√	√	√	√	√	√
	Object Oriented Analysis and Design Laboratory	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VI	Theory of Computation and Compiler Design	√	√	√	√	√			√	√	√	√	√	√	√	√
	Mobile Networks and Application Development	√	√	√	√	√					√	√	√	√	√	√

	Computer Graphics and Applications	√	√	√	√	√					√	√	√	√	√	√
	Data Science and Big Data Analytics	√	√	√	√	√	√	√				√	√	√	√	√
	Mobile Networks And Application Development Laboratory	√	√	√	√	√					√	√	√	√	√	√
	Mini Project	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VII	Neural Networks and Deep Learning	√	√	√	√	√	√			√	√	√	√	√	√	√
	Cloud and Edge Computing	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Cryptography and Network Security	√	√	√	√	√				√	√	√	√	√	√	√
	Organizational Behavior	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Cloud and Edge Computing Laboratory	√	√	√	√	√			√	√	√	√	√	√	√	√
	Project Phase- I	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
VIII	Project Phase- II	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

PROFESSIONAL ELECTIVE COURSES (PEC)

Sem	**Course Title**	**Program Outcomes (POs)**												**PSOs**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
V	Optimization Techniques	√	√	√	√	√					√	√	√	√	√	√
	Video Creation and Editing	√	√	√	√	√					√	√	√	√	√	√
	Information Storage and Management	√	√	√	√	√					√	√	√	√	√	√
	Knowledge Engineering	√	√	√	√	√		√			√	√	√	√	√	√
	Fundamentals of Digital Image Processing	√	√	√	√	√				√	√	√	√	√	√	√
VI	Fuzzy Logic and Artificial Neural Networks	√	√	√	√	√					√		√	√	√	√
	Software Testing and Quality Assurance	√	√	√	√	√						√	√	√	√	√

	Natural Language Processing Tools And Applications	√	√	√	√	√			√		√	√	√	√	√	√
	Engineering Ethics and Human Values	√	√	√	√	√			√	√	√	√	√	√	√	√
	Image and Video Analytics	√	√	√	√	√					√	√	√	√	√	√
	Web Development Frameworks	√	√	√	√	√					√	√	√	√	√	√
	Management Information Systems	√	√	√	√	√					√	√	√	√	√	√
VII	Parallel Algorithms	√	√	√	√	√		√			√	√	√	√	√	√
	Augmented and Virtual Reality	√	√	√	√	√			√	√	√	√	√	√	√	√
	Virtualization Techniques	√	√	√	√	√					√	√	√	√	√	√
	Storage Area Networks	√	√	√	√	√						√	√	√	√	√
	UI/UX Application Development	√	√	√	√	√	√					√	√	√	√	√
VII	Software Agents	√	√	√	√	√						√	√	√	√	√
	5G Networks	√	√	√	√	√					√	√	√	√	√	√
	Social Network Analytics	√	√	√	√	√					√	√	√	√	√	√
	Information Theory and Coding	√	√	√	√	√					√	√	√	√	√	√
	Electronic Commerce	√	√	√	√	√					√	√	√	√	√	√
VIII	Affective Computing	√	√	√	√	√					√		√	√	√	√
	Social Media Mining	√	√	√	√	√					√	√	√	√	√	√
	Speech Processing and Synthesis	√	√	√	√	√	√				√	√	√	√	√	√
	Introduction to Digital Currencies	√	√	√	√	√					√	√	√	√	√	√
	Trust Networks	√	√	√	√	√			√	√	√	√	√	√	√	√
VIII	Artificial Intelligence and Robotics	√	√	√	√	√		√				√	√	√	√	√
	IoT Platform for Smart City Planning	√	√	√	√	√			√		√	√	√	√	√	√
	Blockchain Technologies	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

SEMESTER – I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics – I **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	3	3	0	0	3
5.	GE1105	Problem Solving and Python Programming **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	6	2	0	4	4
PRACTICALS								
7.	GE1107	Python Programming Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	BSC	4	0	0	4	2
		TOTAL		**30**	**17**	**1**	**12**	**24**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics- II **(Common for all branches of B.E. /B. Tech Programmes Except AI-DS & AI-ML)**	BSC	4	3	1	0	4
3.	PH1252	Physics for Information Science **(Common to CSE, IT, AI-DS & AI-ML)**	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering **(Common for all branches of B.E. /B. Tech Programmes)**	HSMC	3	3	0	0	3
5.	BE1251	Basic Electrical Electronics and Measurement Engineering **(Common to CSE, IT, AI-DS & AI-ML)**	ESC	3	3	0	0	3
6.	CS1206	Programming in C **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
PRACTICALS								
7.	GE1207	Engineering Practices Laboratory **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	4	0	0	4	2
8.	CS1208	Programming in C Laboratory **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	4	0	0	4	2
TOTAL				**27**	**18**	**1**	**8**	**23**

SEMESTER – III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1351	Probability and Statistics **(Common to CSE, IT & AI-DS)**	BSC	4	3	1	0	4
2	IT1301	Java Programming	PCC	3	3	0	0	3
3	CS1301	Digital Principles & Logic Design(Lab Integrated) **(Common to CSE & IT)**	ESC	5	3	0	2	4
4	CS1302	Data Structures **(Common to CSE, IT, AI-DS & AI-ML, ECE-IV Sem)**	PCC	3	3	0	0	3
5	CS1304	Computer Architecture **(Common to CSE & IT)**	PCC	3	3	0	0	3
6	CS1305	Software Engineering **(Common to CSE & IT)**	PCC	3	3	0	0	3
PRACTICALS								
7	CS1307	Data Structures Laboratory using C **(Common to CSE, IT, AI-DS & AI-ML, ECE-IV Sem)**	PCC	4	0	0	4	2
8	IT1308	Java Programming Laboratory	PCC	4	0	0	4	2
9.	HS1310	Professional Skills Laboratory **(Common to IT & AI-ML)**	HSMC	2	0	0	2	1
Total				**31**	**18**	**1**	**12**	**25**

SEMESTER – IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1453	Discrete Mathematics **(Common to CSE, IT & AI-DS)**	BSC	4	3	1	0	4
2	CS1401	Design and Analysis of Algorithms **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
3	CS1402	Operating Systems **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
4	CS1403	Database Design and Management (Lab Integrated) **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	5	3	0	2	4
5	IT1401	Computer Communication	PCC	3	3	0	0	3
6	ML1401	Foundations of Machine Learning **(Common to IT, AI-ML & AI-DS)**	PCC	3	3	0	0	3
PRACTICALS								
7	CS1407	Operating Systems Laboratory **(Common to CSE, IT & AI-ML)**	PCC	4	0	0	4	2
8	ML1408	Machine Learning Laboratory **(Common to IT, AI-ML & AI-DS)**	PCC	4	0	0	4	2
Total				**29**	**18**	**1**	**10**	**24**

SEMESTER – V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1501	Algebra and Number Theory **(Common to CSE &IT)**	BSC	4	3	1	0	4
2	CS1502	Object Oriented Analysis and Design **(Common to CSE & IT)**	PCC	3	3	0	0	3
3	IT1501	Web Technology	PCC	3	3	0	0	3
4	IT1502	Computational Intelligence (Lab Integrated)	PCC	5	3	0	2	4
5		Open Elective-I	OEC	3	3	0	0	3
6		Professional Elective-1	PEC	3	3	0	0	3
PRACTICALS								
7	IT1507	Web Technology Laboratory	PCC	4	0	0	4	2
8	CS1508	Object Oriented Analysis and Design Laboratory **(Common to CSE & IT)**	PCC	4	0	0	4	2
Total				**29**	**18**	**1**	**10**	**24**

SEMESTER – VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	IT1601	Theory of Computation and Compiler Design	PCC	3	3	0	0	3
2	IT1602	Mobile Networks and Application Development	PCC	3	3	0	0	3
3	IT1603	Computer Graphics and Applications	PCC	3	3	0	0	3
4	IT1604	Data Science and Big Data Analytics	PCC	3	3	0	0	3
5		Open Elective-II	OEC	3	3	0	0	3
6		Professional Elective-II	PEC	3	3	0	0	3
PRACTICAL								
7	IT1607	Mobile Networks and Application Development Laboratory	PCC	4	0	0	4	2
8	IT1608	Mini Project	EEC	4	0	0	4	2
Total				**26**	**18**	0	**8**	**22**
9		Value Added Course	EEC					2
10		Audit Course (Optional)	AC					

For Value Added Courses, the grade earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER – VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	IT1701	Neural Networks and Deep Learning	PCC	3	3	0	0	3
2	IT1702	Cloud and Edge Computing	PCC	3	3	0	0	3
3	CS1703	Cryptography and Network Security **(Common to CSE & IT)**	PCC	3	3	0	0	3
4	IT1703	Organizational Behavior	PCC	3	3	0	0	3
5		Professional Elective-III	PEC	3	3	0	0	3
6		Professional Elective-IV	PEC	3	3	0	0	3
PRACTICALS								
7	IT1707	Cloud and Edge Computing Laboratory	PCC	4	0	0	4	2
8	IT1708	Project Phase – 1	EEC	4	0	0	4	2
Total				**26**	**18**	0	**8**	**22**
9	IT1709	Internship	EEC					1

*Two weeks summer internship carries one credit and it will be done during VI semester vacation and same evaluated in VII semester.

SEMESTER – VIII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective-V	PEC	3	3	0	0	3
2		Professional Elective-VI	PEC	3	3	0	0	3
PRACTICALS								
3	IT1807	Project Phase-II	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

* Audit Course is optional
* Students will undergo Industrial Training / Internship during vacation

Total Credits: 180

HUMANITICS SCIENCE AND MANAGEMENT COURSES (HSMC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	HS1101	Communicative English	HSMC	3	3	0	0	3
2	HS1201	Professional English	HSMC	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
4	HS1309	Professional Skills Laboratory	HSMC	2	0	0	2	1

BASIC SCIENCE COURSES (BSC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	MA1102	Engineering Mathematics - I	BSC	4	3	1	0	4
2	PH1103	Engineering Physics	BSC	3	3	0	0	3
3	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5	MA1202	Engineering Mathematics- II	BSC	4	3	1	0	4
6	PH1252	Physics for Information Science	BSC	3	3	0	0	3
7	MA1351	Probability and Statistics	BSC	4	3	1	0	4
8	MA1453	Discrete Mathematics	BSC	4	3	1	0	4
9	MA1501	Algebra and Number Theory	BSC	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	GE1105	Problem Solving and Python Programming	ESC	3	3	0	0	3
2	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1251	Basic Electrical and Electronics Engineering	ESC	3	3	0	0	3
5	GE1207	Engineering Practice Laboratory	ESC	4	0	0	4	2
6	CS1301	Digital Principles & Logic Design(Lab Integrated)	ESC	5	3	0	2	4

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CS1206	Programming in C	PCC	3	3	0	0	3
2	CS1208	Programming in C Laboratory	PCC	4	0	0	0	2
3	IT1301	Java Programming	PCC	3	3	0	0	3
4	CS1302	Data Structure	PCC	3	3	0	0	3
5	CS1304	Computer Architecture	PCC	3	3	0	0	3
6	CS1305	Software Engineering	PCC	3	3	0	0	3
7	CS1307	Data Structures Laboratory using C	PCC	4	0	0	4	2
8	IT1308	Java Programming Laboratory	PCC	4	0	0	4	2
9	CS1401	Design and Analysis of Algorithms	PCC	3	3	0	0	3
10	CS1402	Operating Systems	PCC	3	3	0	0	3
11	CS1403	Database Design and Management (Lab Integrated)	PCC	5	3	0	2	4
12	IT1401	Computer Communication	PCC	3	3	0	0	3
13	ML1401	Foundations of Machine Learning	PCC	3	3	0	0	3
14	CS1407	Operating Systems Laboratory	PCC	4	0	0	4	2
15	ML1408	Machine Learning Laboratory	PCC	4	0	0	4	2
16	CS1502	Object Oriented Analysis and Design	PCC	3	3	0	0	3
17	IT1501	Web Technology	PCC	3	3	0	0	3
18	IT1502	Computational Intelligence (Lab Integrated)	PCC	5	3	0	2	4
19	IT1507	Web technology Laboratory	PCC	4	0	0	4	2
20	CS1508	Object Oriented Analysis and Design Lab	PCC	4	0	0	4	2
21	IT1601	Theory of Computation and Compiler Design	PCC	3	3	0	0	3
22	IT1602	Mobile Networks and Application Development	PCC	3	3	0	0	3
23	IT1603	Computer Graphics and Applications	PCC	3	3	0	0	3

24	IT1604	Data Science and Big Data Analytics	PCC	3	3	0	0	3
25	IT1607	Mobile Networks and Application Development Laboratory	PCC	4	0	0	4	2
26	IT1701	Neural Networks and Deep Learning	PCC	3	3	0	0	3
27	IT1702	Cloud and Edge Computing	PCC	3	3	0	0	3
28	CS1703	Cryptography Algorithms and Applications	PCC	3	3	0	0	3
29	IT1703	Organizational Behavior	PCC	3	3	0	0	3
30	IT1707	Cloud and Edge Computing Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVE – I (SEMESTER V)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1511	Optimization Techniques	PEC	3	3	0	0	3
2	IT1512	Video Creation and Editing	PEC	3	3	0	0	3
3	IT1513	Information Storage and Management	PEC	3	3	0	0	3
4	IT1514	Knowledge Engineering	PEC	3	3	0	0	3
5	CS1515	Fundamentals of Digital Image Processing	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (SEMESTER VI)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1611	Fuzzy Logic and Artificial Neural Networks	PEC	3	3	0	0	3
2	IT1612	Software Testing and Quality Assurance	PEC	3	3	0	0	3
3	IT1613	Natural Language Processing Tools and Applications	PEC	3	3	0	0	3
4	DS1611	Image and Video Analytics	PEC	3	3	0	0	3
5	GE1614	Engineering Ethics and Human Values	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1711	Web Development Frameworks	PEC	3	3	0	0	3
2	IT1712	Management Information Systems	PEC	3	3	0	0	3
4	IT1714	Parallel Algorithms	PEC	3	3	0	0	3
5	IT1715	Augmented and Virtual Reality	PEC	3	3	0	0	3
6	CS1712	Virtualization Techniques	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE –IV (SEMESTER VII)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1721	Storage Area Networks	PEC	3	3	0	0	3
2	IT1722	UI/UX Application Development	PEC	3	3	0	0	3
3	IT1723	Software Agents	PEC	3	3	0	0	3
4	IT1724	5G Networks	PEC	3	3	0	0	3
5	DS1723	Social Network Analytics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1811	Information Theory and Coding	PEC	3	3	0	0	3
2	IT1812	Electronic Commerce	PEC	3	3	0	0	3
3	IT1813	Affective Computing	PEC	3	3	0	0	3
4	IT1814	Social Media Mining	PEC	3	3	0	0	3
5	DS1812	Speech Processing and Synthesis	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (SEMESTER VIII)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1821	Introduction to Digital Currencies	PEC	3	3	0	0	3
2	IT1822	Trust Networks	PEC	3	3	0	0	3
3	IT1823	Artificial Intelligence and Robotics	PEC	3	3	0	0	3
4	IT1824	IoT Platform for Smart City Planning	PEC	3	3	0	0	3
5	CS1824	Blockchain Technologies	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES – I & II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OBT101	Industrial Biotechnology	OEC	3	3	0	0	3
2	OBT104	Biosensors	OEC	3	3	0	0	3
3	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3
4	OCE102	Introduction to Geographic Information System	OEC	3	3	0	0	3
5	OCH101	Hospital Management	OEC	3	3	0	0	3
6	OEC103	Basics of Embedded Systems and IoT	OEC	3	3	0	0	3
7	OEE101	Basic Circuit Theory	OEC	3	3	0	0	3
8	OEE103	Introduction to Renewable Energy Systems	OEC	3	3	0	0	3
9	OEI102	Robotics	OEC	3	3	0	0	3
10	OMB101	Total Quality Management	OEC	3	3	0	0	3
11	OME104	Industrial Safety Engineering	OEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	IT1608	Mini Project	EEC	4	0	0	4	2
2	IT1708	Project Phase-I	EEC	4	0	0	4	2
3	IT1807	Project Phase-II	EEC	20	0	0	20	10
VALUE ADEED COURSES								
4	IVA001	Industrial Internet of Things	EEC	3	1	0	2	2
5	IVA002	Augmented Reality & Virtual Reality	EEC	3	1	0	2	2
6	IVA003	Ethical Hacking - Cyber Security	EEC	3	1	0	2	2
7	IVA004	Blockchain and Crypto Currencies	EEC	3	1	0	2	2
8	IVA005	Industrial Practices with Devops	EEC	3	1	0	2	2
9	IVA006	Applied Machine Learning With Python	EEC	3	1	0	2	2

AUDIT COURSES (AC)

Sl. No.	Course Code	Subject Name	Category	Contact Periods	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

* Registration for any of these courses is optional to students

CREDIT SUMMARY

	I	II	III	IV	V	VI	VII	VIII	Total	PERCENTAGE OF CREDIT
HSMC	3	6	1						10	5.56
BSC	12	7	4	4	4				31	17.22
ESC	9	5	4						18	10
PCC		5	16	20	14	14	14		83	46.11
PEC					3	3	6	6	18	10
OEC					3	3			6	3.33
EEC						2	2	10	14	7.78
Total	**24**	**23**	**25**	**24**	**24**	**22**	**22**	**16**	**180**	100

Board Chairman	Dr. A. Chandrasekar	
Dean Academics	Dr. G. Sreekumar	
Principal	Dr. Vaddi Seshagiri Rao	

B.Tech. INFORMATION TECHNOLOGY
REGULATION – 2021
CHOICE BASED CREDIT SYSTEM
I - VIII SEMESTERS SYLLABUS
SEMESTER I

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	**SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS**	**9**
Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		**CO1**
UNIT II	**GENERAL READING AND FREE WRITING**	**9**
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.		**CO2**
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		**CO3**
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	**9**
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		**CO4**

UNIT V	EXTENDED WRITING	9
Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing-brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	1	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		**CO1**
UNIT II	**CALCULUS OF ONE VARIABLE**	**12**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		**CO2**
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		**CO3**
UNIT IV	**INTEGRAL CALCULUS**	**12**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		**CO4**
UNIT V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., —Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	P	T	C
(Common for all branches of B.E. /B. Tech Programmes)		3	0	0	3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity.
- Principles of laser and fiber optics and its various technological applications.
- Thermal conduction in solids, heat exchangers and its applications in various devices.
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques.

UNIT I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity- I shaped girders - stress due to bending in beams.		**CO1**
UNIT II	**LASER AND FIBER OPTICS**	**9**
Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber-Endoscopy-Fiber optic communication system.		**CO2**
UNIT III	**THERMAL PHYSICS**	**9**
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- conduction through compound media (series and parallel)- Lee's disc method: theory and experiment - Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		**CO3**
UNIT IV	**QUANTUM PHYSICS**	**9**
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope- tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		**CO4**
UNIT V	**CRYSTAL PHYSICS**	**9**
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal		

systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).	**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2013.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2014.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young’s modulus by various methods.
CO2	Principle of laser, Einstein’s coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.
CO3	The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee’s disc method and radial flow of heat.
CO4	The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunnelling electron microscopy and its applications.
CO5	The importance of various crystal structures, Miller indices and various growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	P	T	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

To make the student conversant with the

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non–conventional energy sources and energy storage device

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.		**CO1**
UNIT II	**SURFACE CHEMISTRY AND CATALYSIS**	**9**
Surface chemistry : Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **Catalysis**: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.		**CO2**
UNIT III	**PHASE RULE AND ALLOYS**	**9**
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **Alloys**: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		CO3
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate) – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **Combustion of fuels**: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		CO4
UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell .Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd., Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media, New Delhi., (2010).
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

COURSE OUTCOMES

Upon completion of the course, the students should be

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file based program

UNIT I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**
UNIT II	**INTRODUCTION TO PYTHON**	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode; Introduction to colab, pycharm and jupyter idle(s) ,values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators; Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, , expressions, tuple assignment; Accepting input from Console, printing statements, Simple 'Python' programs.		**CO2**
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions, function definition and use, flow of execution, parameters and arguments; local and global scope, return values, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, List Manipulation, mutability, aliasing, cloning lists, list parameters; Lists as arrays, Tuples: tuple assignment, tuple as return value, Tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.		**CO4**

UNIT V	FILES, MODULES, PACKAGES	9
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions-open(), close(), read(), readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments. Errors and exceptions, handling exceptions, modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy file.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO2	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO3	3	3	3	-	2	-	-	2	3	2	-	2	1	2	2
CO4	3	3	3	-	2	-	-	2	3	2	-	2	1	2	2
CO5	3	3	3	-	2	-	-	2	3	2	-	2	1	2	1

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	2	0	4	4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

Experiment	CO
1. Write an algorithm, draw flowchart illustrating mail merge concept.	CO1
2. Write an algorithm , draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two dimensional arrays. • Transpose, addition, multiplication, scalar , determinant of a matrix	
5. Program to explore string functions and recursive functions.	CO2
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	CO3
11. Demonstrate Exceptions in Python.	
12. Applications**:** Implementing GUI using turtle, pygame.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Python 3 interpreter for Windows/Linux

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.

3. Shroff “Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	3	2	-	2	2	-	-
CO2	3	3	3	-	2	-	-	2	3	2	-	2	2	1	1
CO3	3	3	3	-	2	-	-	2	3	2	-	2	2	-	1

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties , Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS - PHYSICS

(A minimum of 5 experiments to be performed from the given list)	
1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	CO1
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	CO1
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	CO2
4. Determination of dispersive power of prism using Spectrometer.	CO2
5. (a) Determination of wavelength and particle size using a laser. (b) Determination of numerical aperture and acceptance angle of an optical fibre. (c) Determination of width of the groove of compact disc using laser.	CO2
6. Determination of Young's modulus of the material of the given beam by uniform bending method.	CO1
7. Determination of energy band gap of the semiconductor.	CO2
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	CO2
DEMONSTRATION EXPERIMENT	
1. Determination of thickness of a thin sheet / wire – Air wedge method	CO1

LIST OF EXPERIMENTS - CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)	
1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	CO5
2. Determination of total, temporary & permanent hardness of water by EDTA method.	CO5
3. Determination of DO content of water sample by Winkler's method.	CO5
4. Determination of chloride content of water sample by argentometric method.	CO3
5. Estimation of copper content of the given solution by Iodometry.	CO3
6. Determination of strength of given hydrochloric acid using pH meter.	CO3
7. Determination of strength of acids in a mixture of acids using conductivity meter.	CO4
8. Estimation of iron content of the given solution using potentiometer.	CO4
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	CO4
10. Conductometric titration of strong acid vs strong base.	CO4
DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).	CO3
2. Estimation of sodium and potassium present in water using flame	CO5

TOTAL : 60 PERIODS

COURSE OUTCOMES **Upon completion of the course, the students should be**	
CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the procedure to estimate the amount of dissolved oxygen present in the water.
CO2	Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating. Able to understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.
CO3	Able to understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor. Able to understand the principle and procedure involved in the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of microscope and its applications in determining the moduli. Able to understand the concept of determining the emf values by using potentiometer.
CO5	Able to calculate the particle size of poly crystalline solids. Able to understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

SEMESTER II

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
(Common for all branches of B.E. /B. Tech Programmes)		3	0	0	3

OBJECTIVES

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	INTRODUCTION TO PROFESSIONAL ENGLISH	9
Listening: Listening to technical talks with comprehension tasks -Speaking– conversationmethodsinreallifeoccurrencesusingexpressions of different emotions and imperative usages- Reading – reading short technical texts from journals- newspapers-Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations- Vocabulary Development- technical vocabulary Language Development –tenses- subject verb agreement - compound words.		**CO1**
UNIT II	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		**CO2**
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		**CO3**
UNIT IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		**CO4**
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	-	-	3
CO2	-	1	-	2	-	-	-	-	-	3	-	-	-	-	-
CO3	-	2	-	3	-	-	-	-	1	2	-	-	3	-	1
CO4	-	-	-	-	1	-	-	-	2	2	-	-	1	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	2	-	1

MA1202	ENGINEERING MATHEMATICS - II	L	T	P	C
(Common for all branches of B.E. /B. Tech Programmes Except AI-DS & AI-ML)		3	1	0	4

OBJECTIVES

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients		**CO1**
UNIT II	**VECTOR CALCULUS**	**12**
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and application in evaluating line, surface and volume integrals		**CO2**
UNIT III	**COMPLEX VARIABLES**	**12**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = Z + C$, CZ, $1/Z$ - Bilinear transformation		**CO3**
UNIT IV	**COMPLEX INTEGRATION**	**12**
Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line)		**CO4**
UNIT V	**LAPLACE TRANSFORMS**	**12**
Existence conditions – Transforms of elementary functions –Basic properties – Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals –– Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCE BOOKS

1. G Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., ― Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, ―Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., ―Advanced Engineering Mathematics ―Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply various techniques in solving differential equations
CO2	Gradient, divergence and curl of a vector point function and related identities
CO3	Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification
CO4	Analytic functions, conformal mapping and complex integration
CO5	Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	3	2	-	-	1	1	3	3	3	3
CO2	3	3	2	3	2	2	1	-	-	-	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	3	3

PH1252	PHYSICS FOR INFORMATION SCIENCE	L	P	T	C
(Common to CSE, IT, AI-DS & AI-ML)		3	0	0	3

OBJECTIVES

To make the student

- To acquire knowledge on the electron transport properties
- To understand the essential principles of semiconductor device
- To have the necessary understanding in optical properties of materials.
- To grasp the principles of magnetic materials and its applications.
- To understand the basics of Nano-electronic devices.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9
Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - Electron effective mass - concept of hole - Applications of low resistive and high resistive materials.		**CO1**
UNIT II	**SEMICONDUCTOR PHYSICS**	**9**
Intrinsic semiconductors - Energy band diagram - direct and indirect band gap semiconductors - carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n-type & p-type semiconductors - variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - carrier transport in semiconductors - Hall effect and devices - Ohmic contacts – Schottky diode - Semiconducting polymers.		**CO2**
UNIT III	**MAGNETIC PROPERTIES OF MATERIALS**	**9**
Magnetism in materials - magnetic dipole moment - magnetic permeability and susceptibility - Microscopic classification of magnetic materials : diamagnetism - paramagnetism - ferromagnetism - antiferromagnetism - ferrimagnetism - Curie temperature - Domain Theory - M versus H behaviour - Hard and soft magnetic materials - examples and uses - Magnetic principle in computer data storage - Magnetic hard disc - Spintronics - GMR Sensor (Giant Magnetoresistance) - TMR (Tunnel Magnetoresistance)		**CO3**
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - p-i-n Photodiodes - Avalanche Photodiodes -Optical data storage techniques- Holography - applications.		**CO4**

UNIT V	NANO DEVICES	9
Electron density in bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Ballistic transport - Carbon nanotubes: properties and applications - Material Processing by chemical vapour deposition and Laser ablation method - Graphene: properties and applications		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jasprit Singh, — Semiconductor Devices: Basic Principles, Wiley 2012.
2. Donald Neaman, Dhrubes Biswas , Semiconductor Physics and Devices (SIE), 4^{th} Edition, 2017
3. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.
4. Kasap, S.O. — Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
5. Kittel, C. — Introduction to Solid State Physics, Wiley, 2005.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. —Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. —Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. —Nanotechnology: Understanding small systems, CRC press, 2014

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1	Gain knowledge on classical and quantum electron theories and energy band structures.
CO2	Acquire knowledge on basics of semiconductor physics and its applications in various devices.
CO3	Get knowledge on magnetic properties of materials and their applications in data storage.
CO4	Have the necessary understanding on the functioning of optical materials for Optoelectronics.
CO5	Understand the basics of quantum structures and their applications in nano electronic devices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	2	2	3
CO3	3	3	1	1	2	2	1	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	P	T	C
(Common for all branches of B.E. /B. Tech Programmes)		3	0	0	3

OBJECTIVES

- To study the inter relationship between living organisms and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	11
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.		**CO1**
UNIT II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		**CO2**
UNIT III	**NATURAL RESOURCES**	**9**
Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		**CO3**
UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**8**
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland		**CO4**

reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.

UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	8
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hyderabad, (2015).
3. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd, Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies - From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, the students should be able

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to the environmental problems.
CO5	To understand the impact of environment on human population and human health.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

BE1251	BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
(Common to CSE, IT, AI-DS & AI-ML)		3	0	0	3

OBJECTIVES

- To learn the fundamental laws, network theorems and analyse the electric circuits.
- To study the basic principles of electrical machines and their performance.
- To study the fundamentals of power systems.
- To learn the characteristics of various electron devices and Op Amp integrated circuit.
- To understand the principle and operation of measuring instruments and transducers.

UNIT I	**ELECTRIC CIRCUITS ANALYSIS**	**9**
Ohms Law, Kirchhoff's Law-Instantaneous power - Series and parallel circuit: analysis of resistive, capacitive and inductive network, star delta conversion, Nodal analysis and mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, superposition theorem and maximum power transfer theorem. Three phase ac supply –Instantaneous power, Reactive power and apparent power.		**CO1**
UNIT II	**ELECTRICAL MACHINES**	**9**
DC and AC ROTATING MACHINES: Types, Construction, principle, EMF and torque equation, application, Speed Control. Basics of Stepper Motor and Brushless DC motors. Transformers-Introduction, types and construction, working principle of Ideal transformer, EMF equation, All day efficiency calculation.		**CO2**
UNIT III	**FUNDAMENTALS OF POWER SYSTEM**	**9**
Structure of power system. Sources of electrical energy – Non-renewable, Renewable- Storage systems: Batteries-Ni-Cd, Pb -Acid and Li-ion, SOC (State of Charge), DOD (Depth of Discharge)Characteristics. Utilization of electrical power - DC and AC load applications. - Electric circuit Protection-need for earthing, fuses and circuit breakers.		**CO3**
UNIT IV	**ELECTRON DEVICES AND INTEGRATED CIRCUITS**	**9**
PN Junction-VI Characteristics of Diode, Zener diode, Rectifiers, Zener voltage regulator. Transistor configurations – CE amplifier - RC and LC oscillators. Op Amps – Basic characteristics and its applications.		**CO4**
UNIT V	**MEASURING INSTRUMENTS AND TRANSDUCERS**	**9**
Characteristic of measurement-errors in measurement – Principle and working of indicting instrument- Moving Coil meter, Moving Iron meter, Energy meter and watt meter, Cathode Ray Oscilloscope –- Transducers, thermo-electric, RTD, Strain gauge, LVDT, LDR, and piezoelectric transducer.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, fourth Edition, 2019
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCE BOOKS

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. S.Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, sixth edition,2017.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to learn the fundamental laws, theorems of electrical circuits and to analyze them
CO2	Ability to understand the basic construction and operating principle of dc and ac machines.
CO3	Ability to understand the electrical power generation, energy storage and utilization of electric power.
CO4	Ability to understand the characteristics of various electronic devices and Op Amp integrated circuit
CO5	Ability to understand the principles and operation of measuring instruments and transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO2	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO3	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO4	3	3	3	3	1	1	1	3	3	3	1	3	3	1	3
CO5	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2

CS1206	PROGRAMMING IN C	L	T	P	C
(Common to CSE, IT, AI-DS & AI-ML)		3	0	0	3

OBJECTIVES

- To develop C Programs using basic programming constructs
- To develop C programs using arrays, strings and functions
- To develop applications in C using pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT I	**BASICS OF C PROGRAMMING**	**9**
An overview of C: History of C; Compiler Vs. Interpreter, Structure of a C Program, Library and Linking, Compiling a C Program; Basic data types , Modifying the basic data types, Variables: Type qualifiers, Storage class specifiers; Constants: Enumeration Constants; Keywords; Operators: Precedence and Associativity; Expressions: Order of evaluation, Type conversion in expression, Casts; Input/Output statements; Assignment statements, Selection statements; Iteration statements; Jump statements; Expression statements; Pre-processor directives: Compilation process		**CO1**
UNIT II	**ARRAYS, STRINGS AND FUNCTIONS**	**9**
Introduction to Arrays: Declaration, Initialization, Single dimensional array, Two dimensional arrays, Array Manipulations; String operations: length, compare, concatenate, copy; Functions: General form of a function, Function Arguments, Built-in functions, return statement, Recursion		**CO2**
UNIT III	**POINTERS**	**9**
Pointers: Declaring and defining pointers, Pointer operators, Pointer expression; Pointer Assignment, Pointer Conversions, Pointer arithmetic, Pointer Comparisons; Pointers and Arrays: Array of pointers; Multiple Indirection; Pointers to function; Problems with Pointers; Parameter passing: Pass by value, Pass by reference.		**CO3**
UNIT IV	**STRUCTURES AND UNIONS**	**9**
Structure: Accessing Structure members, Structure Assignments; Nested structures; Pointer and Structures; Array of structures; Passing Structures to Functions: Passing structure member to function, Passing entire structure to functions; Arrays in Structures; Self-referential structures; Dynamic memory allocation; typedef statement, Union and Enumeration.		**CO4**
UNIT V	**FILE PROCESSING**	**9**
File System Basics: File Pointer, Opening and Closing a File; Reading and Writing Character; Working with String: fputs() and fgets(); rewind(); ferror(); fread() and fwrite(); Erasing files; Types of file processing: Sequential access; Random access: fprintf() and fscanf(), fseek() and ftell(); Command line arguments.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill.
2. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, -The C Programming language‖, Second Edition, Pearson Education, 2006.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, -C How to Program‖, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, -Programming in C‖, CENGAGE Learning India pvt. Ltd., 2011.
3. Pradip Dey, Manas Ghosh, -Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, -Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C using structures and union.
CO5	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

GE1207	ENGINEERING PRACTICES LAB	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13** **CO1**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) **Hands-on-exercise:**
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE **18** **CO2**

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)	
III ELECTRICAL ENGINEERING PRACTICE 13 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	**CO3**
5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.	**CO4**
IV ELECTRONICS ENGINEERING PRACTICE 16 1. Study of electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	**CO5**
TOTAL : 60 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	**1 each**

ELECTRICAL		
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
ELECTRONICS		
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipments to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO2	3	2	3	-	-	3	-	-	-	-	-	3	3	3	3
CO3	3	1	2	-	-	2	-	-	-	-	-	3	3	3	3
CO4	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO5	3	2	2	-	-	2	-	-	-	-	-	3	2	2	2

CS1208	PROGRAMMING IN C LAB	L	T	P	C
	(Common to CSE, IT, AI-DS & AI-ML)	0	0	4	2

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS

1. C programming using simple statements and expressions.	CO1
2. Scientific problem-solving using decision making and looping.	
3. Generating different patterns using multiple control statements.	
4. Problems solving using one dimensional array.	
5. Mathematical problem solving using two dimensional arrays.	
6. Solving problems using string functions.	CO2
7. Solving problems with user defined functions.	
8. Solving problems using recursive function.	
9. Solving problems with dynamic memory allocation.	
10. Realtime application using structures and unions.	
11. Realtime problem solving using sequential and random-access file.	CO3
12. Solving problems with command line argument.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
4. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
5. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
6. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving string, functions, recursion, pointers, and structures.
CO3	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

SEMESTER III

MA1351	PROBABILITY AND STATISTICS	L	T	P	C
	Common to CSE, IT, AI-DS	3	1	0	4

OBJECTIVES

- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in engineering applications.
- To acquaint the knowledge of testing of hypothesis for small and large samples, which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I	**PROBABILITY AND RANDOM VARIABLES**	**12**
Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete andcontinuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		**CO1**
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**12**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linearregression – Central limit theorem (for independent and identically distributed random variables).		**CO2**
UNIT III	**RANDOM PROCESSES**	**12**
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		**CO3**
UNIT IV	**TESTING OF HYPOTHESIS**	**12**
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit.		**CO4**
UNIT V	**DESIGN OF EXPERIMENTS**	**12**
One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics forEngineers", Pearson Education, Asia, 9th Edition, 2017.
2. Ibe, O.C., —Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Indian Reprint, 2014.

REFERENCE BOOKS

1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2017.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4thEdition,Elsevier, 2009.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Give exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Pave ideas to handle situations involving more than one random variable and functions of random variables.
CO3	Give an understanding and characterizes phenomena which evolve with respect to time in a probabilistic manner and modelling the real life phenomena.
CO4	Gain the knowledge on Large Samples and Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO5	Design of experiments, carry them out, and analyze the data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	3	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	3	2	3	3	2	1	-	-	-	2	2	3	2	1
CO5	3	3	2	3	2	2	1	-	-	-	1	2	2	1	1

IT1301	JAVA PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand Object Oriented Programming concepts and fundamentals of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces with database connectivity

UNIT I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS	9
Object Oriented Programming concepts - Abstraction – objects and classes - Encapsulation- Inheritance –Polymorphism- Characteristics of Java – The Java Environment-. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays - JavaDoc comments.		**CO1**
UNIT II	**PACKAGES, INHERITANCE AND INTERFACES**	**9**
Inheritance – Super classes- sub classes – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface - Object cloning -inner classes, Array Lists – Strings, Packages		**CO2**
UNIT III	**EXCEPTION HANDLING AND I/O CONCEPTS**	**9**
Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files		**CO3**
UNIT IV	**CONCURRENT AND GENERIC PROGRAMMING**	**9**
Multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types		**CO4**
UNIT V	**EVENT DRIVEN PROGRAMMING AND DATABASE CONNECTIVITY**	**9**
Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events – AWT event hierarchy – layout management - Swing Components- JDBC Architecture - Establishing Connectivity – Working with statements - Creating and executing SQL statements - Working with Result Set.-Simple Java Applications		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
2. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
3. Judith Bishop, “Java Gently : Programming Principles Explained”, 3rd Edition, 2000.

REFERENCE BOOKS

1. T. Budd, "An Introduction to Object Oriented Programming", 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , "Introduction to Java programming", 7th Edition, Pearson education, 2010.
3. C Xavier , "Java Programming – A Practical Approach", Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, "The Java programming language", 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamental ideas behind the object oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification
CO3	Build Java applications using exceptions and I/O streams
CO4	A modern coverage of concurrent programming that focuses on high-level synchronization constructs
CO5	Know the concept of event handling used in GUI with Database Connectivity

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	2	-	-	2	1	1	1	2	2	1
CO2	1	1	2	1	1	1	2	1	2	1	1	1	2	2	2
CO3	1	1	1	1	1	-	-	1	2	2	2	1	1	2	2
CO4	1	1	2	-	1	-	1	-	1	1	2	1	3	1	3
CO5	2	2	2	2	2	-	1	1	2	1	2	2	1	2	2

<table>
<tr><td>CS1301</td><td>DIGITAL PRINCIPLES AND LOGIC DESIGN (Lab Integrated)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">Common to CSE &IT</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td colspan="6">OBJECTIVES
❖ To learn Boolean algebra and simplification of Boolean functions.
❖ To learn to design and analyze different combinational circuits.
❖ To study the basics of synchronous sequential logic, analyze and design sequential circuits.
❖ To learn about basic memory devices and programmable logic devices to build simple digital systems.
❖ To learn to write code in Hardware Definition Language for designing larger digital systems</td></tr>
<tr><td>UNIT I</td><td colspan="4">BOOLEAN ALGEBRA AND LOGIC GATES</td><td>9+6</td></tr>
<tr><td colspan="5">Number Systems: Digital and Binary – Number-Base Conversions – Octal and Hexadecimal Numbers – Complements of Numbers – Signed Binary Numbers - Arithmetic Operations – Binary Codes – Binary Logic - Boolean Algebra – Axiomatic Definition of Boolean algebra - Theorems and Postulates – Boolean Functions – Canonical and Standard Forms – Simplification of Boolean Functions – Digital Logic Gates – Implementation of Universal gates
Lab component:
• Verification of Boolean Theorems using basic gates</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">COMBINATIONAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="5">Combinational Circuits – Analysis and Design Procedures - Binary Adders – Subtractor – Multiplier - Decimal Adder - Parity Generator and Checker – Four-bit Binary Parallel Adder - Magnitude Comparator – Decoders – Encoders –Multiplexers – Demultiplexers - Introduction to HDL – HDL Models of Combinational circuits
Lab component:
• Design and implement Half/Full Adder and Subtractor.
• Design and Implementation of Decoders, Encoders, Multiplexers and Demultiplexers</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">SYNCHRONOUS SEQUENTIAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="5">Sequential Circuits – Storage Elements: Latches, Flip-Flops – Interconversion of Flip-Flops - Analysis of Clocked Sequential Circuits – State Reduction and Assignment – Design Procedure – Registers and Counters – HDL Models of Sequential Circuits
Lab component:
• Design and implement shift-registers.
• Design and implement synchronous counters</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="4">ASYNCHRONOUS SEQUENTIAL LOGIC</td><td>9+6</td></tr>
<tr><td colspan="5">Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards
Lab component:
• Design and Implementation of Asynchronous Sequential Circuit
• Design and implement of Serial Parity Generator.</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td colspan="4">SYSTEM DESIGN</td><td>9+6</td></tr>
<tr><td colspan="5">RAM – Memory Decoding – Error Detection and Correction – ROM – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Design of Digital System using PLA and PAL
Lab component:
• Coding Combinational circuits using HDL
• Coding Sequential circuits using HDL</td><td>CO5</td></tr>
<tr><td colspan="6" align="right">TOTAL : 75 PERIODS</td></tr>
</table>

TEXT BOOKS

1. M. Morris Mano, Michael D. Ciletti, “Digital Design”, Fifth Edition, Pearson Education, 2013.
2. A. Saha and N. Manna, “Digital Principles and Logic Design”, Infinity Science Press LLC, 2007
3. David A. Patterson, John L. Hennessy, “Computer Organization and Design, The Hardware/Software Interface”, Fifth Edition, Morgan Kaufmann/Elsevier, 2013.

REFERENCE BOOKS

1. Charles H. Roth Jr., “Fundamentals of Logic Design”, Fifth Edition, Jaico Publishing House, 2003.
2. John F. Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson Education, 2007.
3. Donald D. Givone, “Digital Principles and Design”, Tata McGraw Hill, 2003.
4. G. K. Kharate, “Digital Electronics”, Oxford University Press, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Simplify Boolean functions using KMAP
CO2	Design and Analysis of Combinational Logic Circuits
CO3	Design and Analysis of Synchronous Sequential Logic Circuits
CO4	Design and Analysis of Asynchronous Sequential Logic Circuits
CO5	Implement designs using Programmable Logic Devices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO2	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO3	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO4	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO5	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML & ECE-IV Sem	3	0	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I	**LINEAR DATA STRUCTURES – LIST**	**9**
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		**CO1**
UNIT II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	**9**
Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.		**CO2**
UNIT III	**NON-LINEAR DATA STRUCTURES – TREES**	**9**
Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.		**CO3**
UNIT IV	**NON-LINEAR DATA STRUCTURES – GRAPHS**	**9**
Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3

CS1304	COMPUTER ARCHITECTURE	L	P	T	C
	Common to CSE, IT & EEE (Elective)	3	0	0	3

OBJECTIVES

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating-point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies and the ways of communication with I/O devices.

UNIT I	**BASIC STRUCTURE OF A COMPUTER SYSTEM**	**9**
Eight ideas-Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.		**CO1**
UNIT II	**DATA REPRESENTATION AND ARITHMETIC FOR COMPUTERS**	**9**
Signed number representation, Addition and Subtraction – Multiplication – Division – Fixed- and Floating-Point Representation – Floating Point Operations.		**CO2**
UNIT III	**DATA PATH AND CONTROL UNIT**	**9**
A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.		**CO3**
UNIT IV	**PARALLELISM**	**9**
Parallel Processing challenges – Flynn‘s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware Multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.		**CO4**
UNIT V	**MEMORY AND PERIPHERAL DEVICES**	**9**
Memory Hierarchy - Memory technologies – Cache memory – Measuring and improving cache performance – virtual memory, TLBs – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits – USB		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. M. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organizationand Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012

REFERENCE BOOKS

1. William Stallings, ―Computer Organization and Architecture – Designing for Performance‖, Tenth Edition, Pearson Education, 2016.
2. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
3. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
4. Jim Ledin, ―Modern Computer architecture and Organization‖, Packt Publishing,2020.
5. Douglas Comer, ―Essentials of Computer Architecture ‖,Taylor and Francis Group 2020

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics structure of computers, operations and instructions.
CO2	Design arithmetic and logic unit.
CO3	Understand pipelined execution and design control unit.
CO4	Understand parallel processing architectures.
CO5	Understand the various memory systems and I/O communication

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO2	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO3	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO4	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO5	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2

CS1305	SOFTWARE ENGINEERING	L	T	P	C
	(Common to CSE & IT)	3	0	0	3

OBJECTIVES

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing, SQA and maintenance measures

UNIT I	**SOFTWARE PROCESS AND AGILE DEVELOPMENT**	**9**
Introduction: The Evolving Role of Software, Software Characteristics, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile process-Extreme programming-XP Process.		**CO1**
UNIT II	**REQUIREMENTS ANALYSIS AND SPECIFICATION**	**9**
Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.		**CO2**
UNIT III	**SOFTWARE DESIGN**	**9**
Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.		**CO3**
UNIT IV	**TESTING AND MAINTENANCE**	**9**
Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.		**CO4**
UNIT V	**PROJECT MANAGEMENT AND SQA**	**9**
Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan, SQA-Concepts, Cost of Quality, Software Quality Group (SQA).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Roger S. Pressman, ―Software Engineering – A Practitioner‟s Approach‖, Seventh Edition, McGraw-Hill International Edition, 2010.
2. Ian Sommerville, ―Software Engineering‖, 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS

1. Rajib Mall, ―Fundamentals of Software Engineering‖, Third Edition, PHI Learning PrivateLimited, 2009.
2. Pankaj Jalote, ―Software Engineering, A Precise Approach‖, Wiley India, 2010.
3. Kelkar S.A., ―Software Engineering‖, Prentice Hall of India Pvt Ltd, 2007.
4. Fairley R., ―Software Engineering Concepts‖, Tata McGraw Hill, New Delhi, 2008.
5. Harry Hariom Choudhary , ―Java Coding Standards‖, Amazon Kindle, USA, 2013. 3. Bernard Homes., ―Fundamentals of Software Testing‖, Wiley & Sons, USA, 2012.
6. Stephen R.Schach, ―Software Engineering‖, Tata McGraw-Hill Publishing Company Limited,2007.
7. http://nptel.ac.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the key activities in managing a software project and process models.
CO2	Concepts of requirements engineering and Analysis Modeling.
CO3	Apply systematic procedure for software design and deployment.
CO4	Compare and contrast the various testing and maintenance.
CO5	Manage project schedule, SQA, estimate project cost and effort required.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	2	3	2	3	3	3	3	3	2	2
CO2	3	3	3	3	2	2	2	2	3	3	3	3	2	3	3
CO3	2	3	3	3	3	2	3	2	3	3	3	3	2	3	3
CO4	3	2	3	3	3	2	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	2	2	2	3	3	3	3	3	2	2

CS1307	DATA STRUCTURES LABORATORY USING C	L	T	P	C
Common to CSE, IT, AI-ML, AI-DS and ECE IV Sem		0	0	4	2

OBJECTIVES

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

LIST OF EXPERIMENTS

Experiment	CO
1. **IMPLIMENTATION OF LIST** Write C programs to a) Array implementation of Stack ADTs. b) Array implementation of Queue ADTs.	CO1
2. **LIST ADT** Array implementation of List ADT.	
3. **IMPLEMENTATION OF STACK AND QUEUE** Write C programs to a) Design and implement Single Linked List. b) Design and implement Stack and its operations using List. c) Design and implement Queue and its operations using List.	
4. **APPLICATIONS OF LINEAR DATA STRUCTURE** Write C programs for the following: a) Design and implement polynomial ADT using list b) Uses Stack operations to convert infix expression into postfix expression. c) Uses Stack operations for evaluating the postfix expression.	CO2
5. **APPLICATIONS OF TREE** a) Write a C program to Design and implement binary tree. b) Traverse the above binary tree recursively in pre-order, post-order & in-order.	
6. **IMPLEMENTATION OF TREE** Write a C program to Design and implement binary search tree.	
7. **IMPLEMENTATION OF ADVANCED TREE** a) Design and Implement AVL tree using Templates. b) Design and Implement heap tree using Templates.	CO3
8. **IMPLEMENTATION OF SHORTEST PATH ALGORITHMS** Write C programs for the following: a) Design and Implement Dijkstra‘s algorithm b) Design and Implement Floyd Warshall algorithm.	
9. **IMPLEMENTATION OF MINIMUM SPANNING TREE** Write C programs for the following: a) Design and Implement Kruskal’s algorithm. b) Design and Implement Prim’s algorithm.	CO3
10. **GRAPH TRAVERSAL & APPLICATIONS** Write C programs to implement the following algorithms: a) Depth first search.	

b) Breadth first search.
c) Toplogical Sorting.

11. **SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION**

a) Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
   i. Insertion sort
   ii. Selection sort
   iii. Quick sort
   iv. Merge sort

b) Write C programs for implement linear search and binary search.

c) Write C programs for implement Hashing – any two collision techniques

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using C‖, Second Edition , Oxford University Press, 2011.

WEB REFERENCES

1. https://www.mygreatlearning.com/blog/data-structures-using-c/
2. https://www.faceprep.in/data-structures/data-structures-programs/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Write functions to implement linear and non-linear data structure operations
CO2	Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

IT1308	JAVA PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To build software development skills using java programming for real-world applications
- Implement Object Oriented programming concept using basic syntaxes of control Structures, strings and function for developing skills of logic building activity.
- Identify classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem
- Identify and describe common abstract user interface components to design GUI in Java using Swing along with response to events and Database Connectivity using JDBC.

LIST OF EXPERIMENTS

No.	Experiment	CO
1.	Develop a java application to generate electricity bill. Create a class with the following Consumer no., consumer name, previous month reading, current month reading, and type of EB connection (i.e. domestic or commercial) .Compute the bill amount using the following tariff. If the type of the EB connection is domestic. Calculate the amount to be pain follows. First 100 units –Rs.1 per unit 101-200 units –Rs.2.50 per unit 201-500 units –Rs.4 per unit >501 unit –Rs.6 per unit If the type of the EB connection is commercial ,calculate the amount to be paid follows First 100 units –Rs.2 per unit 101-200 units –Rs.4.50 per unit 201-500 units –Rs. 6 per unit >501 units –Rs. 7 per unit	**CO1**
2.	Develop a java application with Employee class with Emp_name, Emp_id, Address,Mail_id,Mobile_no as members. Inherit the classes,Programmer,Assistant Professor, Associate Professor with Professor from employee class. Add basic Pay(BP) as the member of all the inherited classes with 97% of BP as DA,10% of BP as HRA,12% of BP as PF,0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.	
3.	Write a Java program to make frequency count of words in a given text	
4.	Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.	
5.	Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementation	
6.	Complete the following: 1. Create a package named shape. 2. Create some classes in the package representing some common shapes like Square,Triangle, and Circle. 3. Import and compile these classes in other program.	
7.	Write a Java program to implement user defined exception handling.	**CO2**
8.	Write a java program to find the maximum value from the given type of elements using a generic function.	
9.	Write a program in Java for String handling which performs the following: i) Checks the capacity of StringBuffer objects. ii) Reverses the contents of a string given on console and converts the resultant string in upper case. iii) Reads a string from console and appends it to the resultant string of ii.	
10.	Write a program to perform string operations using ArrayList. Write functions for the following a. Append - add at end b. Insert – add at particular index c. Search	

d. List all string starts with given letter	
11. Write a Java program to read copy content of one file to other by handling all file related exceptions	
12. Write a Java program that creates three threads. First thread displays “Good Morning” everyone second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.	
13. Write a java Program to create a window when we press a. M or m the window displays Good Morning b. A or a the window displays Good After Noon c. E or e the window displays Good Evening d. N or n the window displays Good Night	**CO3**
14. Create a GUI program in java with the following components. a. A frame with Flow layout. b. Add the following components on to the frame. i. Two Text Field ii. A button with the label display c. Allow the user to enter data into the JTextField d. When the button is clicked paint the frame by displaying the data entered in the JTextField e. Allow the user to properly close the frame	
15. Design and Develop the GUI application with database connectivity of your choice	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with any JDK IDE (like NetBeans 1.8v) 30 Nos.

(or)

Server with Java Web Server supporting 30 terminals

REFERENCE BOOKS

1. Herbert schildt , The complete reference, 11th edition, Tata Mc Graw Hill, New Delhi. 2018.

WEB REFERENCES

1. https://www.startertutorials.com/corejava/resources
2. https://docs.oracle.com/javase/tutorial/
3. https://wiki.c2.com/?JavaLinks

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Demonstrates how to achieve reusability using inheritance, interfaces and packages and describes faster application development can be achieved
CO2	To be able to make an understanding to developing Strings and exception handling, Multithreading and File Handling
CO3	Identify, Design & develop Graphical user interfaces using principal Java Swing components and JDBC

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	1	2	-	-	2	2	2	-	2	2	3	2
CO2	3	3	3	2	2	-	-	2	2	2	1	2	3	3	2
CO3	3	3	3	2	2	-	-	2	2	2	1	2	2	3	2

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
Common to IT & AI-ML		0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS	
UNIT I	**6**
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	**CO1**
UNIT II	**6**
Self-Introduction-organizing the material - Introducing oneself to the audience ─ introducing the topic — answering questions — individual presentation practice—— Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	**CO2**
UNIT III	**6**
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -─ questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others‘ views / ideas; Arguing against others‘ views or ideas, etc	**CO3**
UNIT IV	**6**
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette ─ dress code ─ body language ─ attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them	**CO4**
UNIT V	**6**
Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management- developing a long-term career plan making career changes	**CO5**
TOTAL : 30 PERIODS	

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	1	2	3	-	-	2	1	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	1	2	-	-	-	-	2
CO4	-	-	-	-	1	-	-	-	2	2	-	-	-	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	2	2

SEMESTER IV

MA1453	DISCRETE MATHEMATICS	L	T	P	C
(Common to CSE, IT & AI-DS)		3	1	0	4

OBJECTIVES

- To introduce Mathematical Logic, Inference Theory and proof methods.
- To provide fundamental principles on combinatorial counting techniques.
- To introduce graph models, their representation, connectivity and traverse ability.
- To explain the fundamental algebraic structures, groups and their algebraic properties.
- To introduce partial ordering and some functions on a set.

UNIT I	**LOGIC AND PROOFS**	**12**
Propositional Logic – Propositional Equivalences – Normal Forms - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.		**CO1**
UNIT II	**COMBINATORICS**	**12**
Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations -Generating Functions - Solving Linear Recurrence Relations Using Generating Functions– Inclusion – Exclusion – Principle and Its Applications.		**CO2**
UNIT III	**SETS AND FUNCTIONS**	**12**
Set -Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.		**CO3**
UNIT IV	**GRAPHS**	**12**
Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.		**CO4**
UNIT V	**ALGEBRAIC STRUCTURES**	**12**
Groups – Subgroups – Homomorphisms – Isomorphism - Normal Subgroup and Coset – Lagrange's Theorem.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2012.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, Thirtieth Reprint, New Delhi, 2011.

REFERENCE BOOKS

1. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, Fifth Edition, New Delhi, 2014
2. Seymour Lipschutz and Mark Lipson," Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
3. Thomas Koshy," Discrete Mathematics with Applications", Elsevier Publications, Boston, 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Construct proofs by using direct proof, proof by contraposition, proof by contradiction. Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositions. Logic helps in arriving inferences for any problem.
CO2	Solve problems such as permutation and combination and in generating functions. Prove mathematical theorems using mathematical induction. Demonstrate basic counting principles, compute and interpret the meaning in the context of the particular application. Helps to apply the combinatorial techniques in Algorithms and Data structure for analysis and design.
CO3	Understand relations on a set and functions on a set
CO4	Apply the concepts of graph theory in data structures, data mining, image segmentation and in clustering.
CO5	Familiar with algebraic systems, groups, sub groups, Lagrange's theorem and normal subgroups. In Coding algorithms and in theoretical computer science algebraic structures are applied.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO2	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO3	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO4	3	3	2	2	1	1	-	-	-	-	1	2	2	2	1
CO5	3	3	2	2	1	1	-	-	-	-	1	2	2	1	1

CS1401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Common for CSE, IT, AI-DS and AI-ML	3	0	0	3

OBJECTIVES

- To learn the general framework for analyzing algorithm efficiency
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

UNIT I	**INTRODUCTION**	**9**
Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – The Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Nonrecursive and Recursive Algorithms – Empirical Analysis of Algorithms.		**CO1**
UNIT II	**DECREASE AND CONQUER AND DIVIDE-AND-CONQUER**	**9**
Decrease-and-Conquer– Insertion Sort – Binary Search – Computing a Median and the Selection Problem – Divide-and-Conquer – Merge Sort – Quicksort – The Closest –Pair and Convex –Hull Problems by Divide-and-Conquer.		**CO2**
UNIT III	**DYMANIC PROGRAMMING AND GREEDY TECHNIQUE**	**9**
The Knapsack Problem and Memory Functions – Optimal Binary Search Trees – Warshall's Algorithm – Floyd's Algorithm – Greedy Technique – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman Trees and Codes.		**CO3**
UNIT IV	**ITERATIVE IMPROVEMENT**	**9**
Graphical Method – The Simplex Method – The maximum Flow Problem – Maximum Matching in Bipartite Graphs – The Stable Marriage Problem.		**CO4**
UNIT V	**BACKTRACKING, BRANCH-AND-BOUND AND APPROXIMATION ALGORITHMS**	**9**
P, NP, and NP- Complete Problems – Backtracking – n-Queens Problem – Hamiltonian Circuit Problem – Subset-Sum Problem – Branch-and-Bound – Assignment Problem – Knapsack Problem – Traveling Salesman Problem – Approximation Algorithms for the Traveling Salesman Problem and the Knapsack Problem.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Steven S. Skiena, “The Algorithm Design Manual”, Second Edition, Springer, 2008.
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education, 2011.
3. Donald E. Knuth, “Art of Computer Programming, Volume I - Fundamental Algorithms”, Third Edition, Addison Wesley, 1997.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to investigate an algorithm’s efficiency with respect to running time
CO2	Design and implement problems using algorithmic design techniques such as decrease and conquer and divide and conquer
CO3	Ability to understand the design techniques such as Dynamic programming and Greedy technique
CO4	Ability to understand the iterative design techniques
CO5	Understand the variations among tractable and intractable problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO2	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO3	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO4	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO5	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2

CS1402	OPERATING SYSTEMS	L	T	P	C
Common to CSE, IT, AI-DS & AI-ML		3	0	0	3

OBJECTIVES

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I	OPERATING SYSTEM OVERVIEW	9
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.		**CO1**
UNIT II	**PROCESS MANAGEMENT**	**9**
Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		**CO2**
UNIT III	**STORAGE MANAGEMENT**	**9**
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Need for Page Replacement, Page Replacement Algorithm, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		**CO3**
UNIT IV	**FILE SYSTEMS AND I/O SYSTEMS**	**9**
Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.		**CO4**
UNIT V	**CASE STUDY**	**9**
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, —Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS

1. RamazElmasri, A. Gil Carrick, David Levine, —Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, —Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, —Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education
6. Daniel P Bovet and Marco Cesati, —Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.
7. Neil Smyth, —iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.
8. http://nptel.ac.in/.
9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Analyze various scheduling algorithms.
CO2	Understand deadlock, prevention and avoidance algorithms.
CO3	Compare and contrast various memory management schemes.
CO4	Understand the functionality of file systems.
CO5	Perform administrative tasks on Linux Servers and Compare iOS and Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	-	-	-	-	-	2	2	2	2	1
CO2	3	2	1	1	-	-	-	-	-	-	2	2	2	2	1
CO3	3	2	1	1	-	-	-	-	-	-	2	2	2	2	1
CO4	3	2	1	1	-	-	-	-	-	-	2	2	2	2	1
CO5	3	1	2	1	1	-	1	-	1	1	2	2	2	2	2

CS1403	DATABASE DESIGN AND MANAGEMENT (Lab Integrated)	L	T	P	C
Common for CSE, IT, AI-DS & AI-ML		3	0	2	4

OBJECTIVES

- ❖ To learn the fundamentals of data models, ER diagrams and to study SQL and relational database design.
- ❖ To familiarize relational model with Relational Database design and Normal Forms.
- ❖ To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- ❖ To understand the implementation techniques by learning file organization and Query Optimization.
  To understand the concepts of distributed databases, Object Oriented databases and XML databases.

UNIT I	INTRODUCTION TO RELATIONAL DATABASES	9 + 6
Purpose of Database System – Views of data – Data Models – Database System Architecture Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping– Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features **Lab Component** • Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements .Database Querying – Simple queries, Nested queries, Sub queries and Joins • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views, Synonyms, Sequences. • Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)		**CO1**
UNIT II	**RELATIONAL DATABASE DESIGN**	**9 + 6**
Embedded SQL– Dynamic SQL - Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **Lab Component** • Simple Embedded SQL Program to demonstrate the concepts. • Database Design using normalization and Implementation for any application.		**CO2**
UNIT III	**TRANSACTIONS**	**9 + 6**
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery. **Lab Component** • Usage of Transaction control language commands like commit, rollback and save point. • Develop Programs using BEFORE and AFTER Triggers for INSERT, DELETE and UPDATE statements		**CO3**
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9 + 6**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing. Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation. **Lab Component** • Implementation of B tree and B+ Tree. • Develop programs to demonstrate hashing techniques.		**CO4**

UNIT V	ADVANCED TOPICS	9 + 6
Distributed Databases: Architecture, Data Storage, Data Fragmentation - Replication and Allocation Techniques for Distributed Database Design. Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery. **Lab Component** • Database Connectivity with Front End Tools • Case Study using real life database applications.		CO5

PRACTICALS: 30 PERIODS
THEORY: 45 PERIODS
TOTAL : 75 PERIODS

TEXT BOOKS

1. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson, Seventh Edition, Global Edition,2016
2. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill,2012.
3. Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, An Introduction to Cloud Databases, O'Reilly Media, Inc.,2019.

REFERENCE BOOKS

1. C.J.Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education,2004.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Map ER model to Relational model to perform database design effectively
CO2	Able to understand the various normal forms and to minimize the redundancy in the relations
CO3	Able to know the logic behind the transaction processing, concurrency control and to recover system from failures.
CO4	Able to organize, index the files and to optimize the given queries
CO5	Able to know the concepts of distributed databases, Object Oriented databases and XML databases

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

IT1401	COMPUTER COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of communication
- To impart knowledge on basics of analog and digital communication.
- To understand the basics of data communication models
- To explore the various layers and its functionalities in data communication model

UNIT I	BASICS OF COMMUNICATION	9
Introduction to Communication systems – basic model, point to point, broadcast communication; modulation-need for modulation, types of modulation, Base band and Pass band transmission; Demodulation (detection) - Coherent and Non-coherent detection; Noise – types of noise; Analog to Digital Conversion (ADC) process– Sampling , Quantization and Coding; Sampling theorem, types of sampling – ideal, natural and flat –top sampling; nyquist rate, Signal reconstruction, types of quantization, Quantization noise, Aliasing.		**CO1**
UNIT II	**ANALOG AND DIGITAL COMMUNICATION**	**9**
Amplitude modulation – types of amplitude modulation- Standard AM with Full Carrier ,Comparison of different amplitude modulations; Angle modulation (FM and PM), FM generation using PM, PM generation using FM, Comparison of Narrowband and Wideband FM, Comparison of AM,FM and PM. Analog pulse modulation – PAM,PWM,PPM; Digital pulse modulation – Pulse Code Modulation (PCM), Delta modulation (DM), Adaptive Delta modulation (ADM), Multiplexing – Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM).		**CO2**
UNIT III	**INTRODUCTION TO DATA COMMUNICATION AND OSI MODEL**	**9**
Introduction to computer communication: Transmission modes - Switching: circuit switching and packet switching, OSI model, Layers in OSI model, TCP/IP protocol suite. Physical Layer: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable), Data Link Layer: Framing, Flow control (stop and wait , sliding window flow control) ,Error control, HDLC, Media access control: Ethernet (802.3), CSMA/CD, Logical link control, Wireless LAN (802.11), CSMA/CA.		**CO3**
UNIT IV	**NETWORK LAYER COMPONENTS AND FUNCTIONS**	**9**
Network Layer Logical addressing: IPv4 & IPV6, Subnetting, DHCP, Virtual LAN, Networking devices (Hubs, Bridges & Switches), Network topologies. Routing: Routing and Forwarding, Static routing and Dynamic routing, Routing Algorithms: Distance vector routing algorithm, Link state routing (Dijkstra’s algorithm), Routing Protocols: Routing Information protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), MPLS.		**CO4**

UNIT V	**TRANSPORT, SESSION AMD APPLICATION LAYER**	**9**
Transport Layer –UDP, TCP, Congestion Control & Quality of Service – Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics, Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, POP3, MIME, SNMP.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Wayne Thomasi, "Advanced Electronic Communication Systems", 6th Edition, PHI Publishers, 2003.
2. Simon Haykins, "Communication Systems" John Wiley, 5th Edition, March 2009.
3. John G. Proakis, Masoud Salehi, "Digital Communication", McGraw Hill 5th edition November 6, 2007.

REFERENCE BOOKS

1. Bernard Sklar, "Digital Communication, Fundamentals and Application", Pearson Education Asia, 2nd Edition, Jan. 21,2001.
2. Behrouz A. Forouzen, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.
3. Andrew S.Tanenbaum, "Computer Networks", 5th Edition, Pearson, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe the essential basics of communication
CO2	Classify different types of analog digital modulation schemes
CO3	Comprehend the need of data communication models
CO4	Identify the required network layer components and functions
CO5	Analyze the various protocols required in various layers

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

ML1401	FOUNDATIONS OF MACHINE LEARNING	L	T	P	C
Common for IT, AI-DS & AI-ML		3	0	0	3

OBJECTIVES

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	**INTRODUCTION**	**9**
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – The Bias-Variance Trade-off, FIND–S Algorithm, Candidate Elimination Algorithm		**CO1**
UNIT II	**SUPERVISED LEARNING**	**9**
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		**CO2**
UNIT III	**UNSUPERVISED LEARNING**	**9**
Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA)		**CO3**
UNIT IV	**GRAPHICAL MODELS**	**9**
Bayesian Networks – Conditional Independence – Markov Random Fields – Learning – Naive Bayes Classifiers – Markov Model – Hidden Markov Model.		**CO4**
UNIT V	**ADVANCED LEARNING**	**9**
Reinforcement Learning – Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines – Deep Learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Press, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Second Edition, Springer, 2008.
6. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Gain knowledge about basic concepts of machine learning techniques
CO2	Develop predictive model based on both input and output data
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Ability to address the problem of learning control strategies for autonomous agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

CS1407	OPERATING SYSTEMS LABORATORY	L	T	P	C
	Common to IT, CSE and AI-ML	0	0	4	2

OBJECTIVES

- To learn basic Unix commands, shell programming and to implement various Process Management functions such as IPC and Scheduling.
- To implement Process Synchronization, Deadlock Detection and Avoidance and Memory Allocation methods.
- To implement Paging Techniques and File Management Techniques.

LIST OF EXPERIMENTS

Experiment	CO
1. Simulation of Unix Commands like cp, ls, grep, cd, mkdir, cat, rm etc.,	**CO1**
2. Implementation of Shell Programs.	
3. Implementation of CPU Scheduling Algorithms.	
4. Implementation of Producer Consumer problem using Semaphore.	
5. Implementation of Inter-process Communication using Shared memory.	
6. Implementation of Threading and Synchronization Applications.	**CO2**
7. Implementation of Bankers Algorithm for Deadlock Avoidance.	
8. Implementation of Deadlock Detection Algorithm.	
9. Implementation of Contiguous Memory Allocation.	
10. Implementation of Memory Management scheme using Paging.	**CO3**
11. Implementation of Page Replacement Algorithms.	
12. Implementation of Directory Structures.	
13. Implementation of File Allocation Strategies.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, ―Operating System Concepts‖, 9th Edition, John Wiley and Sons Inc., 2012.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications with shell programming and Scheduling mechanisms.
CO2	Design and develop applications for synchronization, deadlock avoidance and detection.
CO3	Develop applications for implementing Paging and File management concepts.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	-	-	2	2	2	2	2	1
CO2	3	3	3	3	3	-	-	-	-	2	2	2	2	2	1
CO3	3	3	3	3	3	-	-	-	-	2	2	2	2	2	1

ML1408	MACHINE LEARNING LABORATORY	L	T	P	C
	Common for IT, AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To make use of Data sets in implementing the machine learning algorithms
- To implement the machine learning concepts and algorithms in any suitable language of choice
- To understand the practical aspects of probabilistic graphical models.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV File	CO1
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.	
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	CO2
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	CO3
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library lasses/API	
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library lasses/API in the program.	
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Aurelien Geron , "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts, Tools, and Techniques to Build Intelligent Systems", Second Edition, O'Reilly Media
2. Fabio Nelli, "Python Data Analytics with Pandas, Numpy, and Matplotlib", Second Edition, Apress, 2018

3. Practical Machine Learning with Python: A Problem-Solver's Guide to Building Real-World Intelligent Systems" Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress.

WEB REFERENCES

1. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
2. Web Resources: https://www.anaconda.com/enterprise-machine-learning-getting-started/
3. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Update the general and specific boundary for each new example in concept learning
CO2	Develop supervised learning predictive model for general data set
CO3	Ability to apply knowledge representation and machine learning techniques to real world problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

SEMESTER V

MA1501	ALGEBRA AND NUMBER THEORY	L	T	P	C
	(Common to CSE & IT)	3	1	0	4

OBJECTIVES

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To introduce and apply the concepts of rings, finite fields and polynomials.
- To understand the basic concepts in number theory
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject

UNIT I	**GROUPS AND RINGS**	**12**
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem. Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism		**CO1**
UNIT II	**FINITE FIELDS AND POLYNOMIALS**	**12**
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields		**CO2**
UNIT III	**DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS**	**12**
Division algorithm – Base - b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM		**CO3**
UNIT IV	**DIOPHANTINE EQUATIONS AND CONGRUENCES**	**12**
Linear Diophantine equations – Congruence‘s – Linear Congruence‘s - Applications: Divisibility tests - Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems		**CO4**
UNIT V	**CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS**	**12**
Wilson‘s theorem – Fermat‘s little theorem – Euler‘s theorem – Euler‘s Phi functions – Tau and Sigma functions		**CO5**

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5th Edition, New Delhi, 2007.
2. Koshy, T., ―Elementary Number Theory with Applications‖, Elsevier Publications, New Delhi, 2002

REFERENCE BOOKS

1. Lidl, R. and Pitz, G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2nd Edition, 2006.
2. Niven, I., Zuckerman.H.S., and Montgomery, H.L., ―An Introduction to Theory of Numbers, John Wiley and Sons , Singapore, 2004.
3. San Ling and Chaoping Xing, ―Coding Theory – A first Coursel, Cambridge Publications, Cambridge, 2004

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the basic notions of groups, rings, fields which will then be used to solve related problems.
CO2	Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
CO3	Demonstrate accurate and efficient use of advanced algebraic techniques.
CO4	Demonstrate their mastery by solving non - trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text.
CO5	Apply integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO2	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2

CS1502	OBJECT ORIENTED ANALYSIS AND DESIGN	L	T	P	C
(Common to CSE &IT)		3	0	0	3

OBJECTIVES

- To capture the requirements specifications of an intended software system
- To design software with static and dynamic UML diagrams
- To map the design properly to code
- To improve the software design with design patterns

To test the software against its requirements specifications

UNIT I	**INTRODUCTION**	**9**
Introduction to OOAD with OO Basics - Unified Process – UML diagrams, Use Cases – Case study – the Next Gen Point of Sale (POS) system, Inception Use case Modelling, use case modeling - Relating Use cases – include, extend and generalization.		**CO1**
UNIT II	**STATIC MODELLING**	**9**
Class Diagram - Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes - Domain Modeling using class diagrams - Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition		**CO2**
UNIT III	**DYNAMIC MODELLING**	**9**
Dynamic Diagrams - UML interaction diagrams - System sequence diagram – Collaboration diagram - Communication diagram - State machine diagram and Modelling – State Diagram - Activity diagram, Implementation Diagram - UML package diagram - Component and Deployment Diagrams		**CO3**
UNIT IV	**DESIGN PATTERNS**	**9**
GRASP: Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller. Design Patterns – Creational – Factory method – Structural – Bridge – Adapter – Behavioral– Strategy – Observer, Applying Gang of Four design patterns – Mapping design to code		**CO4**
UNIT V	**TESTING**	**9**
Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans, Revisiting and consolidating all salient points and key insights based on the team projects.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, 3rd. Edition, Pearson Education, 2005.
2. Carol Britton, Jill Doake, “A Student Guide to Object-oriented Development”, Elsevier Butterworth-Heinemann, 2005

REFERENCE BOOKS

1. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third Edition, Addison Wesley, 2003.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Reusable Object-Oriented Software”, Pearson, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify and map basic software system requirements in UML
CO2	Express software design with UML diagrams
CO3	Design and implement software systems using OO methodology
CO4	Improve software design using design patterns
CO5	Test the software system developed against the intended requirements

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1501	WEB TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic internet protocols and explore HTML, CSS
- To design interactive web pages using Javascript and working with DOM
- To understand the concepts of MVC and React Framework
- To work with Node.js for building high scale web applications
- To develop RESTful APIs with Express JS as backend web application framework

UNIT I	**Web Essentials, HTML & CSS**	**9**
Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients-Web Servers - XHTML: Syntax and Semantics - HTML Basic Elements - HTML5 control elements – Semantic elements – Audio – Video controls – CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – CSS Box Model – Backgrounds – Border Images – Colors – Text Transformation and Shadows – Transitions – Animations.		**CO1**
UNIT II	**Client-Side Scripting & HTML DOM**	**9**
Introduction to JavaScript-Perspective-Syntax-Variables and Data Types-Statements Operators-Literals-Functions-Objects-Arrays-Built-in Objects. DOM-Introduction to the Document Object Model - DOM History and Levels-Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling - Working with JSON		**CO2**
UNIT III	**React**	**9**
Web Application Frameworks - MVC (Model-View-Controller) framework – Need for front end frameworks – JSX - Getting started with React – Virtual DOM - Creating components – Props – States - Handling user events - Conditional rendering – Loop Array - HTML forms using React – Routing-AJAX		**CO3**
UNIT IV	**Node.js**	**9**
Understanding Node.js - Package management and NPM - Callbacks-Promises- Async-Await - Event Loop - Event Emitter - File System – Global Objects - Timers in Node JS - MySQL - Manipulating and Accessing MySQL Database from Node.js		**CO4**
UNIT V	**Express Framework**	**9**
Express Framework - Configuring Routes – Express JS Request – Response – GET - POST - Processing URLs - Processing Query Strings and Form Parameters - Cookies - Using Response Objects - Implementing Sessions - REST API - Rendering JSON Data		**CO5**

THEORY : 45 PERIODS

TEXT BOOKS

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2007.
2. Zammetti, Frank, “Modern Full-Stack Development”, Apress, 2020.
3. Brad Dayley, “Node.js, MongoDB, and AngularJS Web Development”, 2nd edition, Addison Wesley, 2017.
4. Azat Mardan, “Express. js Guide: The Comprehensive Book on Express. Js”, Leanpub, 2014.

REFERENCE BOOKS

1. Jon Duckett, “JavaScript and JQuery: Interactive Front-End Web Development”, Wiley,2014
2. Wieruch Robin, “The Road to React”, 2021 Edition with React Hooks
3. Alex Banks, Eve Porcello, “Learning React, Modern Patterns for Developing React Apps”, O'Reilly Media, 2020.
4. KrasimirTsonev, “Node.js by Example Paperback”, May 2015.
5. Azat Mardan, “Pro Express.js”, Apress 2014.

WEB REFERENCES

- https://javascript.info/

- https://react.dev/
- https://nodejs.org/en/
- https://expressjs.com/en/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand web fundamentals
CO2	Create dynamic web pages using DHTML and java script that is easy to navigate and use
CO3	Implement React features and create component-based web pages using them
CO4	Generate dynamic page content using Node.js and create application using Node.js with MySQL
CO5	Build scalable web apps quickly and efficiently using Express framework

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	1	-	1	-	-	-	1	1	1	1	1	-	2
CO2	-	-	1	-	1	-	-	-	1	1	1	1	1	-	2
CO3	-	-	2	-	2	-	-	-	1	1	1	2	2	1	2
CO4	-	-	2	-	2	-	-	-	1	1	1	2	2	1	2
CO5	-	-	2	-	2	-	-	-	1	1	1	2	2	1	2

IT1502	COMPUTATIONAL INTELLIGENCE (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

OBJECTIVES

1. To understand the various characteristics of intelligent agents.
2. To learn the different search strategies in AI.
3. To understand the knowledge in solving AI problems.
4. To learn the concepts of learning and communication in AI.
5. To know about the various applications of AI.

UNIT I	INTRODUCTION AND PROBLEM SOLVING	9+6
Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents - Structure – Problem solving agents – Uninformed search strategies – Breadth first search – Uniform cost search – Depth first search – Depth limited search – Bidirectional search – Searching with partial Information. **Lab Component:** 1. Solve any problem using depth and breadth first search. 2. Write a program to solve water Jug Problem		**CO1**
UNIT II	**INFORMED SEARCH AND GAME PLAYING**	**9+6**
Informed search Strategies – A* Heuristic function – Hill Climbing – Simulated Annealing – Constraint Specification problem – Local Search in continuous space – Genetic algorithm – Optimal decisions in games - Pruning - Imperfect decisions –Alpha-Beta pruning – Games that include an element of chance. **Lab Component** 3. Write a program to perform A* search 4. Write a program to solve 8 queens problem		**CO2**
UNIT III	**KNOWLEDGE AND REASONING**	**9+6**
Knowledge based agent – The Wumpus world environment – Propositional logic – Inference rules – First-order logic – Syntax and semantics – Situation calculus – Building a knowledge base – Electronic circuit domain – Ontological Engineering – Forward and backward chaining – Resolution – Truth maintenance system-Mental Events and Mental Objects **Lab Component** 5. Study of PROLOG. Write the following programs using PROLOG Program to perform the operations on list. Program to categorize animal characteristics. Program to read address of a person using compound variable. Program of fun to show concept of cut operator 6. Write a program to demonstrate family relationship		**CO3**
UNIT IV	**UNCERTAINTY**	**9+6**
Non monotonic reasoning-Closed-World Reasoning- Circumscription- Default Logic- Vagueness, Uncertainty, and Degrees of Belief- Objective Probability- Subjective Probability- Dempster–Shafer Theory- Fuzzy Logic-Fuzzy rules-fuzzy inference-Temporal Logic-Temporal Reasoning **Lab Component**		**CO4**

7. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets

UNIT V	APPLICATIONS	9+6

APPLICATIONS

Natural language processing-Morphological Analysis-Syntax analysis-Semantic Analysis-AII applications – Language Models – Information Retrieval – Information Extraction – Machine Translation – Machine Learning – Symbol-Based – Machine Learning: Connectionist – Machine Learning. **CO5**

8.Write a program to preprocessing in text using NLTK library

TOTAL : 75 PERIODS

TEXT BOOKS

1. Stuart J.Russel, Peter Norvig, "Artificial Intelligence A Modern Approach ", 3rd Edition, Pearson Education, 2009.

REFERENCE BOOKS

1. Elaine Rich, Kevin Knight, "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.
2. M. Tim Jones, "Artificial Intelligence: A Systems Approach (Computer Science)", Jones and Bartlett Publishers, Inc., 1 st Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	An ability to identify, analyze the search algorithm for the AI problems.
CO2	Represent a problem using first order logic.
CO3	Provide the knowledge based agent to solve the problem.
CO4	Understand the Informed search strategies.
CO5	Apply the baye's rule to solve the problem for societal concern.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3

IT1507	WEB TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To design dynamic websites with good aesthetic sense using HTML5, CSS3 and Java script
- To work with Express, Node.js, MySQL
- To practice AJAX framework and explore REST API

LIST OF EXPERIMENTS

1. Design a Webpage using all HTML elements	CO1
2. Create a web page with all types of Cascading style sheets and CSS Selectors	
3. Write Client-Side Scripts for Validating Web Form Controls using DHTML 4. Design the following using JavaScript and DOM a. Include Image Slide Show b. Digital clock 5. Develop a web application to implement online quiz system using HTML, CSS and Javascript	
	CO2
6. Create a <TodoItem> component in React and reuse it inside a <TodoList> component 7. Design a shopping cart application using React. Your shopping webpage should have the provisions for selecting the list of items from different category, Once the items are selected on clicking the submit button the items in the cart with its price should be displayed. 8. Develop a Command Line Application for an online super market using NodeJS & MySQL to perform: a) search based on product id or name b) On retrieving the results, display the product details of different brands in table format with the Price field in sorted order	
	CO3
9. Create a basic CRUD operation API by following REST syntax for a given model student with the following fields [field names] 10.To build an AJAX Application	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 60 STUDENTS

Standalone desktops 60 Nos. with internet

Node JS (along with NPM), Chrome/Mozilla Firefox, Mongo DB Server, Visual Studio Code, NPM Libraries: angular-cli, react, MySQL, express

REFERENCE BOOKS

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2007
2. KrasimirTsonev, “Node.js by Example Paperback”, May 2015
3. Wieruch Robin, “The Road to React”, 2021 Edition with React Hooks

WEB REFERENCES	
https://nodejs.org/en/download/ https://reactjs.org/	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Create an interactive Webpage
CO2	Build a Webpage and use Node.js as Server-Side JS framework and create component based web pages using React and Express JS and connect with Backend using MySQL
CO3	Understand AJAX Framework and REST API

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	2	-	2	-	-	-	1	2	1	2	2	1	2
CO2	1	-	2	-	2	-	-	-	1	2	1	2	2	1	2
CO3	1	-	2	-	2	-	-	-	1	2	1	2	2	1	2

CS1508	OBJECT ORIENTED ANALYSIS AND DESIGN LABORATORY	L	T	P	C
	(Common to CSE &IT)	0	0	4	2

OBJECTIVES

- To capture the requirements specification for an intended software system
- To draw the UML diagrams for the given specification
- To map the design properly to code
- To test the software system thoroughly for all scenarios
- To improve the design by applying appropriate design patterns.

LIST OF EXPERIMENTS

1. Identify a software system that needs to be developed.	CO1
2. Document the Software Requirements Specification (SRS) for the identified system.	
3. Identify use cases and develop the Use Case model.	
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.	
5. Using the identified scenarios, find the interaction between objects and represent them usingUML Sequence and Collaboration Diagrams	CO2
6. Draw relevant State Chart and Activity Diagrams for the same system.	
7. Implement the system as per the detailed design	
8. Test the software system for all the scenarios identified as per the use case diagram	CO3
9. Improve the reusability and maintainability of the software system by applying appropriate design patterns.	
10. Implement the modified system and test it for various scenarios	

Suggested domain for mini project

- Passport automation system.
- Book bank
- Exam registration
- Stock maintenance system.
- Online course reservation system
- Airline/Railway reservation system
- Software personnel management system
- Credit card processing
- e-book management system
- Recruitment system
- Foreign trading system
- Conference management system
- BPO management system
- Library management system

- Student information system

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Desktop or server with node of 30 systems

1. Windows 7 or higher
2. ArgoUML that supports UML 1.4 and higher
3. Selenium, JUnit or Apache JMeter

REFERENCE BOOKS

1. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third Edition, Addison Wesley, 2003.
2. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Patterns: Elements of Reusable Object-Oriented Software”, Pearson, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Approach a real world problem, which is uncertain and provide appropriate reasoning.
CO2	Develop solutions using supervised learning techniques and know how to deal with problems with hidden variables.
CO3	Use natural language processing and program basics of robotics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

SEMESTER VI

IT1601	THEORY OF COMPUTATION AND COMPILER DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explore the theoretical foundations of computer science from the perspective of formal languages and classify machines by their power to recognize languages.
- To explore the principles, algorithms, and data structures involved in the design and construction of compilers.

UNIT I	**INTRODUCTION TO AUTOMATA**	**9**
Formal Language and Regular Expressions: Languages, Definition Languages regular expressions, Finite Automata – DFA, NFA. Conversion of a regular expression to NFA, NFA to DFA.Applications of Finite Automata to lexical analysis, lex tools.		**CO1**
UNIT II	**AUTOMATA GRAMMAR AND PARSING**	**9**
Context-Free grammars and parsing: Context-free grammars, derivation, parse trees, ambiguity LL(K) grammars and LL(1) parsing Bottom-up parsing, handle pruning, LR Grammar Parsing, LALR parsing, parsing ambiguous grammars, YACC programming specification.		**CO2**
UNIT III	**SEMANTIC AND CONTEXT-SENSITIVE FEATURES**	**9**
Semantics: Syntax directed translation, S-attributed, and L-attributed grammars, Intermediate code – abstract syntax tree, translation of simple statements, and control flow statements. Context-Sensitive features – Chomsky hierarchy of languages and recognizers. Type checking, type conversions, the equivalence of type expressions, overloading of functions and operations.		**CO3**
UNIT IV	**CODE OPTIMIZATION**	**9**
The symbol table, Storage organization, storage allocation strategies scope access to now local names, parameters, language facilities for dynamics storage allocation. Code optimization Principal sources of optimization, optimization of basic blocks, peephole optimization, flow graphs, optimization techniques.		**CO4**
UNIT V	**CODE GENERATION**	**9**
Code generation: Machine-dependent code generation, object code forms, generic code generation algorithm, Register allocation, and assignment. Using DAG representation of Block.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. John E. Hopcroft, Rajeev M & J D Ullman: "Introduction to Automata Theory Languages &Computation", 3rd Edition, Pearson Education, 2007.
2. Aho, Ullman, Ravisethi: "Compilers Principles, Techniques, and Tools", 2nd Edition, Pearson Education, 2009.

REFERENCE BOOKS

1. Tremblay J P, Sorenson G P: "The Theory & Practice of Compiler writing", 1st Edition, BSP publication, 2010.
2. Appel W & Andrew G M: "Modern Compiler Implementation in C", 1st Edition, Cambridge University Press, 2003.
3. Louden: "Compiler Construction, Principles & Practice", 1st Edition, Thomson Press, 2006.
4. Sipser Michael: "Introduction to Theory of computation", 1st Edition, Thomson, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain deterministic and non-deterministic machines.
CO2	Comprehend the hierarchy of problems arising in the computer sciences.
CO3	Design a deterministic finite-state machine to accept a specified language.
CO4	Explain how a compiler can be constructed for a simple context-free language.
CO5	Determine a language's location in the Chomsky hierarchy (regular sets, context-free, context-sensitive, and recursively enumerable languages).

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1602	MOBILE NETWORKS AND APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To endow with the knowledge required to understand emerging communications networks
- To describe the basic concepts and principles in mobile computing
- To understand the concept of Wireless LANs, PAN, and Mobile Networks
- To explain the structure and components for Mobile IP and Mobility Management
- To familiarize with Mobile apps development aspects

UNIT I	**WIRELESS COMMUNICATION SYSTEMS**	**9**
Cellular Networks - Types of handover - IEEE 802.11: System and Protocol Architecture - Bluetooth : User Scenarios– Architecture - GSM – Architecture - Location tracking and call setup - Mobility management - Handover- GSM SMS–International roaming for GSM – Mobile Number portability - VoIP service for Mobile Networks – GPRS –Architecture - Attach and detach procedures		**CO1**
UNIT II	**MOBILE NETWORK AND TRANSPORT LAYERS**	**9**
Mobile IP – Dynamic Host Configuration Protocol-Mobile Ad Hoc Routing Protocols– Multicast routing-TCP overWireless Networks – Indirect TCP – Snooping TCP – Mobile TCP – Fast Retransmit / Fast Recovery –Transmission/Timeout Freezing-Selective Retransmission – Transaction Oriented TCP- TCP over 2.5 / 3G wirelessNetworks		**CO2**
UNIT III	**INTRODUCTION TO ANDROID**	**9**
Mobile Application development and trends – Android overview and Versions – Android open stack, features – Setting up Android environment (Eclipse, SDK, AVD)- Simple Android application development – Anatomy of Android applications – Activity and Life cycle – Intents, services and Content Providers		**CO3**
UNIT IV	**ANDROID USER INTERFACE**	**9**
Android Architecture - Activity life cycle - Android User Interface – Layouts: Linear, Absolute, Table, Relative, Frame, Scrollview, Resize and reposition - Screen orientation – Views: Textview, EditText, Button, ImageButton, Checkbox, ToggleButton, RadioButton, RadioGroup, ProgressBar, AutocompleteText, Picker, Listviews and Webview– Displaying pictures with views: Gallery and ImageView, ImageSwitcher, Gridview – Displaying Menus: Helper methods, Option and Context		**CO4**
UNIT V	**NETWORKING SERVICES & APPLICATION COMPONENTS IN ANDROID**	**9**
SMS Messaging: Sending and Receiving – Sending email and networking – Downloading binary and text data files – Access Web services – Developing android services: create your		**CO5**

own services, performing long running task in a serviceperforming repeated task in a service- Location based service - Display map, zoom control, view and change, Marking, Geocoding, Get location - Publish Android applications and Deployment

TOTAL : 45 PERIODS

TEXT BOOKS

1.Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2008.
2. Yi Bing Lin Inrichchlamtac, "Wireless and mobile network architecture", Wiley India Edition, Second Edition,2008.
3. Bill Phillips, Chris Stewart, and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide" ,PearsonEducation, Third Edition, 2017.

REFERENCE BOOKS

1. William Stallings, "Wireless Communications and Networks", Pearson Education, Second Edition, 2009.
2. Ed Burnette (2010), "Hello Android: Introducing Google's Mobile Development Platform", The Pragmatic Publishers, 3rd edition, North Carolina USA
3. Wei-Meng Lee, "Beginning Android 4 Application Development", John Wiley, First edition, 2012.
4. Reto Meier, "Professional Android 4 Application Development", John Wiley, Second edition, 2012.
5. ZigurdMednieks, Laird Dornin, Blake Meike G, Masumi Nakamura (2011), "Programming Android: Java Programming for the New Generation of Mobile Devices", OReilly Media, USA

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the various types of handoff and Mobile Networks
CO2	Attain the knowledge to administrate and to maintain a Mobile Communication
CO3	Apply the network and transport layer protocols for mobile networks
CO4	Design and develop simple mobile applications with Android
CO5	Develop mobile applications using various components in Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1603	COMPUTER GRAPHICS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the line, circle and ellipse drawing algorithms and to study the 2-D transformations
- To apply transformations and texture on the object
- To motivate the students to create the 3-D scenes by adding lighting and shades to the objects in the scene.
- To enable the students to perform modeling
- To have in-depth idea about advanced rendering.

UNIT I	ILLUMINATION MODELS & OUTPUT PRIMITIVES	9
Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection. Overview of graphics systems – Video display devices, Raster scan systems, Random scan systems,Graphics Software-Application; Output primitives – points and lines, line drawing algorithms, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.		
UNIT II	**2D GRAPHICS**	**9**
Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations- Affine Transformations ; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; widow-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.		**CO2**
UNIT III	**3D GRAPHICS**	**9**
Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.		**CO3**
UNIT IV	**FRACTALS AND ANIMATIONS**	**9**
Fractals and Self similarity – Peano curves – Creating image by iterated functions – Mandelbrot sets – Julia Sets – Random Fractals – Overview of Ray Tracing – Intersecting rays with other primitives – Adding Surface texture – Reflections and Transparency – Boolean operations on Objects; Animations – General Computer Animation- Design of Animation sequences – animation function – raster animation – key frame systems – motion specification –morphing – tweening.		**CO4**

UNIT V	GRAPHICS PROGRAMMING	9
OpenGL – Basic graphics primitives – Drawing three dimensional objects - Drawing three dimensional scenes- Introduction to Shading models – Flat and Smooth shading – Adding texture to faces – Adding shadows of objects – Building a camera in a program – Creating shaded objects – Rendering texture – Drawing Shadows; WebGL Application- Context-Geometry- Shaders-Associating attributes and buffer objects -Drawing a model		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007
2. Edward Angel, Dave Shreiner, "Interactive Computer Graphics: A Top Down Approach with WebGL", PearsonEducation, Seventh Edition, 2015
3. F .S. Hill, "Computer Graphics using OPENGL", Pearson Education, Second Edition, 2003

REFERENCE BOOKS

1. Kouichi Matsuda, Rodger Lea, "WebGL Programming Guide: Interactive 3D Graphics Programming withWebGL", Pearson Education, 2013
2. Patrick Cozzi, "WebGL Insights", CRC Press
3. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics Principles and Practicein C", Pearson Education, Second Edition, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop the line, circle and ellipse drawing algorithms.
CO2	Design and Apply two dimensional objects & transformations
CO3	Design and Apply three dimensional objects & transformations
CO4	Design Animation Sequences
CO5	Create and Design objects using Graphics programming

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1604	DATA SCIENCE AND BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the fundamental Concepts of Data Science and Big Data Analytics
- To Explore the Analytical Theory and Methods with Clustering, Association, Regression and Classification
- To Understand and learn about the Time Series Analysis
- To know about the research that requires the integration of large amount of data.

UNIT I	INTRODUCTION TO BIG DATA AND DATA ANALYTICS LIFE CYCLE	9
Evolution of Big Data- Big data characteristics -Validating-Big Data Uses Cases-Data Analytics Life cycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize, Exploratory Data Analysis, Statistical Methods for Evaluation, Map Reduce Programming Model		CO1
UNIT II	ANALYTICAL THEORY AND METHODS	9
Clustering, K-Means, Association Rules, Apriori Algorithm, Evaluation of Candidate Rules, Regression – Linear Regression and Logistic Regression, Classification -Decision Trees, Naïve Bayes		CO2
UNIT III	TIME SERIES ANALYSIS	9
Overview of Time Series Analysis, ARIMA Model; Text Analysis: Text Analysis Steps, Stop WordRemoval, Tokenization, Stemming and Lemmatization, Representing Text: Term-Document Matrix, Term Frequency— Inverse Document Frequency (TFIDF). Determining Sentiments.		CO3
UNIT IV	STREAM MEMORY	9
Introduction to Streams Concepts- Stream Data Model and Architecture- Stream Computing, Sampling Data in a Stream, - Filtering Streams- Counting Distinct Elements in a Stream- Estimating Moments- Decaying Window- Real Time Analytics Platform (RTAP Applications)- Case Studies-Real Time Sentiment Analysis, Stock Market Predictions, Using Graph Analytics for Big Data: Graph Analytics		CO4
UNIT V	NOSQL DATA MANAGEMENT	9
NoSQL Databases: Schema-Less Models- Increasing Flexibility for Data Manipulation -Key Value Stores-Document Stores- Tabular Stores- Object Data Stores- Graph Databases: Hive-Sharing -Hbase- Analyzing big data with Twitter- Big data for E-Commerce-BigData for Blogs		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. EMC Education Services “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2012.
2. Hastie, Trevor, et al., “The elements of statistical learning: Data Mining, Inference, and Prediction”, Vol. 2. No. 1. New York: Springer, 2009.
3. V.K. Jain,”Big Data &Hadoop”, Khanna Publishing House, 2017.

REFERENCE BOOKS

1. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012
2. Mark Gardener, “Beginning R The statistical Programming Language”, Wiley, 2015.
3. Han, Kamber, and J Pei, “Data Mining Concepts and Techniques”, 3rd edition, Morgan Kaufman, 2012.
4. Big Data Black Book, DT Editorial Services, Wiley India
5. V.K. Jain, “Data Science & Analytics”, Khanna Publishing House Beginner’s Guide for Data Analysis using R Programming, Jeeva Jose, ISBN: 978-93-86173454.
6. Montgomery, Douglas C., and George C. Runger John, “Applied statistics and probability for engineers”, Wiley & Sons, 6th edition,2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understands various phases of the data analytics life cycle.
CO2	Apply statistical methods to data for inferences.
CO3	Analyze data using Classification, Graphical and computational methods
CO4	Understand Big Data technologies and NOSQL
CO5	Analyze various types of data using Data Analytics Techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	-	-	-	1	1	2	2	2
CO2	1	2	2	1	2	1	1	-	-	-	1	1	2	2	2
CO3	2	2	2	2	1	`1	1	-	-	-	1	1	2	2	2
CO4	2	2	2	2	2	1	1	-	-	-	1	1	2	2	2
CO5	2	2	2	2	2	1	1	-	-	-	1	1	2	2	2

IT1607	MOBILE NETWORKS AND APPLICATION DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To demonstrate knowledge of programming for Mobile network communications
- To develop mobile Applications using Android

LIST OF EXPERIMENTS

1.	Simulation of mobile network	CO1
2.	Measurement of network parameters in mobile Network	
3.	Develop an application for changing the font, color and size of the given text that uses GUI components, Font and Colors	
4.	Develop an application for collecting students information that uses Layout Managers and event listeners.	
5.	Implement a native Calculator to perform various operations using appropriate GUI Components.	
6.	Write an application that display line, circle, rectangle and other 2D graphical primitives on the screen.	
7.	Develop an application for implementing payroll system by connecting the database where the actual data is stored and retrieved.	CO2
8.	Develop an application that makes use of RSS Feed.	
9.	Implement an application that implements Multi-threading	
10.	Develop a native application that uses GPS location information.	
11.	Implement an application that writes data to the SD card.	CO3
12.	Implement an application that creates an alert upon receiving a message.	
13.	Develop an application to send an email.	
14.	Write a mobile application that creates alarm clock.	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Windows or Android or iOS or Equivalent Mobile Application Development Tools with appropriate emulators and debuggers 30 Nos.

REFERENCE BOOKS

1. Erik Hellman, "Android Programming – Pushing the Limits", 1st Edition, Wiley India Pvt Ltd, 2014.
2. Dawn Griffiths and David Griffiths, "Head First Android Development", 1st Edition, O'Reilly SPD Publishers, 2015.
3. J F DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition, Wiley India Pvt Ltd, 2016.
4. AnubhavPradhan, Anil V Deshpande, " Composing Mobile Apps" using Android, Wiley 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Create, test and debug Android application by setting up Android development environment
CO2	Demonstrate methods in storing, sharing and retrieving data in Android applications
CO3	Simulate Mobile networks and analyze the QoS Parameters

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

SEMESTER VII

IT1701	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics in deep neural networks
- To analyze optimization and regularization concepts in neural networks.
- To estimate the concepts of deep learning for computer vision.
- To analyze the key computations of deep learning to evaluate Object Detection.
- To understand the concepts of Sequence Models with RNN

UNIT I	**INTRODUCTION**	**9**
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction – Perceptron Learning Algorithm - Activation Functions – Need for non-linear activation functions – Chain Rule and Backpropagation – Deep Neural Networks – Shallow vs Deep Networks		**CO1**
UNIT II	**OPTIMIZATION AND REGULARIZATION IN NEURAL NETWORKS**	**9**
Regularization – L1 and L2 regularization – Dropout – Vanishing and Exploding Gradients – Weight Initialization – He and Xavier initialization – Gradient checking – Mini Batch Gradient Descent – Momentum – RMSProp – Adam Optimization – Local Optima – Learning Rate Decay		**CO2**
UNIT III	**DEEP LEARNING FOR COMPUTER VISION**	**9**
Introduction to Computer Vision – Edge detection with Kernels – Padding and Strides – Pooling layers – Convolutional Neural Networks – CNN Architectures [VGG16 - ResNets – Inception Net – MobileNet] – What CNNs learn – Transfer Learning – Data Augmentation		**CO3**
UNIT IV	**ADVANCED COMPUTER VISION WITH DEEP LEARNING**	**9**
Object Detection – Landmark Detection – Sliding Windows – Intersection Over Union – Non Max Suppression – Anchor boxes – YOLO Algorithm – Object Detection accuracy metrics – Image Segmentation – UNet architecture – Transpose Convolution – Semantic Segmentation with UNet – Image2Image Translation with UNet		**CO4**
UNIT V	**SEQUENCE MODELS**	**9**
Recurrent Neural Networks – Backpropagation through Time – Language Models – Vanishing Gradients with RNNs – GRU – LSTM – Bidirectional RNNs – Deep RNNs – Word Embeddings – Learning Word Embeddings – Word2Vec – Negative Sampling – GloVE Embeddings – Attention Mechanism – Self Attention – Transformer Architecture – Positional Encodings -		**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications, 2021.

REFERENCE BOOKS

1. Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly, 2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’ReillyMedia, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7. S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications”, PHI Learning, 2017.
8. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9. James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Apply Deep Learning concepts in Artificial Neural Networks
CO2	Understand the concepts of Regularization and Optimization required in Deep Learning
CO3	Apply Computer vision concepts in Deep Learning
CO4	Analyze the key computations of Object detection using Advanced Computer Vision.
CO5	Apply Sequence Models with RNN for suitable applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	-	-	1	1	1	2	2	2	2
CO2	2	2	1	2	2	1	-	-	1	1	1	2	2	2	2
CO3	2	2	2	2	2	1	-	-	1	1	1	2	2	2	2
CO4	2	2	2	2	2	1	-	-	1	1	1	2	2	2	2
CO5	2	2	2	2	2	1	-	-	1	1	1	2	2	2	2

IT1702	CLOUD AND EDGE COMPUTING	L	P	T	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of cloud and utility computing.
- To educate students on the architecture of cloud computing and virtualization.
- To familiarize with cloud storage solutions, service level agreements, and pipeline management.
- To introduce fog and edge computing paradigms, including their architectures, components, and use cases.
- To explore middleware solutions for edge cloud architectures and address security management concerns in edge computing environments.

UNIT I	INTRODUCTION TO CLOUD COMPUTING	9
Origins of Cloud computing – Cloud Components – Cloud Characteristics – Elasticity in Cloud - Comparing cloud providers with traditional IT service providers - Advantages of Cloud Computing - Cloud Deployment Models: Public clouds – Private clouds – Community clouds - Hybrid clouds – Types of cloud services: Software as a Service (SaaS) - Platform as a Service (PaaS) - Infrastructure as a Service (IaaS) - Anything as a service (XaaS).		**CO1**
UNIT II	**CLOUD ARCHITECTURE & VIRTUALIZATION**	**9**
Layered Cloud Architecture – NIST Cloud Computing Reference - Challenges and risks in Cloud adoption - Basics of Virtualization – Types of Virtualizations – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.		**CO2**
UNIT III	**CLOUD STORAGE AND PIPELINE**	**9**
Cloud Storage –Advantages of Cloud Storage – Cloud Storage Providers – S3, Service Level Agreements - Types of SLA – Lifecycle of SLA - SLA Management - Pipeline overview, create and configure pipeline, Building WDL pipeline with graphical Pipeline Builder, launch a pipeline, Delete and unregister Pipeline.		**CO3**
UNIT IV	**FOG AND EDGE COMPUTING PARADIGMS**	**9**
Fog computing - Open Fog reference architecture - Fog topologies - Edge Computing and Architectures - Components of Edge Computing - Orchestration of Network Slices in Fog, Edge and Clouds: Introduction - Network Slicing - Network Slicing in Software-Defined Clouds - Network Slicing Management in Edge and Fog - Edge Computing to support User Applications: 5G-Slicing & Self-driving cars.		**CO4**
UNIT V	**MIDDLEWARE FOR EDGE CLOUD ARCHITECTURES**	**9**
Edge cloud architectures – Use Case - Lightweight Edge Clouds – Clusters for Lightweight Edge Clouds – Architecture management – Storage and Orchestration – Security Management for Edge Cloud Architectures – Smart Surveillance Video Stream Processing at the Edge - A Case Study: Human Object Detection & Object Tracking		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rajkumar Buyya, Satish Narayana Srirama, Fog and Edge Computing: Principles and Paradigms, wiley publication, 2019.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, — Cloud Computing: Implementation, Management and Security, CRC Press, 2017.

REFERENCE BOOKS

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
2. Albert Y. Zomaya, Assad Abbas, Samee U. Khan ,"Fog Computing Theory and Practice", Wiley 21 April 2020.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing
CO2	Identify the architecture, infrastructure and delivery models of cloud computing.
CO3	Identify the advantages of cloud storage, understand different cloud storage providers and service level agreements, and Data Pipelines.
CO4	Identify the Fog and Edge architecture.
CO5	Apply knowledge of edge cloud architectures in real-world use cases, manage architecture.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	2	3	2	1	3	2	3	2	3	2	3
CO2	3	2	1	3	3	2	2	2	3	2	3	2	3	3	2
CO3	2	1	2	3	3	1	3	3	3	2	3	1	3	2	3
CO4	3	2	2	2	3	2	3	3	3	2	2	2	3	1	2
CO5	2	1	1	2	2	2	3	1	3	2	2	3	3	3	2

CS1703	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
(Common to CSE & IT)		3	0	0	3

OBJECTIVES

- To define security attacks, services and mechanisms.
- To review modern symmetric-key ciphers based on algebraic structures.
- To understand asymmetric-key cryptography based on some topics in number theory.
- To define cryptographic data integrity algorithms and mutual trust.
- To discuss various security practices and system security measures.

UNIT I	**FUNDAMENTALS**	**9**
Computer Security Concepts – The OSI Security Architecture - Security Attacks, Services and Mechanisms - Model for network security – Classical Encryption Techniques: Substitution Techniques, Transposition Techniques, Steganography – Legal and Ethical Aspects.		**CO1**
UNIT II	**SYMMETRIC CRYPTOGRAPHY**	**9**
Mathematics of Symmetric Key Cryptography: Algebraic structures — Modular arithmetic- GF (2^n Fields) –The Euclidian Algorithm- Polynomial Arithmetic - Symmetric Key Ciphers: Block Cipher and Data Encryption Standard (DES) - Advanced Encryption Standard (AES) — Block Cipher Operation – Random Bit Generation and Stream Ciphers - RC4.		**CO2**
UNIT III	**PUBLIC KEY CRYPTOGRAPHY**	**9**
Mathematics of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Chinese Remainder Theorem — Quadratic Congruence- Exponentiation and Logarithm - Asymmetric Key Ciphers: RSA Cryptosystem – Rabin Cryptosystem - Diffie Hellman Key Exchange - ElGamal Cryptosystem – Elliptic Curve Arithmetic - Elliptic Curve Cryptography.		**CO3**
UNIT IV	**CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS AND MUTUAL TRUST**	**9**
Cryptographic Hash Functions – Message Authentication Codes - Digital Signatures –Key Management and Distribution – X.509 Certificates - User Authentication- Kerberos		**CO4**
UNIT V	**INTERNET SECURITY AND SYSTEM SECURITY**	**9**
Electronic Mail security – PGP, S/MIME – IP security – Cloud Security- Wireless Network Security – System Security: Intruders – Malicious software – Firewalls.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 5th Edition, 2011.
2. Behrouz A.Forouzan, Introduction to Cryptography and Network Security, McGraw-Hill Ferouzan Networking Series, 2008.

REFERENCE BOOKS

1. Shyamala C K, N Harini and Dr T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt. Ltd.
2. Charlie Kaufman, Radia Periman and Mike Speciner, Network Security: private Communication in a public World, Prentice Hall, ISBN 0-13-046019-2
3. William Stallings, "Network Security Essentials Applications and Standards", 2nd edition, Pearson Education, 2003.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe the key security requirements of confidentiality, Integrity and availability
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms
CO3	Examines of asymmetric key cryptosystem and design principles
CO4	Describe the various cryptographic data integrity algorithms and various aspects of key management and distribution.
CO5	Understand various network Security practices and System level security issues

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

IT1703	ORGANIZATIONAL BEHAVIOR	L	P	T	C
		3	0	0	3

OBJECTIVES

To make the students conversant to

- Analyze the determinants of group culture and strategies for establishing productive relationships with associates.
- Understand the concept and determinants of personality, including the Myers-Briggs Type Indicator (MBTI).
- Understand the concept of motivation and examine need, content, and process theories of motivation.
- Promote innovation and shape organizational culture to foster a culture of innovation.
- Address barriers to inclusion and combat unconscious bias to make the business case for diversity and inclusion.

UNIT I	LEADERSHIP AND ORGANIZATIONAL BEHAVIOUR (LEAD)	9
The determinants of group culture-Establishing productive relationships with associates-Develop a vision of the future-Align the organization behind that vision-Motivate people to achieve their vision-Design effective organizations and change them to achieve superior performance.		CO1
UNIT II	PERSONALITY & PERCEPTION	9
Concept of Personality-Determinants of Personality-Concept of Myers-Briggs Type Indicator (MBTI), Concept of Perception-Factors that influence Perception-Nature of Perception-Process of Perception-Individual Values.		CO2
UNIT III	LEARNING & MOTIVATION	9
Concept of Learning-Theories of Learning: Classical Conditioning-Operant Conditioning-Social Learning-Reinforcement-Concept of Motivation-Need, Content, and Process theories of Motivation-Contributions of Maslow, McGregor, Herzberg, Vroom and Adam.		CO3
UNIT IV	ORGANIZATIONAL CULTURE AND CHANGE MANAGEMENT	9
Understanding organizational culture and why it's important-Exploring the continuum of corporate culture-the good, the bad, and the ugly-Translating understanding into action and impact-Diagnose the need for organizational change in response to external shifts or internal challenges-Utilize the change model to implement organizational change successfully-Appreciate how to overcome resistance to change-Steps for driving innovation within established organizations-how to shape organizational culture into a culture of innovation.		CO4
UNIT V	DIVERSITY, EQUITY AND INCLUSION	9
Understand gender imbalance, race identity and LGBTQ+ communities-managing bias and creating safe, inclusive work environments-Building and nurturing an inclusive and diverse team to changing customer needs-Defining, understanding, and leveraging different types of diversity to increase business outcomes-Addressing known and unknown barriers to build inclusive and diverse teams, Making the business case and combating unconscious bias.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. McShane, S., Von Glinow, M. A., & Rai, H. (2022). "Organizational Behavior" (9th edition.). McGraw-Hill Education.
2. Coyle, D. (2018). "The Culture Code: The Secrets of Highly Successful Groups". Bantam Books

3. Huxley, A. (2004). “The Doors of Perception and Heaven and Hell”. Harper Perennial Modern Classics.

REFERENCE BOOKS

1. Harvard Business Review, Kotter, J. P., Kim, W. C., & Mauborgne, R. A. (2011). “HBR's 10 Must Reads on Change Management (including featured article "Leading Change," by John P. Kotter)”. Harvard Business Review Press.
2. Wisdom, J. P., & Jenkins, L. D. (2021). “Millennials' Guide to Diversity, Equity & Inclusion: What No One Ever Told You About the Importance of Diversity, Equity, and Inclusion”.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	To learn effective organizational behavior
CO2	To understand human behavior, perceptions and values in a better way
CO3	To gain knowledge on learning tendencies and motivation
CO4	To explore successful change management strategies
CO5	To equip skills required to become an inclusive leader

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	1	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	1	2	2	2	2	3	3	2
CO3	3	3	3	3	2	1	2	1	1	2	2	2	3	3	2
CO4	3	3	3	3	2	1	1	1	1	2	2	2	3	3	2
CO5	3	3	3	3	2	1	2	1	2	2	2	2	3	3	2

IT1707	CLOUD AND EDGE COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To Setup an account on Amazon Web Services and Create S3 storage service.
- Design and deploy the pricing models on AWS cloud services and pipeline.
- Design & Synthesize new techniques and tools using AWS IoT for Edge.

LIST OF EXPERIMENTS

Experiment	CO
1. Setting up an AWS Account and Implementing Multi-Factor Authentication (MFA).	CO1
2. Launching EC2 Instances with Custom AMIs and User Data Scripts.	
3.Implementing S3 with Versioning, Lifecycle Policies, and Cross-Region Replication.	
4.Configuring a Highly Available Web Application using EC2, ELB, and Auto Scaling.	
5.Designing a Multi-tier VPC Architecture with NAT Gateways and VPN Connection	
6.Implementing Auto Scaling with Custom Metrics and Scheduled Actions.	CO2
7.Setting up Application Load Balancer with Path-based Routing and SSL/TLS.	
8.Deploying a Containerized Application using ECS with Fargate.	
9.Implementing a CI/CD Pipeline with Jenkins, CodePipeline, and Blue/Green Deployment.	
10.Designing a Serverless Architecture with API Gateway, Lambda, and DynamoDB.	
11.Implementing a Disaster Recovery Solution using Route 53 and Cross-Region Replication.	CO3
12.Deploy and connect RTOS using AWS IoT for edge.	
13.Manage and secure RTOS using AWS IoT for edge.	
14.Case Study –DevOps Services and Solutions.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1.John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
2.Albert Y. Zomaya, Assad Abbas, Samee U. Khan, “Fog Computing Theory and Practice”,Wiley21 April 2020

WEB REFERENCES

1. https://github.com/Amey-Thakur/CLOUD-COMPUTING-LAB.
2. www.nitttrchd.ac.in/imee/Labmanuals/manual%20Internet%20of%20Things%20I.pdf.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understands the various Services in AWS like Storage, Infrastructure, Compute, Data and also Learn to Setup an account on Amazon Web Services(AWS).
CO2	Understand the pricing models on AWS cloud services and pipeline.
CO3	Design & Synthesize new techniques and tools using AWS IoT for Edge.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

SEMESTER V

PROFESSIONAL ELECTIVE – I

IT1511	**OPTIMIZATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To introduce the basic concepts of linear programming
- To educate on the advancements in Linear programming techniques
- To introduce non-linear programming techniques
- To introduce the interior point methods of solving problems
- To introduce the dynamic programming method

UNIT I	**LINEAR PROGRAMMING**	**9**
Introduction - formulation of linear programming model-Graphical solution–solving LPP using simplex algorithm – Revised Simplex Method.		**CO1**
UNIT II	**ADVANCES IN LPP**	**9**
Dualit theory- Dual simplex method - Sensitivity analysis–-Transportation problems– Assignment problems-Traveling sales man problem -Data Envelopment Analysis.		**CO2**
UNIT III	**NON LINEAR PROGRAMMING**	**9**
Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.		**CO3**
UNIT IV	**INTERIOR POINT METHODS**	**9**
Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.		**CO4**
UNIT V	**DYNAMIC PROGRAMMING**	**9**
Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion– Computational procedure–Conversion offinal value problem in to Initial value problem.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006
3. Hamdy ATaha, "Operations Research –An Introduction", Prentice Hall India, 2003.

REFERENCE BOOKS

1. Philips, Ravindran and Solberg, “Operations Research”, John Wiley, 2002.
2. Ronald L.Rardin, “Optimization in Operation Research” Pearson Education Pvt. Ltd. New Delhi, 2005.”

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand ethical issues, environmental impact and acquire management skills
CO2	To Understand about the linear programming techniques
CO3	To Understand about the Non Linear programming techniques
CO4	To Understand about interior point methods of solving problems.
CO5	To Understand the dynamic programming method

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	-	-	-	-	2	2	2	3	3	2

IT1512	VIDEO CREATION AND EDITING	L	P	T	C
		3	0	0	3

OBJECTIVES

1. To provide a comprehensive understanding of linear and non-linear editing principles.
2. To explore various storytelling techniques and their application in digital media.
3. To equip students with practical skills in audio and video recording and editing.
4. To familiarize students with industry-standard software tools, specifically AVID XPRESS DV 4 and Final Cut Pro.
5. To develop critical thinking and creative problem-solving skills in the context of video production.

UNIT I	FUNDAMENTALS OF VIDEO EDITING	9
History of video editing-Linear vs. non-linear editing concepts-Digital video formats and codecs-Introduction to editing software interfaces-Basic editing terminology and techniques.		CO1
UNIT II	**STORYTELLING AND EDITING TECHNIQUES**	**9**
Narrative structures in video-Visual storytelling with cuts, transitions, and effects-Pacing and rhythm in editing-Legal and ethical considerations in editing-Scriptwriting and storyboarding for video		CO2
UNIT III	**AUDIO AND VIDEO PRODUCTION**	**9**
Principles of audio and video capture-Digital signal processing and audio mixing-Color correction and grading-Exporting and distribution formats-Camera operation and shot composition		CO3
UNIT IV	**ADVANCED EDITING WITH FINAL CUT PRO**	**9**
Mastering the Final Cut Pro Interface-Editing and fine-tuning clips-Compositing and visual effects-Motion graphics and titles-Advanced audio editing		CO4
UNIT V	**PROFESSIONAL EDITING WITH AVID XPRESS DV 4**	**9**
Navigating the AVID XPRESS DV 4 workspace-Media management and organization-Advanced trimming and editing techniques-Working with multicam sequences-Outputting and delivering final projects		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.

REFERENCE BOOKS

1. Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.
2. Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw – Hill 2003.

COURSE OUTCOMES **Upon successful completion of this course, students will be able to:**	
CO1	Analyze the advantages and constraints of non-linear editing workflows.
CO2	Apply different storytelling methods to enhance the narrative impact of video content.
CO3	Execute professional-quality audio and video recording and post-production techniques.
CO4	Utilize advanced editing features and effects in Final Cut Pro and AVID XPRESS DV 4.
CO5	Produce a portfolio of video projects that demonstrate proficiency in digital video editing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	-	-	-	1	2	3	2	3	2	2
CO2	3	3	3	2	3	-	-	-	2	2	2	1	2	2	3
CO3	2	1	2	2	2	-	-	-	2	1	1	2	2	2	2
CO4	3	3	1	1	1	-	-	-	1	1	1	3	3	3	3
CO5	2	1	2	1	2	-	-	-	3	1	1	3	3	3	3

IT1513	INFORMATION STORAGE AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the storage architecture and available technologies.
- To learn to establish & manage a data center.
- To learn security aspects of storage & data center.

UNIT I	**STORAGE TECHNOLOGY**	**9**
Information Storage- Evolution of Storage Technology and Architecture, Data Center Infrastructure, Information Lifecycle; Storage System Environment- Components of a Storage System Environment, Disk Drive Components, Disk Drive Performance, Fundamental Laws Governing Disk Performance, Logical Components of the Host.		**CO1**
UNIT II	**STORAGE SYSTEMS ARCHITECTURE**	**9**
Concept of RAID and its components, Different RAID levels, and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Hotspare, Stripping, and Mirroring, Compare and contrast integrated and modular storage systems, Intelligent Storage System - Components of an Intelligent Storage System, Intelligent Storage Array - EMC CLARiiON: Storage array, Architecture, and Management.		**CO2**
UNIT III	**INTRODUCTION TO NETWORKED STORAGE**	**9**
Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understanding the need for long-term archiving solutions, and describe how CAS full fill the need, understanding the appropriateness of the different networked storage options for different application environments		**CO3**
UNIT IV	**INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS**	**9**
List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR), RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, the architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center		**CO4**
UNIT V	**SECURING STORAGE AND STORAGE VIRTUALIZATION**	**9**
Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level, and file-level virtualization technologies and processes.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010

REFERENCE BOOKS

1. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001.
2. Robert Spalding, ―Storage Networks: The Complete Reference―, Tata McGraw Hill , Osborne, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basic terminologies of storage technologies and the environment
CO2	Explain the physical and logical components of a storage infrastructure including storage subsystems, RAID, and intelligent storage systems
CO3	Describe storage networking technologies such as FCSAN, IP-SAN, NAS, and object-based, and unified storage
CO4	Develop skills in data center infrastructure management to efficiently monitor and manage data center resources
CO5	Describe information security requirements and solutions, and identify parameters for managing and monitoring storage infrastructure in classic, virtualized and cloud environments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1514	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about first order logics
- To acquire knowledge about reasoning
- To apply object-oriented concepts for various expert systems
- To assess uncertainty using non monotonic logic
- To understand various action and planning strategies for problem solving

UNIT I	**INTRODUCTION**	**9**
Knowledge Representation and Reasoning – First order Logic – Syntax- Semantics Pragmatics – Expressing Knowledge – Levels of Representation – Knowledge Acquisition and Sharing – Sharing Ontologies – Language Ontologies –Language Patterns – Tools for Knowledge Acquisition		**CO1**
UNIT II	**RESOLUTION AND REASONING**	**9**
Proportional Case – Handling Variables and Quantifiers – Dealing with Intractability – Reasoning with Horn Clauses - Procedural Control of Reasoning – Rules in Production– Description Logic - Issues in Engineering		**CO2**
UNIT III	**REPRESENTATION**	**9**
Object Oriented Representations – Frame Formalism – Structured Descriptions – Meaning and Entailment - Taxonomies and Classification – Inheritance – Networks – Strategies for Defeasible Inheritance – Formal Account of Inheritance Networks		**CO3**
UNIT IV	**DEFAULTS, UNCERTAINTY AND EXPRESSIVENESS**	**9**
Defaults – Introduction – Closed World Reasoning – Circumscription – Default Logic imitations of Logic – Fuzzy Logic – Non monotonic Logic – Theories and World – Semiotics – Auto epistemic Logic - Vagueness – Uncertainty and Degrees of Belief – Non categorical Reasoning – Objective and Subjective Probability- linguistic fuzzy rule-based classification system - fuzzy cognitive maps- fuzzy for large data		**CO4**
UNIT V	**ACTIONS AND PLANNING**	**9**
Explanation and Diagnosis – Purpose – Syntax, Semantics of Context – First Order Reasoning Modal Reasoning in Context – Encapsulating Objects in Context – Agents – Actions – Situational Calculus – Frame Problem – Complex Actions – Planning –Strips– Planning as Reasoning – Hierarchical and Conditional Planning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael K. Bergman "A Knowledge Representation Practionary: Guidance from Charles Sanders Peirce." Springer -2018.
2. Ronald Brachman, Hector Levesque, "Knowledge Representation and Reasoning ", The Morgan Kaufmann Series, First Edition.

REFERENCE BOOKS

1. John F. Sowa, "Knowledge Representation: Logical, Philosophical, and Computational Foundations", Brokes/Cole, First Edition, 2000.
2. Arthur B. Markman, "Knowledge Representation", Lawrence Erlbaum Associates,1998.
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, ISBN: 13:978-0-07-008770-5, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Formulate problem in first order logic and ontologies
CO2	Improve resolution and reasoning with horn clauses
CO3	Apply object-oriented abstractions for knowledge representation
CO4	Solve problems with uncertainty using fuzzy rules
CO5	Design and develop applications with action and planning

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2

CS1515	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
	(Common to CSE &IT)	3	0	0	3

OBJECTIVES

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I	**DIGITAL IMAGE FUNDAMENTALS**	**9**
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.		**CO1**
UNIT II	**IMAGE ENHANCEMENT**	**9**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement		**CO2**
UNIT III	**IMAGE RESTORATION**	**9**
Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering		**CO3**
UNIT IV	**IMAGE SEGMENTATION**	**9**
Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		**CO4**
UNIT V	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010.
2. Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002.

REFERENCE BOOKS

1. Kenneth R. Castleman,Digital Image Processing Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau,Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt,Digital Image Processing John Wiley, New York, 2002
5. Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To become familiar with digital image fundamentals
CO2	To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
CO3	To learn concepts of degradation function and restoration techniques.
CO4	To study the image segmentation and representation techniques.
CO5	To become familiar with image compression and recognition methods

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

SEMESTER VI

PROFESSIONAL ELECTIVE – II

IT1611	**FUZZY LOGIC AND ARTIFICIAL NEURAL NETWORKS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To impact knowledge on fuzzy logic principles
- To understand models of ANN
- To use the fuzzy logic and neural network for application related to design and manufacture

UNIT I	**INTRODUCTION TO FUZZY LOGIC PRINCIPLES**	**9**
Basic concepts of fuzzy set theory – operations of fuzzy sets – properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types.		**CO1**
UNIT II	**ADVANCED FUZZY LOGIC APPLICATIONS**	**9**
Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multiobjective decision making – fuzzy classification – means clustering – fuzzy pattern recognition – image processing applications – systactic recognition – fuzzy optimization.		**CO2**
UNIT III	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS**	**9**
Fundamentals of neural networks – model of an artificial neuron – neural network architectures – Learning methods – Taxonomy of Neural network architectures – Standard back propagation algorithms – selection of various parameters – variations Applications of back propagation algorithms.		**CO3**
UNIT IV	**OTHER ANN ARCHITECTURES**	**9**
Associative memory – exponential BAM – Associative memory for real coded pattern pairs – Applications adaptive reasonance theory – introduction – ART 1 – ART2 – Applications – neural networks based on competition – kohenen self-organizing maps – learning vector quantization – counter propagation networks – industrial applications..		**CO4**
UNIT V	**RECENT ADVANCES**	**9**
Fundamentals of genetic algorithms – genetic modeling – hybrid systems – integration of fuzzy logic, neural networks and genetic algorithms – non-traditional optimization techniques like ant colony optimization – Particle swarm optimization and artificial immune systems – applications in design and manufacturing.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rajasekaran. S.. Vijayalakshmi Pai. G.A. “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice Hall of India Private Limited, 2003
2. Timothy J.Ross, “Fuzzy logic with Engineering Applications”, McGraw Hill, 2017
3. Zurada J.M. “Introduction to Artificial Neural Systems”, Jaico publishing house, 2016.

REFERENCE BOOKS

1. Klir.G, Yuan B.B. “Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997.
2. Laurene Fausett, “Fundamentals of Neural Networks”, Prentice hall, 1992
3. Gen, M. and Cheng R. “Genetic Algorithm and Engineering Design”, john wiley 1997

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop the skill in basic understanding on fuzzy logic.
CO2	Develop the skill in basic understanding on neural network.
CO3	Explore the functional components of neural classification conducer and the functional components of fuzzy logic classification on controller
CO4	Develop and implement a basic trainable neural network (or) a fuzzy logic system to design and manufacturing.
CO5	Understand the recent advances in fundamentals of genetic algorithm

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2

IT1612	SOFTWARE TESTING AND QUALITY ASSURANCE	L	P	T	C
		3	0	0	3

OBJECTIVES

- To understand software testing and quality assurance as a fundamental component of software life cycle
- To define the scope of SW T & QA projects
- To efficiently perform T & QA activities using modern software tools
- To estimate cost of a T & QA project and manage budgets
- To prepare test plans and schedules for a T&QA project
- To develop T & QA project staffing requirements
- To effectively manage a T & QA project.

UNIT I	**SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES**	**9**
Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black ,test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Team Building		**CO1**
UNIT II	**SYSTEM TESTING**	**9**
System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built-in Testing. Functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models.		**CO2**
UNIT III	**SYSTEM TEST CATEGORIES**	**9**
System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests.		**CO3**
UNIT IV	**SOFTWARE QUALITY**	**9**
Software quality - People's Quality Expectations**,** Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models**-** Test Process Improvement, Testing Maturity Model.		**CO4**
UNIT V	**SOFTWARE QUALITY ASSURANCE**	**9**
Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities**.** QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008.

REFERENCE BOOKS

1. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
2. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004.
3. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Familiar with the process of verification, validation and understand the process of applying tests to software and the fundamental components of a test case.
CO2	Derive test cases from software requirement specifications - including being able to partition input and output domains, form test specifications, and identify valid combinations of input.
CO3	Distinguish between methods of judging test case adequacy and how to design tests that will accomplish the obligations of such methods.
CO4	Understand how to build models of system behavior and prove that their obey required properties.
CO5	Make logical arguments that prove the correctness of program implementations and write code to automate test execution and analysis.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	2	1
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	2	1
CO3	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	-	2	2	3	2	1
CO5	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2

IT1613	NATURAL LANGUAGE PROCESSING TOOLS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explore the fundamental concepts of Natural Language Processing
- To learn the different data pre-processing steps in lexical analysis
- To understand the working of syntactic and semantic analysis using NLTK
- To familiar with text classification and topic modeling methods
- To work with sentiment analysis and machine translation using python

UNIT I	**INTRODUCTION TO NLP**	**9**
Natural language processing – History of NLP – Early NLP systems – Phases of natural language processing – Evaluation of NLP systems - Origins and challenges of NLP – Basic English concepts –- Language and Grammar - Processing Indian Languages		**CO1**
UNIT II	**LEXICAL ANALYSIS USING NLTK**	**9**
Introduction and installation of NLTK – Data Pre-processing: Tokenization – Part of Speech (PoS) Tagging - Word Frequency Counting – Stop Words Removal – Text Normalization – Spelling Correction - Stemming – Lemmatization – Named Entity Recognition		**CO2**
UNIT III	**SYNTACTIC AND SEMANTIC ANALYSIS USING NLTK**	**9**
Feature Extraction: Building Bag of Words (BoW) Model – Building TF-IDF Model – Word Embeddings using word2vec - Sentence Boundary Detection – Parsing - Lexical Resources: WordNet – FrameNet - Word Synonyms and Antonyms using NLTK – Word Negation Tracking - Word Sense Disambiguation		**CO3**
UNIT IV	**TEXT CLASSIFICATION AND TOPIC MODELING**	**9**
Introduction to Text Classification – Machine Learning Overview – Classification Metrics – Confusion Matrix – Developing a Text Classifier – Saving and Loading Models - Introduction to Topic Modelling – Topic Discovery – Topic Modelling Algorithms: Latent Semantic Analysis – Latent Dirichlet Algorithms.		**CO4**
UNIT V	**SENTIMENT ANALYSIS AND MACHINE TRANSLATION**	**9**
Introduction to Sentiment Analysis – Need and Growth of Sentiment Analysis – TextBlob – Understanding Data for Sentiment Analysis – Training Sentiment Models – Introduction to Machine Translation - Problems in Machine Translation - Machine Translation Approaches - Translation involving Indian Languages using Python		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1.Ela Kumar, “Natural Language Processing”, I.K International, New Delhi 2011.
2. SohomGhosh, Dwight Gunning, “Natural Language Processing Fundamentals”, Packt Publishing Limited, 2019.
3. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O'Reilly Media, 1st Edition, 2009.

REFERENCE BOOKS

1. TanveerSiddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition 2008.
3. Christopher D. Manning and HinrichSchutze, “Foundations of Statistical Natural Language Processing”, MITPress, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Familiarize with concept of Natural Language Processing
CO2	Pre-process the data from the collected dataset using NLTK
CO3	Extract the features and do the syntactic and semantic analysis using NLTK
CO4	Classify the text using text classification algorithm and find the recent topic using LSA and LDA
CO5	Find the different emotions and sentiment using sentiment analysis and translate from one natural language to other using machine translation

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	3	-	2	2	2	3	3	2

DS1611	IMAGE AND VIDEO ANALYTICS	L	T	P	C
	Common to IT & AI-DS	3	0	0	3

OBJECTIVES

- To provide a basic foundation towards digital image processing and video processing.
- To learn about image and video enhancement and restoration techniques.
- To provide Compression methods for image analytics applications.
- To Understand Compression methods for video analytics applications
- To learn about feature detection and description

UNIT I	INTRODUCTION TO DIGITAL IMAGE AND VIDEO PROCESSING	9
Digital image representation, Sampling and Quantization, Types of Images, Basic Relations between Pixels - Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations, Introduction to Digital Video, Sampled Video, Video Transmission. Gray-Level Processing: Image Histogram, Linear and Non-linear point operations on Images, Arithmetic Operations between Images, Geometric Image Operations. Binary Image Processing: Image Thresholding, Region labeling, Binary Image Morphology		**CO1**
UNIT II	**IMAGE AND VIDEO ENHANCEMENT AND RESTORATION**	**9**
Spatial domain - Linear and Non-linear Filtering, Morphological filtering, Frequency domain – Homomorphic Filtering, Blotch Detection and Removal - Blotch Detection, Motion Vector Repair and Interpolating Corrupted Intensities, Intensity Flicker Correction - Flicker Parameter Estimation, Brief introduction towards Wavelets, Wavelet based image denoising, Basic methods for image restoration using deconvolution filters		**CO2**
UNIT III	**IMAGE ANALYSIS**	**9**
Image Compression: Huffman coding, Run length coding, LZW coding, Lossless Coding, Wavelets based image compression		**CO3**
UNIT IV	**VIDEO ANALYSIS**	**9**
Video Compression: Basic Concepts and Techniques of Video Coding and the H.264 Standard, MPEG-1 and MPEG-2 Video Standards		**CO4**
UNIT V	**FEATURE DETECTION AND DESCRIPTION**	**9**
Introduction to feature detectors, descriptors, matching and tracking, Basic edge detectors – canny, sobel, prewitt etc., Image Segmentation - Region Based Segmentation – Region Growing and Region Splitting and Merging, Thresholding – Basic global thresholding, optimum global thresholding using Otsu's Method		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOK

1. Alan Bovik, Handbook of Image and Video Processing, Second Edition, Academic Press, 2005.
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Edition, Pearson Education, 2008.
3. Richard Szeliski, Computer Vision – Algorithms and Applications, Springer, 2011

REFERENCE BOOKS

1. Anil K Jain, Fundamentals of Digital Image Processing, PHI, 2011.
2. Oge Marques, Practical Image and Video Processing Using MatLab, Wiley, 2011.
3. John W. Woods, Multidimensional Signal, Image, Video Processing and Coding, Academic Press, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamental principles of image and video analysis
CO2	Apply different filters for enhancement of image and video
CO3	Investigate different coding techniques.
CO4	Comprehend different compression techniques for video.
CO5	Apply the image and video analysis approaches to solve real world problems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO2	2	3	2	3	3	-	-	-	-	2	2	2	3	3	3
CO3	1	2	2	3	3	-	-	-	-	2	2	2	3	3	3
CO4	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO5	1	2	3	3	3	-	-	-	-	2	2	2	3	3	3

GE1614	ENGINEERING ETHICS AND HUMAN VALUES	L	P	T	C
		3	0	0	3

OBJECTIVES

1. Students will understand the importance of Values and Ethics in their Personal lives and professional careers
2. The students will learn the rights and responsibilities
3. Responsibilities of employee, team member and a global citizen.

UNIT I	**HUMAN VALUES**	**9**
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality.		**CO1**
UNIT II	**Engineering Et**	**9**
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories		**CO2**
UNIT III	**Engineering as Social Ex**	**9**
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – The Challenger Case Study		**CO3**
UNIT IV	**Safety, Responsibilities and Ri**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl Case Studies Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination		**CO4**
UNIT V	**Global Is**	**9**
Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Conduct		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2nd Edition, 2009.

REFERENCE BOOKS

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Thompson Wadsworth, A Division of Thomson Learning Inc., United States, 2000
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understanding basic purpose of profession, professional ethics and various moral and social issues.
CO2	Awareness of professional rights and responsibilities of a Engineer, safety and risk benefit analysis of a Engineer
CO3	Acquiring knowledge of various roles of Enbgineer In applying ethical principles at various professional levels
CO4	Professional Ethical values and contemporary issues
CO5	Excelling in competitive and challenging environment to contribute to industrial growth.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

SEMESTER VII

PROFESSIONAL ELECTIVE – III

IT1711	WEB DEVELOPMENT FRAMEWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

1. Understand the fundamentals of web framework
2. Know the concept of the Java web framework
3. Learn the technologies of the Python web framework
4. Be exposed to the concepts of the Web framework
5. Be familiar with the Web framework.

UNIT I	**FUNDAMENTALS OF WEB FRAMEWORK**	**9**
Web framework-History-Types of framework architectures-Model–view–controller (MVC)- Three-tier organization-Introduction to frameworks-Framework applications -General-purpose website frameworks-Server-side-Client-side-Features		**CO1**
UNIT II	**JAVA WEB FRAMEWORK**	**9**
Java Web Frameworks-Struts-The Struts Framework- The Struts Tag Libraries- – Struts Configuration Files- Applying Struts		**CO2**
UNIT III	**STRUTS**	**9**
Struts and Agile Development -Basic Configuration.-Actions and Action Support.-Results and Result Types.-OGNL, the Value Stack, and Custom Tags-Form Tags- Form Validation and Type Conversion Exceptions and Logging-Getting Started with JavaScript-Advanced JavaScript, the DOM, and CSS Themes and Templates-Rich Internet Applications.		**CO3**
UNIT IV	**PYTHON WEB FRAMEWORKS**	**9**
Introduction to Python Frameworks-Web 2.0, Python, and Frameworks-The Role of AJAX in Web 2.0-Web 2.0 with Traditional Python-Introducing the Frameworks-Web Application Frameworks-MVC in Web Application Frameworks-Common Web Application Framework Capabilities		**CO4**
UNIT V	**TURBOGEARS WEB FRAMEWORK**	**9**
Introduction to Turbo Gears- Turbo Gears History-Main Turbo Gears Components-Alternate Components-MVC Architecture in TurboGears-Creating an Example Application-The Controller and View-Introduction to Django - Django History-Django Components-Alternate Components-MVC Architecture in Django-Creating an Example Application		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. James Holmes, Struts The Complete Reference, 2nd Edition, Mc.Graw Hill Professional 2006
2. Donald Brown, Chad Michael Davis, Scott Stanlick ,Struts 2 In Action Dreamtech press 2008

3. Dana Moore, Raymond Budd, William Wright, Professional Python Frameworks Web 2.0 John wiley and sons, 2008
4. Programming with Django and TurboGears, Wiley Publishing
5. Carlos De La Guardia,Python Web Frameworks, OReilly

REFERENCE BOOKS

1. Sue Spielman ,The Struts Framework 1: A Practical guide for Java Programmers, 1st Edition. Elsevier 2002
2. Adrian Holovaty Jacob Kaplan-Moss, The Definitive Guide to Django: Web Development Done Right, Apress, 2009
3. Mark Ramm,Rapid Web applications with TurboGears, Prentice Hall.2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze the fundamentals of web framework
CO2	Use the concept of Java web framework
CO3	Implement the concept using Struts framework
CO4	Apply the concept of python web framework to the problem solutions.
CO5	Critically analyze the various Web frameworks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1712	MANAGEMENT INFORMATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the importance of information in business
- To know the technologies and methods used for effective decision making in an organization.

UNIT I	INTRODUCTION	9
Data, Information, Intelligence, Information Technology, Information System, evolution, types based on functions and hierarchy, System development methodologies, Functional Information Systems, DSS, EIS, KMS, GIS, International Information System.		**CO1**
UNIT II	**SYSTEM ANALYSIS AND DESIGN**	**9**
Case tools - System flow chart, Decision table, Data flow Diagram (DFD), Entity Relationship (ER), Object Oriented Analysis and Design(OOAD), UML diagram.		**CO2**
UNIT III	**DATABASE MANAGEMENT SYSTEMS**	**9**
DBMS – HDBMS, NDBMS, RDBMS, OODBMS, Query Processing, SQL, Concurrency Management, Data warehousing and Data Mart		**CO3**
UNIT IV	**SECURITY, CONTROL AND REPORTING**	**9**
Security, Testing, Error detection, Controls, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT, User Interface and reporting		**CO4**
UNIT V	**NEW IT INITIATIVES**	**9**
Role of information management in ERP, e-business, e-governance, Data Mining, Business Intelligence, Pervasive Computing, Cloud computing, CMM.		**CO5**

TOTAL: 45 PERIODS

TEXT BOOKS

1. Robert Schultheis and Mary Summer, Management Information Systems – The Managers View, Tata McGraw Hill, 2008.
2. Kenneth C. Laudon and Jane Price Laudon, Management Information Systems – Managing the digital firm, PHI Learning / Pearson Education, PHI, Asia, 2012.

REFERENCE BOOKS

1. Rahul de, MIS in Business, Government and Society, Wiley India Pvt Ltd, 2012
2. Gordon Davis, Management Information System : Conceptual Foundations, Structure and Development, Tata McGraw Hill, 21st Reprint 2008.

3. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005. 9th edition, 2013.
4. Turban, McLean and Wetherbe, Information Technology for Management – Transforming Organisations in the Digital Economy, John Wiley, 6th Edition, 2008.
5. Raymond McLeod and Jr. George P. Schell, Management Information Systems, Pearson Education, 2007.
6. James O Brien, Management Information Systems – Managing Information Technology in the E-business enterprise, Tata McGraw Hill, 2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gains knowledge on effective applications of information systems in business
CO2	Gains knowledge on system analysis and design
CO3	Gains knowledge on database management systems
CO4	Gains knowledge on security, control and reporting
CO5	Gains knowledge on new IT Initiatives

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2

IT1714	PARALLEL ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand different parallel architectures and models of computation.
- To introduce the various classes of parallel algorithms.
- To study parallel algorithms for basic problems.

UNIT I	**INTRODUCTION**	**9**
Need for Parallel Processing - Data and Temporal Parallelism - Models of Computation - RAM and PRAM Model – Shared Memory and Message Passing Models- Processor Organisations - PRAM Algorithm – Analysis of PRAM Algorithms- Parallel Programming Languages		**CO1**
UNIT II	**PRAM ALGORITHMS**	**9**
Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting - Merging Two Sorted Lists – Matrix Multiplication - Graph Coloring - Graph Searching		**CO2**
UNIT III	**SIMD ALGORITHMS -I**	**9**
2D Mesh SIMD Model - Parallel Algorithms for Reduction - Prefix Computation - Selection - Odd-Even Merge Sorting - Matrix Multiplication		**CO3**
UNIT IV	**SIMD ALGORITHMS -II**	**9**
Hypercube SIMD Model - Parallel Algorithms for Selection- Odd-Even Merge Sort- Bitonic Sort-Matrix Multiplication Shuffle Exchange SIMD Model - Parallel Algorithms for Reduction -Bitonic Merge Sort - Matrix Multiplication - Minimum Cost Spanning Tree		**CO4**
UNIT V	**MIMD ALGORITHMS**	**9**
UMA Multiprocessor Model -Parallel Summing on Multiprocessor- Matrix Multiplication on Multiprocessors and Multicomputer - Parallel Quick Sort - Mapping Data to Processors.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael J. Quinn, "Parallel Computing : Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", University press, Second edition , 2011.
3. V Rajaraman, C Siva Ram Murthy, " Parallel computers- Architecture and Programming ", PHI learning, 2016.

REFERENCE BOOKS

1. AnanthGrame, George Karpis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", 2nd Edition, Addison Wesley, 2003.
2. M Sasikumar, Dinesh Shikhare and P Ravi Prakash , " Introduction to Parallel Processing", PHI learning , 2013.
3. S.G.Akl, "The Design and Analysis of Parallel Algorithms", PHI, 1989.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop parallel algorithms for standard problems and applications.
CO2	Understand various classes of parallel algorithms
CO3	Apply parallel algorithms for basic problems
CO4	Apply techniques for Multiprocessor Model
CO5	Analyze efficiency of different parallel algorithms.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	2	-	-	2	2	2	3	3	2

IT1715	AUGMENTED AND VIRTUAL REALITY	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality

UNIT I	**VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS**	**9**
The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces		**CO1**
UNIT II	**3D USER INTERFACE INPUT HARDWARE**	**9**
Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces		**CO2**
UNIT III	**SOFTWARE TECHNOLOGIES**	**9**
Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market		**CO3**
UNIT IV	**3D INTERACTION TECHNIQUES**	**9**
3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry . DESIGNING AND DEVELOPING 3D USER INTERFACES: Strategies for Designing and Developing Guidelines and Evaluation. VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.		**CO4**

UNIT V	AUGMENTED AND MIXED REALITY	9
Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.		**CO5**

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Meging Real and Virtual Worlds”, 2005.
5. Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
6. John Vince, “Virtual Reality Systems”, Addison Wesley, 1995.
7. Howard Rheingold, “Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society”, Simon and Schuster, 1991.
8. William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002
9. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013. A Grama, AGupra, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyse and Design a system or process to meet given specifications with realistic engineering constraints.
CO2	Identify problem statements and function as a member of an engineering design team.
CO3	Utilize technical resources
CO4	Propose technical documents related to design mini project results.
CO5	Give technical oral presentations related to design mini project results.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	2	2	2	2	1	-	-	1	1	1	1	1	2	2	2

CS1712	VIRTUALIZATION TECHNIQUES	L	T	P	C
Common to CSE, IT & AI-ML		3	0	0	3

OBJECTIVES

- To understand the concept of virtualization.
- To understand the various issues in virtualization.
- To be familiar with the virtualization of various components/functionalities.
- To compare and analyze various virtual machines products.
- To work with virtualization platforms

UNIT I	INTRODUCTION	9
System Architectures – Virtual Machine Basics – Process Virtual Machines – System Virtual Machines — Taxonomy of Virtual Machines — Emulation: Basic Interpretation — Threaded Interpretation — Pre-Coded & Direct Interpretation — Binary Translation — Full and Para- Virtualization – Types of Hypervisor – Types of Virtualization		CO1
UNIT II	**SERVER VIRTUALIZATION**	**9**
Server Virtualization – Partitioning Techniques – Hardware Virtualization – Virtual Hardware – Types of Server Virtualization — Business Cases for Sever Virtualization — Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform		CO2
UNIT III	**NETWORK VIRTUALIZATION**	**9**
Design of Scalable Enterprise Networks — Virtualizing the Campus — WAN Design — WAN Architecture – WAN virtualization – Virtual Enterprise Transport Virtualization – VLANs and Scalability – Theory Network Device Virtualization Layer 2 – VLANs Layer 3 VRF Instances Layer 2 – VFIs Virtual Firewall Contexts Network Device Virtualization – Datapath Virtualization Layer 2: 802.1q – Trunking Generic Routing Encapsulation – IPSec L2TPv3 Label Switched Paths — Control-Plane Virtualization — Routing Protocols — VRF- Aware Routing — Multi- Topology Routing		CO3
UNIT IV	**STORAGE VIRTUALIZATION**	**9**
Hardware Devices — SCSI — SCSI Communication — Using SCSI Buses — Fiber Channel — Fiber Channel Cables — Fiber Channel Hardware Devices — iSCSI Architecture — Securing iSCSI SAN Backup & Recovery Techniques – RAID – Classic Storage Model – SNIA Shared Storage Model Host based Architecture — Storage based architecture — Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual Tape Libraries		CO4
UNIT V	**APPLYING VIRTUALIZATION**	**9**
Comparison of Virtualization Technologies: Guest OS, Host OS, Hypervisor, Emulation, Kernel Level — Shared Kernel — Enterprise Solutions: Vmware Server, ESXi, Citrix Xen Server, Microsoft Virtual PC, Microsoft Hyper-V, Virtual Box – Server Virtualization: Configuring Server with Server Virtualization, Adjusting & Tuning Virtual Servers, VM Backup and Migration — Desktop Virtualization: Terminal Services, Hosted Desktop, Web Based Solutions, Localized Virtualized Desktop — Network and Storage Virtualization: VPN, VLAN, SAN and VSAN, NAS		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, APress, 2005.
2. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
3. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.

REFERENCE BOOKS	
1. William von Hagen, “Professional Xen Virtualization”, Wrox Publications, January, 2008. 2. Kumar Reddy, Victor Moreno, “Network virtualization”, Cisco Press, July, 2006. 3. Amy Newman, Kenneth Hess, “Practical Virtualization Solutions: Virtualization from the Trenches”, Prentice Hall, October 2009	

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Create a virtual machine and extend it to a virtual network.
CO2	Perform server virtualization.
CO3	Explain the concept of network virtualization.
CO4	Discuss various tasks in storage virtualization.
CO5	Compile all types of virtualization techniques and utilize them in design of virtual machines

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO2	3	3	3	2	1	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	1	2	2	3	3	2
CO5	3	3	2	2	1	-	-	-	-	1	2	2	3	3	2

SEMESTER VII
PROFESSIONAL ELECTIVE – IV

IT1721	**STORAGE AREA NETWORKS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To Identify key challenges in managing information and analyze different storage networking technologies and virtualization
- To Know about components and the implementation of NAS
- Understand CAS architecture and types of archives and forms of virtualization
- Understand the storage infrastructure and management activities
- Understand the Securing Infrastructure.

UNIT I	**STORAGE SYSTEM**	**9**
Introduction to Information Storage: Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application, Host (Compute), Connectivity, Storage. Data Protection: RAID: RAID Implementation Methods, RAID Techniques, RAID Levels, RAID Impact on Disk Performance. Intelligent Storage Systems: Components of Intelligent Storage System, Storage Provisioning.		**CO1**
UNIT II	**STORAGE NETWORKING TECHNOLOGIES**	**9**
Fibre Channel Storage Area Networks: Components of FC SAN, FC connectivity, Fibre Channel Architecture, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE. Network Attached Storage: Components of NAS, NAS I/O Operation, NAS File-Sharing Protocols, File-Level Virtualization, Object-Based Storage and Unified Storage: Object-Based Storage Devices, Content-Addressed Storage, Unified Storage.		**CO2**
UNIT III	**BACKUP, ARCHIVE AND REPLICATION**	**9**
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, BC Technology Solutions. Backup and Archive: Backup Methods, Backup Topologies, Backup Targets, Data Deduplication for Backup, Backup in Virtualized Environments, Data Archive. Local Replication: Replication Terminology, Uses of Local Replicas, Local Replication Technologies, Local Replication in a Virtualized Environment. Remote Replication: Remote Replication Technologies, Three-Site Replication, Remote Replication and Migration in a Virtualized Environment.		**CO3**
UNIT IV	**CLOUD COMPUTING AND VIRTUALIZATION**	**9**
Cloud Enabling Technologies, Characteristics of Cloud Computing, Benefits of Cloud Computing, Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure, Cloud		**CO4**

Challenges and Cloud Adoption Considerations. Virtualization Appliances: Black Box Virtualization, In-Band Virtualization Appliances, Outof-Band Virtualization Appliances, High Availability for Virtualization Appliances, Appliances for Mass Consumption. Storage Automation and Virtualization: Policy-Based Storage Management, Application-Aware Storage Virtualization, Virtualization-Aware Applications.		
UNIT V	**SECURING AND MANAGING STORAGE INFRASTRUCTURE**	**9**
Securing and Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments. Monitoring the Storage Infrastructure, Storage Infrastructure Management activities, Storage Infrastructure Management Challenges, Information Lifecycle management, Storage Tiering.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Information Storage and Management, Author :EMC Education Services, Publisher: Wiley ISBN: 9781118094839

REFERENCE BOOKS

1. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company ISBN : 9780321262516

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify key challenges in managing information and analyze different storage networking technologies and virtualization
CO2	Explain components and the implementation of NAS
CO3	Describe CAS architecture and types of archives and forms of virtualization
CO4	Illustrate the storage infrastructure and management activities
CO5	Illustrate the Securing Infrastructure

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2

IT1722	UI/UX APPLICATION DEVELOPMENT	L	P	T	C
		3	0	0	3

OBJECTIVES

To make the students conversant with

- To understand the fundamental principles of User Interface (UI) and User Experience (UX) design.
- To learn various tools and techniques used for creating intuitive and aesthetically pleasing interfaces.
- To develop the ability to conduct user research and usability testing.
- To gain practical experience in designing and prototyping user interfaces for web and mobile applications.
- To understand the integration of UI/UX design principles with software development processes.

UNIT I	INTRODUCTION TO UI/UX DESIGN	9
Fundamentals of UI Design: Principles of UI, importance of UI in application development. - Fundamentals of UX Design: Principles of UX, user-centered design, difference between UI and UX - Design Thinking: Introduction to design thinking, stages of design thinking. - UI/UX Design Process: Steps in the UI/UX design process, from research to implementation.-Human-Computer Interaction (HCI): Basics of HCI, user behavior, interaction models.-Usability Principles: Usability heuristics, designing for usability.-Visual Design Basics: Color theory, typography, and layout principles.- Accessibility in Design: Importance of accessibility, designing for all users.		**CO1**
UNIT II	**USER RESEARCH AND ANALYSIS**	**9**
Understanding Users: Types of users, user personas, and scenarios.-User Research Methods: Interviews, surveys, focus groups, and observational studies. -Empathy Mapping: Building empathy maps to understand user needs.-User Journey Mapping: Creating user journey maps to visualize user interactions.-Competitor Analysis: Analyzing competitor products, identifying strengths and weaknesses.-Information Architecture (IA): Principles of IA, creating sitemaps and navigation.-Wireframing: Basics of wireframing, low-fidelity vs. high-fidelity wireframes.- Prototyping Tools: Introduction to prototyping tools (e.g., Figma, Sketch, Adobe XD).		**CO2**
UNIT III	**UI DESIGN PRINCIPLES AND TECHNIQUES**	**9**
UI Components: Buttons, forms, icons, and other UI elements.-Design Systems: Creating and using design systems for consistency.-Responsive Design: Principles of responsive web design, media queries.-Grid Systems and Layouts: Using grids for layout, common layout patterns.-Typography in UI Design: Choosing fonts, text hierarchy, readability.-Color Theory in UI Design: Choosing color schemes, color psychology.-Designing for Different Devices: Desktop, tablet, and mobile design considerations.-Micro interactions: Importance of micro interactions, designing subtle interactions.		**CO3**

UNIT IV	UX DESIGN PRINCIPLES AND USABILITY TESTING HEURISTIC EVALUATION	9
Conducting heuristic evaluations, common heuristics.-Usability Testing Methods: Types of usability tests, planning and conducting tests.-Analyzing Test Results: Interpreting usability test results, identifying usability issues.-User Feedback: Gathering and incorporating user feedback.-UX Metrics: Measuring UX success, key performance indicators (KPIs).Interaction Design: Principles of interaction design, designing interactive elements.-Emotional Design: Designing for emotional impact, creating engaging experiences.-Cognitive Load: Understanding cognitive load, designing to minimize cognitive load.		CO4
UNIT V	ADVANCED TOPICS IN UI/UX AND INTEGRATION WITH DEVELOPMENT	9
Advanced Prototyping: High-fidelity prototypes, interactive prototypes.-Animation in UI Design: Adding animations, transitions, and effects (Figma).-Design for Emerging Technologies-Designing for AR/VR(spline 3d), voice interfaces, and IoT.-Agile and UX: Integrating UX design with agile development processes.-Collaboration Tools and Technique*: Tools for collaboration, design handoff.-UI/UX Case Studies: Analyzing successful UI/UX projects (Figma), lessons learned.-Future Trends in UI/UX: Keeping up with the latest trends and innovations.-Portfolio Development: Creating a UI/UX design portfolio, showcasing projects.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability" by Steve Krug, Edition: 3rd Edition (Latest), Publisher: New Riders, ISBN: 978-0321965516
2. The Design of Everyday Things: Revised and Expanded Edition" by Don Norman, Edition: Revised and Expanded Edition, Publisher: Basic Books, ISBN: 978-0465050659
3. About Face: The Essentials of Interaction Design" by Alan Cooper, Robert Reimann, David Cronin, and Christopher Noessel, Edition: 4th Edition (Latest), Publisher: Wiley, ISBN: 978-1118766576.

REFERENCE BOOKS

1. Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Guidelines" by Jeff Johnson, Edition: 2nd Edition (Latest), Publisher: Morgan Kaufmann, ISBN: 978-0124079143.
2. A Project Guide to UX Design: For User Experience Designers in the Field or in the Making" by Russ Unger and Carolyn Chandler, Edition: 2nd Edition (Latest), Publisher: New Riders, ISBN: 978-0321815385
3. Sketching User Experiences: The Workbook" by Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt, and Bill Buxton, Publisher: Morgan Kaufmann, ISBN: 978-0123819598

COURSE OUTCOMES **Upon completion of the course, the students will gain knowledge on**	
CO1	Students will be able to understand the basic concepts of UI/UX design principles to create user-friendly applications.
CO2	Students will be able to conduct user research and interpret usability testing results.
CO3	Students will be able to understand principles, design application using UI techniques.
CO4	Students will be able to understand principles, design application using UX techniques
CO5	Students will understand how to integrate UI/UX in advanced levels of applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	1	-	-	-	-	-	2	3	2	2
CO2	3	3	3	2	3	2	-	-	-	-	-	1	2	2	1
CO3	3	3	2	2	2	1	-	-	-	-	-	2	2	1	1
CO4	3	3	2	2	2	1	-	-	-	-	-	3	3	2	2
CO5	3	3	3	3	2	1	-	-	-	-	-	3	3	2	1

IT1723	SOFTWARE AGENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the how software agents reduce information overhead
- gain knowledge in use of software agents for cooperative learning and personal assistance,
- to know how agent can communicate and share knowledge using agent communication language
- gain knowledge in design of an agent interpreter and intelligent agent
- understand the concept of mobile technology and mobile agents and its security

UNIT I	**AGENT AND USER EXPERIENCE**	**9**
Agent characteristics- object Vs agent. Agent types- Interacting with Agents - Agent From Direct Manipulation to Delegation - Interface Agent, Metaphor with Character – Designing Agents – problem solving agent, rational agent. Direct Manipulation versus Agent Path to Predictable		**CO1**
UNIT II	**AGENTS FOR LEARNING AND ASSISTANCE**	**9**
Agents for Information Sharing and Coordination - Agents that Reduce Work Information Overhead - Agents without Programming Language - Life like Computer character - S/W Agents for cooperative Learning – Multiple Reasoning agents –M system. Learning agents: computational architectures for learning agents; evolution, adaptation; multi-agent learning.		**CO2**
UNIT III	**AGENT COMMUNICATION AND COLLABORATION**	**9**
Overview of Agent Oriented Programming - Agent Communication Language – KQML-Per formatives. Agent Based Framework of Interoperability. Virtual agents: agents in games and virtual environments; companion and coaching agents; modeling personality, emotions; multimodal interaction; verbal and non-verbal expressiveness.		**CO3**
UNIT IV	**AGENT ARCHITECTURE**	**9**
Strategies for agent design. Agent interpreter- BDI architecture. Architecture of Intelligent Agents. Agents for Information Gathering - Open Agent Architecture - Communicative Action for Artificial Agent. Agent societies and societal issues.		**CO4**
UNIT V	**MOBILE AGENTS**	**9**
Mobile agent paradigm - Mobile agent concepts -Mobile agent technology – programming mobile agents –application of mobile agents- Teleshopping. Mobile agent security- trust, reliability and reputation.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jeffrey M.Bradshaw,” Software Agents “, MIT Press 2000, Pearson Indian Reprint 2010.

REFERENCE BOOKS

1. Lin, Fuhua Oscar (Ed.), “Designing Distributed Learning Environments with Intelligent Software Agents”, Information Science Publishing, 2004
2. Russel&Norvig, “ Artificial Intelligence: A Modern Approach “, Prentice Hall, 2nd Edition, 2002.
3. Murch Richard, Johnson Tony ‘Intelligent Software Agents, ’Prentice Hall,1998.
4. Joseph P.Bigus& Jennifer Bigus, “Constructing Intelligent agents with Java: A Programmer’s Guide to Smarter Applications “, Wiley, 1997.
5. Knapik, Michael and Jay Johnson ‘Developing Intelligent Agents for Distributed Systems: Exploring Architecture, Technologies, and Applications’ , McGraw-Hill.1998
6. William R. Cockayne, Michael Zyda, “Mobile Agents”, Prentice Hall, 1998

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understanding the fundamentals of agents and agent programming paradigms.
CO2	Apply agents for learning and assistance
CO3	Apply agent for communication and collaboration
CO4	Understand agent architecture
CO5	Apply in mobile agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	2	2	3	3	2

IT1724	5G NETWORKS	L	P	T	C
		3	0	0	3

OBJECTIVES

To make the students conversant with

- Understand Increased Data Rates
- Analyse Reduced Latency & Evaluate Enhanced Capacity
- Ensure Improved Reliability - Ensure Scalability and Flexibility

UNIT I	**Overview of 5G Broadband Wireless**	**9**
3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.		**CO1**
UNIT II	**5G CHANNEL ACCESS METHODS**	**9**
OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)-Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.		**CO2**
UNIT III	**WIRELESS SENSOR NETWORKS**	**9**
Introduction to wireless sensor network (WSN), WSN-Architecture -Coverage and placement - Topology management in WSN - Applications Mobile WSN - Technologies for sensor nodes & networks - operating environment - Under water WSN - Security of WSN MAC Routing and Transport protocols for WSN.		**CO3**
UNIT IV	**WIRELESS ROUTING PROTOCOLS**	**9**
Medium access problems in wireless networks - Traditional routing - Mobile network layer Mobile IP - Introduction to IPv4 and IPv6 - Data forwarding procedure in Mobile IP (IPv4 and IPv6) - Mobility management Protocol trade-offs - Congestion window management - Mobile transport layer- Traditional TCP - mobile TCP Indirect TCP Reno New-Reno, Tahoe Vegas. UDP.		**CO4**
UNIT V	**INTERNET OF THINGS (IOT) AND GPS SYSTEMS**	**9**
IoT architecture - Main design principles and needed capabilities. **IoT Devices and gateways Case studies :** Sensor body area network - Control of a smart home - Smart vehicles Smart manufacturing and smart factory. Emerging IoT standards - IoT-protocols IoT Local and wide area networking - IEEE 802.15 WPAN Bluetooth – pico - net scatter net - Protocol stack Interface between 802.11 and Bluetooth - Geolocation service techniques and standards - Introduction to GPS-aided GEO augmented navigation (GAGAN) - E.911 ZigBee UWB and RFID.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Robert Schultheis and Mary Summer, Management Information Systems – The Managers View, Tata McGraw Hill, 2008.
2. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

REFERENCE BOOKS

1. Communications Technology5G Mobile And Wireless, Afif Osseiran, Jose Fmonserrat, Patrick Marsch, Cambridge University Press, 2nd Edition 2011.
2. Fundamentals of 5G Mobile Networks, Jonathan Rodriguez, Wiley, 1st Edition 2010.
3. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
4. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.

OURSE OUTCOMES **Upon completion of the course, the students will gain knowledge on**	
CO1	Gains knowledge on effective applications of information systems in business
CO2	Gains knowledge on system analysis and design.
CO3	Gains knowledge on database management systems
CO4	Gains knowledge on security, control and reporting.
CO5	Gains knowledge on new IT Initiatives.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO2	3	3	3	2	2	-	-	-	-	2	2	3	3	3	2
CO3	3	3	3	2	2	-	-	-	-	2	2	3	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	3	3	3	2

DS1723	SOCIAL NETWORK ANALYTICS	L	T	P	C
	Common to IT & AI-DS	3	0	0	3

OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To detect communities in social networks.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

UNIT I	**INTRODUCTION**	**9**
Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Statistical properties of social Networks-Definitions-Data Descriptions-Static properties- Dynamic properties- Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.		**CO1**
UNIT II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION**	**9**
Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.		**CO2**
UNIT III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS**	**9**
Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.		**CO3**
UNIT IV	**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES**	**9**
Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.		**CO4**
UNIT V	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS**	**9**
Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks-		**CO5**

Random Walk based Proximity Measures -Clustering with random walk based measures-Algorithms for Computing Personalized PageRank and Sim Rank – Application-Computer Vision - Text Analysis -Collaborative Filtering - Combating Web Spam.	

TOTAL : 45 PERIODS

TEXT BOOKS

1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.
3. Charu C. Aggarwal, "Social Network Data Analytics", First Edition, Springer 2011.

REFERENCE BOOKS

1. David Camacho,Angel, Gema Bello and Antonio,"The Four Dimensions of Social Network Analysis: An Overview of Research Methods, Applications, and Software Tools" Feb 2020.
2. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition, Springer, 2011.
3. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop semantic web related applications.
CO2	Represent knowledge using ontology.
CO3	Detect communities in social networks.
CO4	Predict human behavior in social web and related communities.
CO5	Visualize social networks.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	3	3	2	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2

SEMESTER VIII

PROFESSIONAL ELECTIVE – V

IT1811	**INFORMATION THEORY AND CODING**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- Understand error–control coding.
- Understand encoding and decoding of digital data streams.
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- Be aware of compression and decompression techniques.
- Learn the concepts of multimedia communication.

UNIT I	**INFORMATION THEORY**	**9**
Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.		**CO1**
UNIT II	**SOURCE CODING: TEXT, AUDIO AND SPEECH**	**9**
Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding		**CO2**
UNIT III	**SOURCE CODING: IMAGE AND VIDEO**	**9**
Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard		**CO3**
UNIT IV	**ERROR CONTROL CODING: BLOCK CODES**	**9**
Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder - CRC		**CO4**
UNIT V	**ERROR CONTROL CODING: CONVOLUTIONAL CODES**	**9**
Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. R Bose, “Information Theory, Coding and Crptography”, TMH 2007
2. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002

REFERENCE BOOKS

1. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
2. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007
3. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design an application with error–control
CO2	Use compression and decompression techniques
CO3	Apply the concepts of multimedia communication
CO4	Apply the concepts of error control coding: block codes
CO5	Apply the concepts of error control coding: convolutional codes

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2

IT1812	ELECTRONIC COMMERCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Discuss fundamentals of e-commerce, types and applications.
- Evaluate the role of the major types of information systems in a business environment and their relationship to each other
- Assess the impact of the Internet and Internet technology on business electronic commerce and electronic business
- Identify the major management challenges for building and using information systems and learn how to find appropriate solutions to those challenges.
- Learn strategies for e-commerce, Mobile Commerce, Wireless Application Protocol, WAP technology and Mobile Information devices.

UNIT I	**INTRODUCTION**	**9**
Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models.		**CO1**
UNIT II	**NETWORK INFRASTRUCTURE FOR E- COMMERCE**	**9**
Internet and Intranet based E-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device.		**CO2**
UNIT III	**WEB SECURITY**	**9**
Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.		**CO3**
UNIT IV	**ENCRYPTION**	**9**
Encryption techniques, Symmetric Encryption: Keys and data encryption standard, Triple encryption, Secret key encryption; Asymmetric encryption: public and private pair key encryption, Digital Signatures, Virtual Private Network.		**CO4**
UNIT V	**ELECTRONIC PAYMENTS**	**9**
Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking.EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ravi Kalakota, Andrew Winston, “Frontiers of Electronic Commerce”, Addison Wesley.

REFERENCE BOOKS

1. Pete Lohsin , John Vacca “Electronic Commerce”, New Age International
2. Goel, Ritendra “E-commerce”, New Age International
3. Laudon, “E-Commerce: Business, Technology, Society”, Pearson Education
4. Bajaj and Nag, “E-Commerce the cutting edge of Business”, TMH
5. Turban, “Electronic Commerce 2004: A Managerial Perspective”, Pearson Education

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basic concepts and technologies used in the field of management information systems
CO2	Understand the processes of developing and implementing information systems
CO3	Be aware of the ethical, social, and security issues of information systems
CO4	Develop an understanding of how various information systems work together to accomplish the information objectives of an organization
CO5	Understand the role of information systems in organizations, the strategic management processes, and the implications for the management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	1	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	1	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	1	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	1	3	3	2	-	-	-	-	2	2	2	3	3	2

IT1813	AFFECTIVE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn emotional recognition techniques.
- To gain a broader knowledge and understanding of the various affective computing models.
- To learn about various machines developed using human emotion.

UNIT I	**Introduction**	**9**
Affective Computing and the Challenge of mood measurement and forecasting. Affective phenomena: emotion, mood, attitude/sentiment, personality. Computers, robots, smartphones with emotional intelligence.		**CO1**
UNIT II	**Emotion Theory**	**9**
Dual-process theories of emotion, Constructivist theories, Appraisal theories. Affective Technology Interaction and Empathy: Computational Appraisal Theory, reinforcement learning based approaches, recognizing emotional context, facial affect recognition		**CO2**
UNIT III	**Emotionand Perception**	**9**
Ethical issues related to emotion and AI, Emotionally Intelligent Human Computer Interaction, Emotion and Perception, Decision-making, and Creativity, Emotion and Learning, Physiology of Emotion, Behavioral game theory, Neurological Mechanisms involved in Emotion,		**CO3**
UNIT IV	**Affect Recognition**	**9**
Affect Recognition by Wearable's and other Machines, Communicating Frustration/Stress in Autism and in Customer Experience, Responding to User Emotion to Reduce User Frustration, Inducing Emotion, Robots/Agents that "have" Emotion, Expression of Emotion by Machines/Agents/Synthetic characters		**CO4**
UNIT V	**Ethical Implications of Affective Computing**	**9**
Philosophical, Social, Ethical Implications of Affective Computing, Machine/Mobile Empathy and Emotional Support, Lie Detection and Stress Detection.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1.Affective Computing and Interaction: Psychological, Cognitive and Neuroscientific Perspectives by DidemGökçay and GülsenYildirim, IGI Global.

2. The Encyclopedia of Human-Computer Interaction by Jonas Lowgren, John M. Carroll, Marc Hassenzahl, andThomas Erickson, Interaction Design Foundation

REFERENCE BOOKS

1. Affective Computing by R.W. Picard, MIT Press.
2. The Oxford Handbook of Affective Computing by R.A. Calvo, S.K. D'Mello, J. Gratch, and A. Kappas,Oxford University Press.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a good understanding of the role of emotion
CO2	Have a good understanding of machine interaction.
CO3	Have an understanding of the aesthetic aspect of machine design.
CO4	Develop systems to reduce the emotional gap between humans and machines
CO5	Develop systems to reduce the emotional gap all within the context of interactions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2

IT1814	SOCIAL MEDIA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To implement Basics of Text Processing over Social Data
- To understand various Characteristics of OSNs
- To understand Fundamentals of Social Data Analytics
- To Apply the concepts of Social Data Analytics
- Able to properly handle Online experiments for Computational Social Science.

UNIT I	**ONLINE SOCIAL NETWORKS (OSNS)**	**9**
Introduction - Types of social networks (e.g., Twitter, Facebook), Measurement and Collection of Social Network Data, Social Networks - Basic Structure and Measures, Basics of Text Processing over Social Data, Entity linking and entity resolution for Social data		**CO1**
UNIT II	**STUDYING CHARACTERISTICS OF OSNS**	**9**
Information Diffusion, Experimental studies over OSNs, Sampling		**CO2**
UNIT III	**FUNDAMENTALS OF SOCIAL DATA ANALYTICS**	**9**
Topic Models, Random Walks, Heterogeneous Information Networks		**CO3**
UNIT IV	**APPLIED SOCIAL DATA ANALYTICS**	**9**
Recommendation Systems, Community identification and link prediction		**CO4**
UNIT V	**ADVANCED TOPICS**	**9**
Online experiments for Computational Social Science, Big Data Sampling		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1.Matthew A. Russell. Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More, 2nd Edition, O'Reilly Media, 2013.

REFERENCE BOOKS

1. Jennifer Golbeck, Analyzing the social web, Morgan Kaufmann, 2013.
2. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To implement Basics of Text Processing over Social Data
CO2	To understand various Characteristics of OSNs
CO3	To understand Fundamentals of Social Data Analytics
CO4	To Apply the concepts of Social Data Analytics
CO5	Able to properly handle Online experiments for Computational Social Science.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2

DS1812	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
	Common to IT & AI-DS	3	0	0	3

OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I	**FUNDAMENTALS OF SPEECH PROCESSING**	**9**
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		**CO1**
UNIT II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	**9**
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.		**CO2**
UNIT III	**SPEECH RECOGNITION**	**9**
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		**CO3**
UNIT IV	**TEXT ANALYSIS**	**9**
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		**CO4**
UNIT V	**SPEECH SYNTHESIS**	**9**
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. James Whitaker, John Liu, and Uday Kamath, Deep learning for NLP and Speech Recognition,Springer,2019.
2. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
3. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
5. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
6. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
CO2	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
CO3	Justify the use of formant and concatenative approaches to speech synthesis
CO4	Identify the apt approach of speech synthesis depending on the language to be processed
CO5	Determine the various encoding techniques for representing speech.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

SEMESTER VIII

PROFESSIONAL ELECTIVE – VI

IT1821	INTRODUCTION TO DIGITAL CURRENCIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the concepts of Bitcoins
- To study Bitcoin Client and Transactions
- To understand Bitcoin Network and Blockchain
- To understand Storage and Mining
- To study Alternative Chains.

UNIT I	**INTRODUCTION**	**9**
How Bitcoins works-Transactions, Blocks, Mining, and the Blockchain-Bitcoin Transactions-Constructing a Transaction-Bitcoin Mining-Mining transactions in blocks -Spending the transaction-Public key cryptography and crypto-currency-Bitcoin Addresses-Wallets		**CO1**
UNIT II	**THE BITCOIN CLIENT AND TRANSACTIONS**	**9**
Bitcoin Core - The reference implementation-Using Bitcoin Core's JSON-RPC API from the command line-Alternative clients, libraries and toolkits-Transaction Lifecycle-Structure-Outputs and Inputs-Chaining and Orphan TransactionsScripts and Script Language-Standard Transactions		**CO2**
UNIT III	**BITCOIN NETWORK AND BLOCKCHAIN**	**9**
Peer-to-Peer Network Architecture-Nodes Types and Roles-The Extended Bitcoin Network-Network Discovery-Full Nodes-Simplified Payment Verification (SPV) Nodes-Bloom Filters and Inventory Updates-Transaction Pools Blockchain-Structure of a Block-Block Header-Block Identifiers-Genesis Block-Linking Blocks in the Blockchain Merkle Trees		**CO3**
UNIT IV	**BITCOIN STORAGE AND MINING**	**9**
Simple Local Storage - Hot and Cold Storage - Splitting and Sharing Keys - Online Wallets and Exchanges - Payment Services - Transaction Fees - Currency Exchange Markets - Task of Bitcoin Miners – Mining Hardware – Energy Consumption and Ecology – Mining Pools – Mining Incentives and strategies – Anonymity Basics – Deanonymize Bitcoin– Mixing - Decentralized Mixing – Zerocoin and Zerocash		**CO4**
UNIT V	**ALTCOINS**	**9**
Altcoins: History and Motivation – Few Altcoins - Relationship Between Bitcoin and Altcoins - Merge Mining - Atomic Cross-chain Swaps - Bitcoin-Backed Altcoins, "Side Chains" - Ethereum		**CO5**

and Smart Contracts - The Block Chain as a Vehicle for Decentralization - Routes to Block Chain Integration - Template for Decentralization

TOTAL : 45 PERIODS

TEXT BOOKS

1. Andreas M.Antonopoulos,“masteringbitcoins” o’reilly media, inc.,2014
2. Arvind Narayanan,”Bitcoin and Cryptocurrency Technologies” Princeton University Press,2016

REFERENCE BOOKS

1. Chris Dannen, Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programmingfor Beginners. Apress 2017
2. ChrisBurniske&jack Tatar, cryptoassets The Innovative Investor’s Guide to Bitcoin and Beyond,McGrawHill,2018
3. S Shukla, M. Dhawan, S. Sharma and S. Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”,Oxford University Press, 2019.
4. Josh Thompson, “Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming”, Create Space Independent Publishing Platform, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement the basic element of Bitcoins
CO2	Realize Bitcoin Client and Transactions
CO3	Use Bitcoin Network and Blockchain
CO4	Work with Mining techniques
CO5	Work with alternate bitcoin techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	1	3	2	-	-	-	-	2	2	2	3	3	2

IT1822	TRUST NETWORKS	L	P	T	C
		3	0	0	3

OBJECTIVES

- Understand how block chain systems (mainly Bitcoin and Ethereum) work
- To securely interact with them
- Design, build, and deploy smart contracts and distributed applications
- Integrate ideas from block chain technology into their own projects.

UNIT I	**Block chain**	**9**
The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS) .		**CO1**
UNIT II	**Crypto Currency**	**9**
cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography		**CO2**
UNIT III	**Crypto Currency Regulation**	**9**
Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.		**CO3**
UNIT IV	**Ethereum**	**9**
Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts		**CO4**
UNIT V	**Trends and Topics**	**9**
Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016. (Free download available)

REFERENCE BOOKS

1. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015 (article available for free download) { curtain raiser kind of generic article, written by seasoned experts and pioneers}.
2. J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (Also available at eprint.iacr.org/2016/1048)
3. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, (eprint.iacr.org/2016/454)
4. R.Pass et al, Fruitchain, a fair blockchain, PODC 2017 (eprint.iacr.org/2016/916).

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	List and describe differences between proof-of-work and proof-of-stake consensus
CO2	Understand the basics of cryptocurrency
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Explain design principles of Ethereum.
CO5	Design, build, and deploy a distributed application.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO2	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO3	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO4	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2
CO5	1	2	2	2	1	-	-	1	1	1	1	1	2	2	2

IT1823	ARTIFICIAL INTELLIGENCE AND ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide an introduction to the basic principles, techniques, and applications of Artificial Intelligence.
- To know about Lisp and Prolog and use of these languages in AI.

UNIT I	**Scope of AI**	**9**
Games theorem, natural language processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction		**CO1**
UNIT II	**Problem solving**	**9**
State space search; Production systems, search space control: depth first, breadth-first search, heuristic search - hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis		**CO2**
UNIT III	**Knowledge Representation**	**9**
Predicate Logic: unification, modus pones, resolution, dependency directed backtracking. Rule based Systems: forward reasoning, conflict resolution, backward reasoning, use of no backtracks. Structured Knowledge Representation: semantic net slots, exceptions and default frames, conceptual dependency, scripts		**CO3**
UNIT IV	**Handling uncertainty and learning**	**9**
Non-monotonic reasoning, probabilistic reasoning, use of certainty factors, fuzzy logic, Concept of learning, learning automation, genetic algorithm, learning by inductions, neural network.		**CO4**
UNIT V	**Robotics and its application**	**9**
Robotics and Its applications, DDD concept, Intelligent robots, Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems-Specifications of Robot-Speed of RobotRobot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems-Hydraulic, Pneumatic and Electric system		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Elaine Rich, Kevin Knight, Artificial Intelligence TMH (Any Edition).
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
3. Max Braber, Logic Programming with Prolog, Springer, 2005.
4. E. Rich and K. Knight, “Artificial intelligence”, MH, 2nd ed., 1992.
5. N.J. Nilsson, “Principles of AI”, Narosa Publ. House, 2000.

REFERENCE BOOKS

1. Robin R Murphy, Introduction to AI Robotics PHI Publication, 2000
2. D. W. Patterson, “Introduction to AI and Expert Systems”, PHI, 1992.
3. R. J. Schalkoff, “Artificial Intelligence - an Engineering Approach”, McGraw Hill Int. Ed., Singapore, 1992.
4. George Lugar, .AI-Structures and Strategies for and Strategies for Complex Problem solving, 4/e,2002, Pearson Educations.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply basics of Fuzzy logic and neural networks
CO2	Explain Expert System and implementation
CO3	Apply Knowledge representation and semantic in Knowledge representation.
CO4	Develop some familiarity with current research problems and research methods in AI.
CO5	Demonstrate and Illustrate about functionalities of Robots and Robotics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	1	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	1	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	1	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	1	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	1	-	-	2	2	2	3	3	2

IT1824	IOT PLATFORM FOR SMART CITY PLANNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Concepts of Internet of Things.
- IoT Architecture and Terminologies.
- IoT working platform for different system.
- IoT standards for smart city planning.
- IoT applications on different sectors.

UNIT I	**INTRODUCTION TO IOT**	**9**
Overview and Introduction - Internet of Things (IoT) - Web of Things (WoT) - Cloud of Things - Need for IoT on Cloud - Services in the Cloud for the Internet of Things - Applications of IoT – Detailed Domain Model.		**CO1**
UNIT II	**IOT ARCHITECTURE**	**9**
IoT Architecture - Sensor Layer - Gateway and Network Layer - Management Service Layer - Application Layer - IoT Enabling Technologies - Addressing Schemes - Data Storage and Analytics – Visualization - Connected Domains – Connected Home -Connected Worker - Connected Automobile - Connected Industry.		**CO2**
UNIT III	**IOT PLATFORMS DESIGN METHODOLOGY**	**9**
IoT Systems – Intel IoT Framework - Qualcomm IoT Framework - Microsoft IoT Framework - ARM IoT Framework - Logical Design - Programming IoT platform (eg: Python, Mono C# , Objective-C, Ruby), Raspberry Pi - Program for Firmware – Case Studies		**CO3**
UNIT IV	**IOT STANDARDS**	**9**
Need for the IOT standards - IOT and Smart City Standards and Policies: Global perspective – Policy Research and Standardization in Europe – Indian Standards formulation – Sectional committee and composition – Challenges in standardization - Digital infrastructure		**CO4**
UNIT V	**IOT APPLICATIONS**	**9**
Lighting as service – Smart Parking -Smart metering – Smart water management- Smart energy– Smart solid waste management - Smart mobility – Smart governance- Challenges in IoT Management.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Olivier Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, Second Edition, Wiley Publisher, 2012.

2. Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, "Architecting the Internet of Things". SpringerScience & Business Media, 2011.

REFERENCE BOOKS

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", 2014.
2. Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.
3. Lu, Yan, Yan Zhang, Laurence T. Yang, HuanshengNing. "The Internet of Things: From RFID to the NextGeneration Pervasive Networked Systems", CRC Press.
4. Massimo Banzi, "Getting Started with Arduino (Make: Projects)", O'Reilly Media. 2008.
5. Samuel Greengard, "The Internet of Things (The MIT Press Essential Knowledge series)", MIT Press, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze the different concepts and theories of Internet of Things.
CO2	Assess the various components of IoT architecture.
CO3	Perform the IoT applications in programming platform
CO4	Adopt the IoT standards for smart city planning
CO5	Apply the understandings of IoT in different sectors of smart city planning.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3	2	-	-	1	-	2	2	2	3	3	2
CO2	3	3	1	3	2	-	-	1	-	2	2	2	3	3	2
CO3	3	3	1	3	2	-	-	1	-	2	2	2	3	3	2
CO4	3	3	1	3	2	-	-	1	-	2	2	2	3	3	2
CO5	3	3	1	3	2	-	-	1	-	2	2	2	3	3	2

CS1824	BLOCKCHAIN TECHNOLOGIES	L	T	P	C
(Common to CSE & IT)		3	0	0	3

OBJECTIVES

- ❖ Understand how blockchain systems (mainly Bitcoin and Ethereum) work
- ❖ To securely interact with them,
- ❖ Design, build, and deploy smart contracts and distributed applications,
- ❖ Integrate ideas from blockchain technology into their own projects.

UNIT I	**BASICS**	**9**
Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.		**CO1**
UNIT II	**BLOCKCHAIN**	**9**
Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.		**CO2**
UNIT III	**DISTRIBUTED CONSENSUS**	**9**
Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.		**CO3**
UNIT IV	**CRYPTOCURRENCY**	**9**
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Name coin		**CO4**
UNIT V	**CRYPTOCURRENCY REGULATION**	**9**
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

REFERENCE BOOKS

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger, “Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Design principles of Bitcoin and Ethereum and Nakamoto consensus
CO2	Learn the simplified Payment Verification protocol and describe differences between proof-of-work and proof-of-stake consensus.
CO3	Interact with a blockchain system by sending and reading transactions.
CO4	Design, build, and deploy a distributed application.
CO5	Evaluate security, privacy, and efficiency of a given blockchain system.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	3	2	3	3	1	2	2	1	1	2	3	3	2
CO2	1	1	2	1	3	2	2	2	2	1	1	2	3	3	2
CO3	1	1	3	2	3	3	1	1	2	1	1	2	3	3	2
CO4	1	1	2	2	3	2	2	2	2	1	1	3	3	3	2
CO5	1	1	3	3	3	2	1	2	2	1	1	2	3	3	2

OPEN ELECTIVES – I & II

OBT101	**INDUSTRIAL BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

UNIT I	**OVERVIEW OF THE CELL**	**9**
Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.		**CO1**
UNIT II	**MICROBIAL GROWTH: PURE CULTURE TECHNIQUES**	**9**
Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures. Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.		**CO2**
UNIT III	**MANAGEMENT OF WASTE**	**9**
Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting		**CO3**
UNIT IV	**BIOREMEDIATION**	**9**
Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex-situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.		**CO4**
UNIT V	**BIOENERGY AND BIOMINING**	**9**
Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,

REFERENCE BOOKS
1. Environmental Biotechnology - Allan Stagg.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	1	2	2	4	2	1	1	1	2	1	1
CO2	2	1	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	3	3	2	1	1	2	4	3	1	2	4	5	1	2	2
CO4	3	3	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	4	5	2	4	3	2	1	2	3	1	1	2	2

OBT104	BIOSENSORS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	**PROTEIN BASED BIOSENSORS**	**9**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		**CO1**
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		**CO2**
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		**CO3**
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		**CO4**
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT I	**BASICS OF NANOTECHNOLOGY**	**9**
Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.		**CO1**
UNIT II	**DIFFERENT CLASSES OF NANOMATERIALS**	**9**
Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon based nano materials (buckyballs, nanotubes, grapheme)- Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		**CO2**
UNIT III	**SYNTHESIS OF NANOMATERIALS**	**9**
Chemical Methods:Metal Nanocrystals by Reduction -Sol - gel processing -Solvothermal Synthesis-Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods:Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		**CO3**
UNIT IV	**CHARACTERIZATION OF NANOSTRUCTURES**	**9**
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)- Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		**CO4**
UNIT V	**APPLICATIONS**	**9**
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices -Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, KamaliKannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt.Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	Develop an ability to critically evaluate the promise of a nanotechnology device.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	1

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data models.
- To know the details of data input and topology
- To know the knowledge on data management and output processes
- To know the data quality and standards

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open-source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		**CO1**
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.		**CO2**
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitiser – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration		**CO3**
UNIT IV	**DATA QUALITY AND STANDARDS**	**9**
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure		**CO4**
UNIT V	**DATA MANAGEMENT AND OUTPUT**	**9**
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - TsungChang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition,2011.
2. Ian Heywood, Sarah Cornelius, SteveCarver,Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2ndEdition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers,2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO2	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2
CO3	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO4	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO5	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration and management.
- To know the market related research process and its HRM
- To understand the recruitment and training processes in hospitals
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I	OVERVIEW OF HOSPITAL ADMINISTRATION	9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		CO1
UNIT II	**HUMAN RESOURCE MANAGEMENT IN HOSPITAL**	**9**
Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.		CO2
UNIT III	**RECRUITMENT AND TRAINING**	**9**
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		CO3
UNIT IV	**SUPPORTIVE SERVICES**	**9**
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		CO4
UNIT V	**COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL**	**9**
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony& Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and issues in supporting departments of hospitals
CO5	Understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1

OEC103	BASICS OF EMBEDDED SYSTEMS AND IOT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IOT

UNIT I	**INTRODUCTION TO EMBEDDED SYSTEM**	**9**
Introduction to Embedded Systems –Building blocks of Embedded System, Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Oscillator and Reset Circuits-Real Time Clock. Introduction to a brief study on a typical embedded processor.		**CO1**
UNIT II	**INTRODUCTION TO EMBEDDED PROCESSORS**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocolsRS232 standard – RS422 – RS 485- Inter Integrated Circuits (I2C), Serial Peripheral Interface (SPI), CAN Bus, – USB- Wi-Fi- Bluetooth- Zigbee - need for Device Drivers.		**CO2**
UNIT III	**INTRODUCTION TO IoT**	**9**
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture		**CO3**
UNIT IV	**IoT PROTOCOLS**	**9**
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP– Security- MQTT- AT Commands		**CO4**
UNIT V	**EMBEDDED And IoT CASE STUDIES**	**9**
Industry 4.0 Concepts - Sensors and Sensor Node – Interfacing using any Embedded Target Boards (Raspberry Pi / Aurdino) – Soil Moisture Monitoring – Weather Monitoring – Air Quality Monitoring – Movement Detection		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Raj Kamal, ‘Embedded Systems-Architecture, Programming, Design’, Second Edition, Mc Graw Hill, 2013. 2. C.R. Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd,2013)
2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things, A Hands-on-Approach”, 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons”, Inc, USA, 2013

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, 1st Edition, John Wiley & Sons Ltd, UK, 2014
2. Peter Waher, “Learning Internet of Things”, 1st Edition, Packt Publishing Ltd, UK, 2015.
3. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi” , 1st Edition, Apress Publishers, USA, 2013.

COURSE OUTCOMES:
By the end of this course, the student should be able to:

CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO 3
CO1	3	3	2	3	-	2	1	2	-	1	2	2	3	3	2
CO2	3	3	2	3	-	3	1	2	-	1	2	2	3	3	2
CO3	3	3	2	3	3	3	1	2	1	1	2	2	3	3	2
CO4	3	3	3	3	-	2	1	2	-	1	2	2	3	3	2
CO5	3	3	3	3	2	3	1	2	1	1	2	2	3	3	2

OEE101	BASIC CIRCUIT THEORY	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I	**BASIC CIRCUITS ANALYSIS**	**9**
Resistive elements - Resistors in series and parallel circuits; Ohm's Law; Kirchoffs laws – methods of analysis-Mesh current and node voltage.		**CO1**
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS**	**9**
Network reduction- voltage and current division, source transformation, star delta conversion; Network theorems- Thevenins and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO2**
UNIT III	**ANALYSIS OF AC CIRCUITS**	**9**
Introduction to AC circuits- Inductive reactance, Capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor; RL, RC , RLC networks; Network reductions- voltage and current division, source transformation; Mesh and node analysis; Network theorems- Thevenins and Norton Theorems, Superposition Theorem , Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		**CO3**
UNIT IV	**THREE PHASE CIRCUITS**	**9**
A.C. circuits – Average and RMS value, Phasor Diagram, Power, Power Factor and Energy; Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced; phasor diagram of voltages and currents; power measurement in three phase circuits.		**CO4**
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance – frequency response, Quality factor and Bandwidth; Self and mutual inductance; Coefficient of coupling; Tuned circuits – Single tuned circuits.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd.,New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”,McGraw Hill, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to introduce electric circuits and its analysis
CO2	Ability to impart knowledge on solving circuit equations using network theorems
CO3	Ability to introduce the phenomenon of resonance in coupled circuits.
CO4	Ability to introduce Phasor diagrams and analysis of three phase circuits
CO5	Ability to impart knowledge on resonance and coupled circuits

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEE103	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	P	T	C
		3	0	0	3

OBJECTIVES

- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

UNIT I	INTRODUCTION	9
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.		CO1
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Reference theory fundamentals-principle of operation and analysis: IG and PMSG		CO2
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers		CO3
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Standalone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system		CO4
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan, “Non-conventional Energy Sources”, Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCE BOOKS

1. Muhammad H. Rashid, “Power Electronics Hand Book”, Third Edition, Butterworth- Heinemann, 2015.
2. Ion Boldea, “Variability Speed Generators”, Second Edition, CRC Press, 2015.
3. Rai. G.D, “Non- conventional Energy Sources”, Khanna Publishers, 2004.
4. Gray, L. Johnson, “Wind Energy Systems”, Prentice Hall, 2006.
5. Andrzej M. Trzynnadlowski, “Introduction to Modern Power Electronics”, Third Edition, WileyIndia Pvt. Ltd, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Ability to understand and analyze power system operation, stability, control and protection.
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization.
CO3	Ability to understand the stand alone and grid connected renewable energy systems.
CO4	Ability to design of power converters for renewable energy applications.
CO5	Ability to acquire knowledge on wind electrical generators and solar energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- ❖ To understand the functions of the basic components of a Robot.
- ❖ To study the use of various types of End of Effectors and Sensors
- ❖ To impart knowledge in Robot Kinematics and Programming
- ❖ To learn Robot safety issues and economics.

UNIT I	**FUNDAMENTALSOF ROBOT**	**9**
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.		**CO1**
UNIT II	**ROBOT DRIVE SYSTEMS ANDEND EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		**CO2**
UNIT III	**SENSORS AND MACHINEVISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		**CO3**
UNIT IV	**ROBOT KINEMATICS AND ROBOTPROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		**CO4**
UNIT V	**IMPLEMENTATION ANDROBOTECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCE BOOKS

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education,2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co.,1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co.,1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill,1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company,2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd.,1991.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functions of the basic components of a Robot.
CO2	Study the use of various types of End of Effectors and Sensors
CO3	Understand Sensors and Machine Vision of Robot
CO4	Understand Robot Kinematics and Robot Programming
CO5	Understand the Implementation of Robots in Industries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	2	3	2	1	2
CO2	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO3	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO4	3	2	1	2	2	-	-	-	-	2	2	3	3	2	2
CO5	2	2	1	2	2	-	-	-	-	2	2	3	2	2	2

OMB101	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the quality philosophies and tools in the managerial perspective.

UNIT I	**INTRODUCTION**	**9**
Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		**CO1**
UNIT II	**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**	**9**
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology		**CO2**
UNIT III	**STATISTICAL PROCESS CONTROL**	**9**
Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations.		**CO3**
UNIT IV	**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**	**9**
Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.		**CO4**
UNIT V	**QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**	**9**
Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS
1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – SacreHermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011 2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.
REFERENCE BOOKS
1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008. 2. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005. 3. PoornimaM.Charantimath, Total Quality Management, Pearson Education, First Indian Reprint 2003. 4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able:

CO1	To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.
CO2	To understand the principles of business process improvement
CO3	To understand and apply the concepts of statistical process control
CO4	To apply the tools and techniques used for quality management
CO5	To understand the methods in organizing and implementation of quality systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948
- To familiarize students with powers of inspectorate of factories
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.
- To prepare onsite and offsite emergency plan.

UNIT I	**FACTORIES ACT – 1948**	**9**
Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948		**CO1**
UNIT II	**ENVIRONMENT ACT – 1986**	**9**
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.		**CO2**
UNIT III	**MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**	**9**
Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.		**CO3**
UNIT IV	**OTHER ACTS AND RULES**	**9**
Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cylinder rules-Explosives Act 1983- Pesticides Act		**CO4**
UNIT V	**INTERNATIONAL ACTS AND STANDARDS**	**9**
Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO2	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO3	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO4	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO5	2	2	-	-	1	2	2	2	2	2	2	2	1	1	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

IVA001	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		1	0	2	2

OBJECTIVES

1.The main learning objective of this course is to make the students an appreciation for:

2. To provide students with good depth of knowledge of Designing Industrial IOT Systems for various application.

3. Knowledge for the design and analysis of Industry 4.0Systems for Electronics Engineering students1.

UNIT I	**INTRODUCTION TO INDUSTRIAL IOT (IIOT) SYSTEMS**	**9**
The Various Industrial Revolutions – Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry – Industry 4.0 revolutions – Support System for Industry 4.0 – Smart Factories.		**CO1**
UNIT II	**IMPLEMENTATION SYSTEMS FOR IIOT**	**9**
Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in IIoT, Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols and IoT Hub systems.		**CO2**
UNIT III	**IIOT DATA MONITORING & CONTROL**	**9**
IoT Gate way – IoT Edge Systems and It's Programming – Cloud computing – Real Time Dashboard for Data Monitoring – Data Analytics and Predictive Maintenance with IIoT technology		**CO3**
UNIT IV	**IIOT Sensors & Networks**	**9**
Next Generation Sensors – Collaborative Platform and Product Lifecycle Management – Industrial IoT- Layers – Software Defined Networks: IIoT Analytics – Security and Fog Computing – Fog Computing in IIoT – Emerging descriptive data standards for IIoT – Cloud data base.		**CO4**
UNIT V	**INDUSTRIAL IOT- APPLICATIONS**	**9**
Healthcare Power Plants – Inventory Management & Quality Control – Plant Safety and Security Oil – Chemical and Pharmaceutical industry – Applications of UAVs in Industries.		**CO5**

TOTAL : 45 PERIODS

REFERENCE:

1. . Industry 4.0: The Industrial Internet of Things Alasdair Gilchrist Publications: Apress.

2. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

4. Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Students can develop a comprehensive understanding of Internet of Things (IoT) technologies, including sensors, communication protocols, cloud computing, and data analytics.
CO2	The program can provide students with hands-on experience in designing, implementing, and managing IoT-based solutions for industrial applications.
CO3	The program can provide students with an understanding of IoT security and privacy issues, including data encryption, access control, and device authentication.
CO4	The program can help students develop effective communication and teamwork skills through group projects and case studies, which are essential for working in cross-functional teams in industrial IoT settings.
CO5	Graduates of the program can be better equipped to take on roles in IoT-based industrial applications and other areas of technology, due to their in-depth knowledge of IoT technologies and their practical experience in designing and implementing industrial IoT solutions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	2	-	-	-	2	2	2	2	2	3
CO2	1	1	1	1	2	2	-	-	1	2	2	2	1	2	2
CO3	3	2	2	2	2	2	-	-	1	1	1	1	2	2	2
CO4	1	1	2	1	2	2	-	-	3	2	2	1	1	2	2
CO5	1	1	1	2	1	2	1	1	2	2	2	2	2	2	2

IVA002	AUGMENTED REALITY & VIRTUAL REALITY	L	T	P	C
		1	0	2	2

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

1. To provide students with good depth of knowledge of Augmented Reality and Virtual Reality
2. Knowledge on Tools and Applications of Augmented Reality and Virtual Reality

UNIT I	**Introduction to Augmented Reality and Virtual Reality (VR)**	**9**
History of AR - Augmented reality characteristics– Difference between Augmented Reality and Virtual Reality– AR technological components– Technologies used in AR– Feature Extraction – Hardware components – AR devices – Importance of AR - Real world uses of AR – AR types – Software tools available for AR.		**CO1**
UNIT II	**Computer Graphics and Geometric Modeling**	**9**
The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference.		**CO2**
UNIT III	**Need of technologies for Augmented Reality & Virtual Reality**	**9**
Hardware technology– virtual scenes – 3D objects– AR & VR components Display – HMD – Eyeglasses– Contact Lenses – significance of AR – AR powered devices – Motion tracking –Virtual environment - VR technology, AR & VR application development drawbacks – Compatibility Performance.		**CO3**
UNIT IV	**Tools and Applications of Augmented Reality & Virtual Reality**	**9**
Tools available for Augmented Reality and Recognition - Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems - Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.		**CO4**
UNIT V	**Augmented Realities and Virtual Reality for Micro Learning**	**9**
Micro learning techniques – Utilizing VR for learning – VR for Practical online assessment – VR info graphics – Virtual case considerations - Utilizing AR for learning – Accessible learning – sensible data – elevated learner engagement - Engineering, Entertainment, Science, Training, Game Development		**CO5**

TOTAL : 45 PERIODS

REFERENCE:

1.Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018
2. Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand the importance of augmented reality in Industry 4.0 with real-time examples
CO2	To describe the history and recent developments of AR
CO3	To provide the need on emerging technologies AR and VR
CO4	To discuss the revolution and impact of AR
CO5	To understand the applications of AR and VR

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

IVA003	ETHICAL HACKING - CYBER SECURITY	L	T	P	C
		1	0	2	2

OBJECTIVES:

- To learn the fundamentals of Cyber Security and Ethical Hacking
- To learn the Foot printing & Reconnaissance and Scanning Networks
- To understand Enumeration and Vulnerability Analysis
- To understand Exploitation on Network
- To learn the Web Attacks and Report Writing

UNIT I	FUNDAMENTALS OF CYBER SECURITY AND ETHICAL HACKING	9
Introduction to Cyber Security - Cyber Security & Ethical Hacking - Domains of Cyber Security - Principles of Cyber security (CIA Triad, Security Models, Principles of Privileges) - Offensive & Defensive Security - Cyber Kill Chain - Types of Security Teams (Red Team, Blue Team, Purple Team) - Cyber Security Frameworks (NIST, MITRE, ISO/IEC) Phases & Methodologies in Ethical Hacking - Introduction to Malware - Types of Malware		CO1
UNIT II	FOOTPRINTING RECONNAISSANCE AND SCANNING NETWORKS	9
Introduction to Foot printing Reconnaissance - Types of Reconnaissance (Passive & Active) - Active Reconnaissance (Ping, Traceroute, Telnet, Whatweb, Wappalyzer, Netcraft) - Passive Reconnaissance (nslookup, whois, dig, DNS Dumpster, Shodan) - Introduction to OSINT (OSINT Framework, OSRFRAMEWORK, Social Searcher,) - Introduction to Scanning Networks - Types of Network Scanning (Port Scan, Service Scan, Vulnerability Scan) - Scanning Techniques - Port Scanning (TCP, UDP) - Host Discovery (ICMP, ARP) - Introduction to Wireshark - Capturing Data Packets - Packet Analysis.		CO2
UNIT III	ENUMERATION AND VULNERABILITY ANALYSIS	9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.		CO3
UNIT IV	EXPLOITATION ON NETWORK	9
Introduction to Exploitation - What is Shell - Types of Linux Shells (Bash, Csh/Tcsh, Ksh, Zsh, Fish) - What is Gaining Access & Maintaining Access - Reverse Shell & Bind Shell - Introduction to Metasploit Framework - Metasploit Modules - Staged Payload & Non-Staged Payload - Using Metasploit Framework Gaining the User Shell Acess - Gaining Root Shell Acess in Metasploit Framework - Introduction to Manual Exploitation - Gaining User Shell in Manual Exploitation - What is Privilege Escalation - Linux & Windows Privilege Escalation - Using Linpeass Script Finding Non-Privilege Path on Linux System - Using Winpeass Script Finding Non-Privilege Path on Windows System - Hands-on Windows & Linux Privilege Escalation - Introduction to Post Exploitation.		CO4
UNIT V	WEB ATTACKS AND REPORT DOCUMENTATION	9
Introduction to OWAP TOP 10 and SANS TOP 25 - Web Server & Web Application Attack Methodology - Indirect Object Reference (IDOR) - SQL Injection - Cross Site Scripting - XML Injection or XML External Internal - Account Hijacking - Sensitive Data Exposure - Server Side Forgery - Race Condition - Generate Proper Vulnerability Assessment Penetration Testing Report Document.		CO5

TOTAL : 45 PERIODS

REFERENCE:

1. Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2. The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.

3. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the importance of fundamentals of cyber security and ethical hacking
CO2	To gain understanding on different foot printing, reconnaissance and scanning methods.
CO3	To demonstrate the enumeration and vulnerability analysis methods
CO4	To acquire knowledge on the options for network protection.
CO5	To gain knowledge on hacking options available in Web applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	-	-	-	2	1	1	1	2	3
CO2	2	2	2	1	1	1	-	-	-	-	1	1	1	2	2
CO3	2	2	2	1	1	1	-	-	-	-	1	1	2	2	2
CO4	2	2	2	1	1	2	-	-	-	-	1	1	2	2	3
CO5	2	2	2	1	1	2	1	1	1	2	1	1	2	2	3

IVA004	BLOCKCHAIN AND CRYPTO CURRENCIES	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To understand Blockchain's fundamental components, and examine decentralization using blockchain.
2. To understand Cryptocurrency and its background concepts.
3. To learn smart contract programing language solidity.
4. To understand public blockchain application development platform and develop distributed applications.
5. To understand enterprise blockchain application development platform and develop distributed enterprise applications

UNIT I	**INTRODUCTION**	**9**
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash function, consensus, byzantine fault-tolerant, distributed computing, 51% attack, digital cash etc.		**CO1**
UNIT II	**CRYPTOCURRENCY BASICS**	**9**
Bitcoin blockchain, Challenges and solutions, Crypto mining, mining types, mining hardware, proof of work, Proof of stake, alternatives to Bitcoin consensus, other crypto currencies like Ethereum, Tether, BNB etc		**CO2**
UNIT III	**SOLIDITY WALKTHROUGH**	**9**
Introduction to Ethereum blockchain – Ethereum Virtual Machine – remix IDE - MetaMask wallet – running simple smart contract – voting application – Lottery application – File sharing application		**CO3**
UNIT IV	**PUBLIC BLOCKCHAIN APPLICATION DEVELOPMENT**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		**CO4**
UNIT V	**ENTERPRISE BLOCKCHAIN APPLICATION DEVELOPMENT**	**9**
Introduction to Hyperledger – Hyperledger Fabric architecture– language supports for hyperledger fabric – setting up hyprledger fabric - Building application in hyperledger fabric.		**CO5**

TOTAL : 45 PERIODS

REFERENCES:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.
4. https://hyperledger-fabric.readthedocs.io/en/latest/tutorials.html

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand Blockchain's fundamental components, and examine decentralization using blockchain.
CO2	Understand Cryptocurrency and its background concepts
CO3	Write smart contract using programing language solidity.
CO4	Develop distributed applications using public blockchain application development platform Ethereum.
CO5	Develop distributed applications using enterprise blockchain application development platform Hyperledger

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	2	1	-	-	1	-	-	1	2	2	3
CO2	3	3	2	-	2	2	-	-	1	-	-	1	2	2	3
CO3	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO4	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
CO5	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3

IVA005	INDUSTRIAL PRACTICES WITH DEVOPS	L	T	P	C
		1	0	2	2

OBJECTIVES

1. To introduce DevOps terminology, definition & concepts
2. To understand the Maven, Profiles and Plugins
3. To understand the concepts of Continuous Integration/ Continuous Testing/ ContinuousDeployment using Jenkins
4. To understand to leverage Cloud-based DevOps tools using Azure DevOps
5. Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

UNIT I	**INTRODUCTION TO DEVOPS**	**9**
Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github		**CO1**
UNIT II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**9**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases (compile build, test, package) Maven Profiles, Maven repositories (local, central, global), Maven plugins, Maven create and build Artifacts, Dependency management, Installation of Gradle, understand build using Gradle		**CO2**
UNIT III	**CONTINUOUS INTEGRATION USING JENKINS**	**9**
Install & Configure Jenkins, Jenkins Architecture Overview, creating a Jenkins Job, configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace		**CO3**
UNIT IV	**BUILDING DEVOPS PIPELINES USING AZURE**	**9**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		**CO4**
UNIT V	**DEVOPS PRACTICALS**	**9**
Create Maven Build pipeline in Azure - Run regression tests using Maven Build pipeline in Azure - Install Jenkins in Cloud - Create CI pipeline using Jenkins - Create a CD pipeline in Jenkins and deploy in Cloud		**CO5**
		TOTAL : 45 PERIODS

REFERENCES:

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Mitesh Soni, Hands-On Azure Devops: CICD Implementation for Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for .DevOps and Microsoft Azure (English Edition) , 2020
3. Mariot Tsitoara, “ Beginning Git and GitHub: A Comprehensive Guide to Version Control Management, and Teamwork for the New Developer”, Second Edition, 2019.
4. https://www.jenkins.io/user-handbook.pdf
5. https://maven.apache.org/guides/getting-started

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand different actions performed through Version control tools like Git.
CO2	Compile and Build using Maven & Gradle applications
CO3	Ability to Perform Continuous Integration using Jenkins.
CO4	Understand to leverage Cloud-based DevOps tools using Azure DevOps
CO5	Develop various Devops applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO3	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	2	2	2

IVA006	APPLIED MACHINE LEARNING WITH PYTHON	L	T	P	C
		1	0	2	2

OBJECTIVES

- To provide a basic understanding of data manipulation.
- To understand scikit learn for model evaluation.
- To provide a comprehensive understanding of neural networks and computer vision.

UNIT I	**DATA MANIPULATION WITH PYTHON LIBRARIES**	**9**
Overview of Data Manipulation with Python-Introduction to Pandas and NumPy-Data Cleaning and Preprocessing-Handling Missing Data-Data Exploration and Analysis		**CO1**
UNIT II	**MACHINE LEARNING BASICS WITH SCIKIT-LEARN**	**9**
Introduction to Machine Learning-Types of Machine Learning Algorithms-Overview of Decision Trees and Random Forests-Hands-on Implementation with Scikit-Learn-Model Evaluation and Validation.		**CO2**
UNIT III	**LINEAR REGRESSION AND BEYOND**	**9**
Linear Regression Fundamentals-Implementing Linear Regression from Scratch-Logistic Regression for Classification-Introduction to Support Vector Machines (SVM)-Hands-on Exercises with Scikit-Learn.		**CO3**
UNIT IV	**ADVANCED MACHINE LEARNING TECHNIQUES**	**9**
Introduction to Gradient Boosting-Implementation of Gradient Boosting with XGBoost-Neural Networks Basics with PyTorch-Deep Learning Fundamentals-Applications of Neural Networks.		**CO4**
UNIT V	**COMPUTER VISION AND TRANSFER LEARNING**	**9**
Image Classification with Convolutional Neural Networks (CNN)-Transfer Learning Concepts and Applications-Hands-on Image Classification with PyTorch-Fine-tuning Pre-trained Models-Building Custom Models for Specific Tasks.		**CO5**
		TOTAL : 45 PERIODS

REFERENCE:	
1. " Data Wrangling with Pandas" by Kevin Markham - A practical guide that delves into data cleaning, preprocessing, handling missing data, and exploratory data analysis using Pandas. 2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron - A comprehensive guide that covers a wide range of machine learning topics, including decision trees, random forests, and model evaluation with scikit-learn.	
COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	To understand a predictive models that can classify or regress on data by recursively partitioning.
CO2	To develop a foundational understanding of the underlying algorithms, optimizing model parameters
CO3	To build a robust and high-performance ensemble model for regression or classification tasks.
CO4	To understand the automatic learning of hierarchical representations from data for tasks such as classification, regression, and feature extraction.
CO5	To incorporating transfer learning are to leverage pre-trained models to efficiently learn and classify features in images, facilitating accurate predictions.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO2	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	1	-	-	-	-	1	-	1	-	-	1
CO4	-	-	-	1	1	-	-	-	-	-	-	1	-	1	1
CO5	-	-	-	-	1	-	-	-	-	1	-	1	-	1	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	**INTRODUCTION**	**6**
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) -Philosophy of the Indian Constitution-Preamble-Salient Features		**CO1**
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**6**
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Emergency Provisions - National Emergency, President Rule, Financial Emergency		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**6**
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		**CO5**
		TOTAL : 30 PERIODS

TEXT BOOKS

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**6**
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		**CO1**
UNIT II	**IMPORTANCE OF VALUES**	**6**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		**CO2**
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**6**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		**CO4**
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**6**
Equality, Non-violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.		**CO5**
		TOTAL : 30 PERIODS

REFERENCE:

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	**INTRODUCTION AND METHODOLOGY**	**6**
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		**CO1**
UNIT II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		**CO2**
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		**CO3**
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**6**
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes		**CO4**
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		**CO5**
		TOTAL : 30 PERIODS

REFERENCE:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I	**INTRODUCTION TO YOGA**	**6**
Definitions of Eight parts of yog.(Ashtanga)		**CO1**
UNIT II	**YAM**	**6**
Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		**CO2**
UNIT III	**NIYAM**	**6**
Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		**CO3**
UNIT IV	**ASAN**	**6**
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes		**CO4**
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		**CO5**

TOTAL : 30 PERIODS

REFERENCE:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do's and Don't's in life through Yam
CO3	Learn Do's and Don't's in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**6**
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**6**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		**CO2**
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		**CO3**
UNIT IV	**EMERGENCY PROVISIONS**	**6**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		**CO4**
UNIT V	**LOCAL ADMINISTRATION**	**6**
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63		**CO5**
		TOTAL : 30 PERIODS

REFERENCE:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010

2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	6
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.		**CO1**
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	**6**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		**CO2**
UNIT III	**RURAL INSTITUTIONS**	**6**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		**CO3**
UNIT IV	**RURAL DEVELOPMENT PROGRAMMES**	**6**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		**CO4**

UNIT V	FIELD WORK	6
Each student selects one programme for field visit Field based practical activities: • Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities • Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site • Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures • Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) • Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization • Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps • Participate in Gram Sabha meetings, and study community participation • Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries • Attend Parent Teacher Association meetings, and interview school drop outs • Visit local Anganwadi Centre and observe the services being provided • Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. • Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys • Raise understanding of people's impacts of climate change, building up community's disaster preparedness • Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants • Formation of committees for common property resource management, village pond maintenance and fishing.		CO5
TOTAL : 30 PERIODS		

Text Books:

1. . Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015

2.A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002

3.United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	**INTRODUCTION TO CULTURE**	**6**
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		**CO1**
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**6**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		**CO2**
UNIT III	**RELIGION AND PHILOSOPHY**	**6**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		**CO3**
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**6**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		**CO4**
UNIT V	**EDUCATION SYSTEM IN INDIA**	**6**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**
		TOTAL : 30 PERIODS

REFERENCE:

1. . Kapil Kapoor, “Text and Interpretation: The India Tradition”, ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Know the contribution of scientists of different eras.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

The main learning objective of this course is to make the students an appreciation for:

- 1. Introduction to Sanga Tamil Literature.
- 2.'Agathinai' and'Purathinai' in SangaTamil Literature.
- 3.'Attruppadai' in SangaTamil Literature.
- 4.'Puranaanuru' in SangaTamil Literature.
- 5.'Pathitrupaththu' in SangaTamil Literature.

UNIT I	**SANGA TAMIL LITERATURE – AN INTRODUCTION**	**6**
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables.		**CO1**
UNIT II	**'AGATHINAI'AND'PURATHINAI'**	**6**
Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History of Culture from Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		**CO2**
UNIT III	**'ATTRUPPADAI'.**	**6**
AttruppadaiLiterature–Attruppadaiin'Puranaanuru'-Attruppadaiin'Pathitrupaththu'-Attruppadaiin 'Paththupaattu'.		**CO3**
UNIT IV	**'PURANAANURU'**	**6**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**
UNIT V	**'PATHITRUPATHTHU'**	**6**
Pathitrupaththuin'Ettuthogai'–Pathitrupaththu'sParables–Tamildynasty:Valor, Administration,Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.		**CO5**
		TOTAL : 30 PERIODS

REFERENCE:

1. . Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub.House, 1967.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’ in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

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B.E. INSTRUMENTATION AND CONTROL ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

Educational Objectives

Bachelor of Instrumentation and Control Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

1. Have successful technical and professional careers in their chosen fields such as Process Control, Electronics & Information Technology.
2. Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics & Instrumentation

Programme Outcomes

The graduates will have the ability to

a. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
b. Identify and formulate Instrumentation Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
c. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
d. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
e. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also being conscious of the limitations.
f. Understand the role and responsibility of the Professional Instrumentation Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
g. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for sustainable Development.
h. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
i. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
j. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
k. Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments.
l. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PEO \ PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓	✓	✓			✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	✓				✓	✓

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	THEORY												
SEM I	Communicative English									✓	✓		✓
	Engineering Mathematics - I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Problem Solving and Python programming	✓	✓	✓	✓	✓							✓
	Engineering Graphics			✓	✓								
	PRACTICAL												
	Problem Solving and Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
	THEORY												
SEM II	Technical English									✓	✓		✓
	Engineering Mathematics - II	✓	✓	✓		✓							✓
	Physics For Electronics Engineering	✓	✓	✓		✓		✓					✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Circuit Theory	✓	✓	✓	✓	✓							✓
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Electric Circuits Laboratory												
	THEORY												
SEM III	Transforms and Partial Differential Equations	✓	✓			✓							✓
	Electron Devices and Circuits	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	Electrical Measurements	✓			✓	✓							✓
	Transducers Engineering	✓	✓	✓	✓	✓							✓
	Object Oriented Programming			✓	✓	✓							✓

	PRACTICALS												
	Measurements and Transducers Laboratory					✓	✓						✓
	Object Oriented Programming Laboratory			✓	✓	✓							✓
	THEORY												
SEM IV	Numerical Methods	✓	✓	✓									✓
	Electrical Machines		✓	✓			✓			✓			✓
	Industrial Instrumentation - I			✓	✓	✓	✓	✓					
	Linear integrated Circuit and Applications	✓	✓	✓		✓							
	Control Systems	✓	✓	✓	✓								
	Communication Engineering	✓	✓	✓		✓							
	PRACTICALS												
	Devices and Machines Laboratory	✓			✓	✓						✓	✓
	Linear and Digital integrated Circuits Laboratory	✓		✓	✓						✓	✓	✓
	THEORY												
SEM V	Analytical Instruments				✓	✓	✓						
	Industrial Instrumentation - II			✓	✓	✓	✓	✓					
	Process Control	✓	✓	✓	✓	✓	✓						
	Microprocessors and Microcontrollers					✓		✓		✓			✓
	Unit Operation and Control	✓		✓		✓					✓		✓
	Open Elective I												
	PRACTICALS												
	Industrial Instrumentation Laboratory			✓	✓	✓	✓			✓	✓		
	Microprocessors and Microcontrollers Laboratory		✓	✓	✓					✓	✓		
	THEORY												
SEM VI	Advanced Control System	✓	✓		✓								
	Logic and Distributed Control System	✓		✓		✓							
	Data Structures												

	Thermal Power Plant Instrumentation			✓	✓	✓							
	Professional Elective I												
	Professional Elective II												
	PRACTICALS												
	Data Structures Laboratory			✓	✓	✓	✓				✓		✓
	Process Control Laboratory		✓	✓	✓	✓	✓			✓	✓		
	Professional Communication									✓	✓	✓	
	THEORY												
	Industrial Data Networks				✓	✓							
	Instrumentation in Petrochemical Industries			✓	✓	✓					✓		✓
	Digital Image Processing	✓		✓		✓							
	Professional Elective III												
SEM VII	Professional Elective IV												
	Open Elective II												
	PRACTICALS												
	Industrial Automation Laboratory		✓		✓	✓	✓			✓			
	Instrumentation System Design Laboratory			✓	✓	✓					✓		
	THEORY												
	Professional Elective V												
SEM VIII	Professional Elective VI												
	PRACTICALS												
	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVE

SL.NO.	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	THEORY												
	MEMS and Nano Science		✓	✓					✓	✓			
ELECTIVE – I	Power Electronics and Drives	✓	✓		✓	✓							
	System Identification	✓		✓	✓	✓		✓					

	Computer Networks				✓	✓							
	Intellectual Property Rights								✓		✓		✓
	Advanced Instrumentation Systems	✓		✓		✓							
ELECTIVE – II	Adaptive Control	✓		✓	✓	✓			✓				
	Applied Soft Computing	✓	✓			✓						✓	✓
	Fibre Optics and Laser Instrumentation			✓									
	Electromagnetic Theory	✓	✓	✓		✓							
	Disaster Management		✓		✓		✓	✓					✓
ELECTIVE – III	Human Rights												
	Operations Research	✓	✓	✓					✓	✓			✓
	Foundation Skills in Integrated Product Development												
	Computer Control of Processes	✓	✓		✓								
	Electronic Instrumentation			✓	✓	✓							
ELECTIVE – IV	Optimal Control	✓		✓		✓			✓				
	Radar and Navigational Aids	✓	✓	✓			✓	✓					
	Total Quality Management		✓			✓	✓	✓	✓	✓	✓		
	VLSI Design	✓		✓		✓							
	Embedded Systems			✓	✓	✓						✓	✓
ELECTIVE – V	Biomedical Instrumentation			✓	✓	✓	✓						✓
	Digital Signal Processing	✓	✓	✓		✓							
	Professional Ethics in Engineering	✓	✓		✓			✓				✓	✓
	Principles of Management					✓	✓			✓			
	Project Management and Finance						✓			✓			
ELECTIVE – VI	Advanced Process Control	✓	✓	✓	✓	✓	✓						
	Robotics and Automation	✓	✓	✓		✓							
	Fundamentals of Nano Science												

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CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA & SYLLABI

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics - I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics -II	BS	4	4	0	0	4
3.	PH8253	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5.	EE8251	Circuit Theory	PC	4	2	2	0	3
6.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	EE8261	Electric Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**25**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	EC8353	Electron Devices and Circuits	ES	3	3	0	0	3
3.	EE8351	Digital Logic Circuits	PC	4	2	2	0	3
4.	EI8351	Electrical Measurements	PC	4	2	2	0	3
5.	EI8352	Transducers Engineering	PC	3	3	0	0	3
6.	CS8392	Object Oriented Programming	ES	3	3	0	0	3
PRACTICALS								
7.	EI8361	Measurements and Transducers Laboratory	PC	4	0	0	4	2
8.	CS8383	Object Oriented Programming Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**17**	**4**	**8**	**23**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8491	Numerical Methods	BS	4	4	0	0	4
2.	EI8451	Electrical Machines	ES	3	3	0	0	3
3.	EI8452	Industrial Instrumentation - I	PC	3	3	0	0	3
4.	EE8451	Linear Integrated Circuits and Applications	PC	3	3	0	0	3
5.	IC8451	Control Systems	PC	5	3	2	0	4
6.	EC8395	Communication Engineering	ES	3	3	0	0	3
PRACTICALS								
7.	EI8461	Devices and Machines Laboratory	PC	4	0	0	4	2
8.	EE8461	Linear and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**19**	**2**	**8**	**24**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI8551	Analytical Instruments	PC	3	3	0	0	3
2.	EI8552	Industrial Instrumentation - II	PC	3	3	0	0	3
3.	EI8553	Process Control	PC	4	2	2	0	3
4.	EE8551	Microprocessors and Microcontrollers	PC	3	3	0	0	3
5.	EI8093	Unit Operation and Control	PC	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7.	EI8561	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
8.	EE8681	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**17**	**2**	**8**	**22**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IC8651	Advanced Control System	PC	4	2	2	0	3
2.	EI8651	Logic and Distributed Control System	PC	3	3	0	0	3
3.	CS8391	Data Structures	ES	3	3	0	0	3
4.	EI8092	Thermal Power Plant Instrumentation	PC	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7.	CS8381	Data Structures Laboratory	ES	4	0	0	4	2
8.	EI8661	Process Control Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**29**	**17**	**2**	**10**	**23**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI8751	Industrial Data Networks	PC	3	3	0	0	3
2.	EI8091	Instrumentation in Petrochemical Industries	PC	3	3	0	0	3
3.	EC8093	Digital Image Processing	PC	3	3	0	0	3
4.		Professional Elective III	PE	3	3	0	0	3
5.		Professional Elective IV	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	EI8761	Industrial Automation Laboratory	PC	4	0	0	4	2
8.	EI8762	Instrumentation System Design Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
3.	IC8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:180

*Course from the curriculum of other UG Programmes.

PROFESSIONAL ELECTIVE – I (VI SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE8072	MEMS and Nano Science	PE	3	3	0	0	3
2.	EI8077	Power Electronics and Drives	PE	3	3	0	0	3
3.	IC8072	System Identification	PE	4	2	2	0	3
4.	EI8074	Computer Networks	PE	4	2	2	0	3
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

1.	EI8071	Adaptive Control	PE	4	2	2	0	3
2.	EI8072	Advanced Instrumentation Systems	PE	3	3	0	0	3
3.	EE8071	Applied Soft Computing	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

1.	EI8075	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
2.	EE8391	Electromagnetic Theory	PE	4	2	2	0	3
3.	GE8071	Disaster Management	PE	3	3	0	0	3
4.	GE8074	Human Rights	PE	3	3	0	0	3
5.	MG8491	Operations Research	PE	3	3	0	0	3
6.	GE8072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

1.	EI8691	Computer Control of Processes	PE	3	3	0	0	3
2.	EI8692	Electronic Instrumentation	PE	3	3	0	0	3
3.	EI8076	Optimal Control	PE	4	2	2	0	3
4.	TL8071	Radar and Navigational Aids	PE	3	3	0	0	3
5.	GE8077	Total Quality Management	PE	3	3	0	0	3
6.	EC8095	VLSI Design	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

1.	EE8691	Embedded Systems	PE	3	3	0	0	3
2.	EI8073	Biomedical Instrumentation	PE	3	3	0	0	3
3.	EE8591	Digital Signal Processing	PE	4	2	2	0	3
4.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
5.	MG8591	Principles of Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

1.	EI8078	Project Management and Finance	PE	3	3	0	0	3
2.	IC8071	Advanced Process Control	PE	4	2	2	0	3
3.	EI8079	Robotics and Automation	PE	3	3	0	0	3
4.	GE8073	Fundamentals of Nanoscience	PE	3	3	0	0	3

***Professional Electives are grouped according to elective number as was done previously.**

HUMANITIES AND SOCIALSCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8253	Physics for Electronics Engineering	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
8.	MA8491	Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
4.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
6.	EC8353	Electron Devices and Circuits	ES	3	3	0	0	3
7.	CS8392	Object Oriented	ES	3	3	0	0	3

		Programming						
8.	CS8383	Object Oriented Programming Laboratory	ES	4	0	0	4	2
9.	EI8451	Electrical Machines	ES	3	3	0	0	3
10.	EC8395	Communication Engineering	ES	3	3	0	0	3
11.	CS8391	Data Structures	ES	3	3	0	0	3
12.	CS8381	Data Structures Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE8251	Circuit Theory	PC	4	2	2	0	3
2.	EE8261	Electric Circuits Laboratory	PC	4	0	0	4	2
3.	EE8351	Digital Logic Circuits	PC	4	2	2	0	3
4.	EI8351	Electrical Measurements	PC	4	2	2	0	3
5.	EI8352	Transducers Engineering	PC	3	3	0	0	3
6.	EI8361	Measurements and Transducers Laboratory	PC	4	0	0	4	2
7.	EI8452	Industrial Instrumentation - I	PC	3	3	0	0	3
8.	EE8451	Linear integrated Circuits and Applications	PC	3	3	0	0	3
9.	IC8451	Control Systems	PC	5	3	2	0	4
10.	EI8461	Devices and Machines Laboratory	PC	4	0	0	4	2
11.	EE8461	Linear and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2
12.	EI8551	Analytical Instruments	PC	3	3	0	0	3
13.	EI8552	Industrial Instrumentation - II	PC	3	3	0	0	3
14.	EI8553	Process Control	PC	4	2	2	0	3
15.	EE8551	Microprocessors and Microcontrollers	PC	3	3	0	0	3
16.	EI8093	Unit Operation and Control	PC	3	3	0	0	3
17.	EI8561	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
18.	EE8681	Microprocessors and	PC		0	0	4	2

		Microcontrollers Laboratory		4				
19.	IC8651	Advanced Control System	PC	4	2	2	0	3
20.	EI8651	Logic and Distributed Control System	PC	3	3	0	0	3
21.	EI8092	Thermal Power Plant Instrumentation	PC	3	3	0	0	3
22.	EI8661	Process Control Laboratory	PC	4	0	0	4	2
23.	EI8751	Industrial Data Networks	PC	3	3	0	0	3
24.	EI8091	Instrumentation in Petrochemical Industries	PC	3	3	0	0	3
25.	EC8093	Digital Image Processing	PC	3	3	0	0	3
26.	EI8761	Industrial Automation Laboratory	PC	4	0	0	4	2
27.	EI8762	Instrumentation System Design Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8581	Professional Communication	EEC	2	0	0	2	1
2.	IC8811	Project work	EEC	20	0	0	20	10

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	7	-	-		-	-		11
2.	BS	12	7	4	4		-	-		27
3.	ES	9	6	8	6	-	5	-		34
4.	PC	-	5	11	14	19	11	13		73
5.	PE						6	6	6	18
6.	OE					3		3	-	6
7.	EEC						1		10	11
	Total	25	25	23	24	22	23	22	16	180
	Non Credit / Mandatory	-	-	-	-	-	-	-	-	0

HS8151	COMMUNICATIVE ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- **Writing**- completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development**- Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**- telephonic conversations. **Speaking –** sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading- short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking**- asking about routine actions and expressing opinions. **Language development**- degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development –** single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines **Writing**- letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past-present continuous and past continuous- **Vocabulary development**- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING **12**

Reading- longer texts- close reading –**Writing**- brainstorming -writing short essays **–** developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks-conversations- **Speaking –** participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations-fixed and semi-fixed expressions

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergarduate Engineers and Technologists**.** Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES

1 Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.

2 Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011

3 Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013

4 Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges.** CengageLearning ,USA: 2007

5 Redston, Chris &Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005

MA8151 **ENGINEERING MATHEMATICS – I**

L	T	P	C
4	0	0	4

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS **12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES **12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151	**ENGINEERING PHYSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS 9

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein’s A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe’s and Lee’s disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY8151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich’s adsorption isotherm – Langmuir’s adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.
Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel.
Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor -

solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

GE8152 ENGINEERING GRAPHICS

L T P C
2 0 4 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE8161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

BS8161	**PHYSICS AND CHEMISTRY LABORATORY** **(Common to all branches of B.E. / B.Tech Programmes)**	**L T P C** **0 0 4 2**

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS8251 **TECHNICAL ENGLISH**

	L	T	P	C
	4	0	0	4

OBJECTIVES: The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newsapapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting cgarts, graphs- **Vocabulary Development-**vocabularyused in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talkls on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- **Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey- **Vocabulary Development- verbal analogies Language Development-** reported speech.

TOTAL : 60 PERIODS

OUTCOMES: At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016.
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication**. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana**, Project Work,** Oxford University Press**,** Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English**. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

MA8251	ENGINEERING MATHEMATICS – II	L T P C 4 0 0 4

OBJECTIVES :

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.

5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH8253	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
	(Common to BME, ME, CC, ECE, EEE, E&I, ICE)	3	0	0	3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and nano devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch thorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein’s relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes – excitons - quantum confined Stark effect – quantum dot laser.

UNIT V NANOELECTRONIC DEVICES 9

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures –Zener-Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport – Coulomb blockade effects - Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the students will able to

- gain knowledge on classical and quantum electron theories, and energy band structuues,
- acquire knowledge on basics of semiconductor physics and its applications in various devices,
- get knowledge on magnetic and dielectric properties of materials,
- have the necessary understanding on the functioning of optical materials for optoelectronics,
- understand the basics of quantum structures and their applications in spintronics and carbon electronics..

TEXT BOOKS:

1. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES

1. Garcia, N. & Damask, A. “Physics for Computer Science Students”. Springer-Verlag, 2012.
2. Hanson, G.W. “Fundamentals of Nanoelectronics”. Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”. CRC Press, 2014

BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING **L T P C**
4 0 0 4

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 15

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

OUTCOMES:

On successful completion of this course, the student will be able to

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Shanmugam Gand Palanichamy MS,"Basic Civil and Mechanical Engineering",Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCES:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,"Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,"BasicCivil Engineering",AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,"Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,2000.

EE8251 CIRCUIT THEORY

	L	T	P	C
	2	2	0	3

OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 6+6

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC IRCUITS 6+6

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS 6+6

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV THREE PHASE CIRCUITS 6+6

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V RESONANCE AND COUPLED CIRCUITS 6+6

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse transients

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCES

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.

3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth‟s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization-environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Benny Joseph, ‘Environmental Science and Engineering’, Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, ‘Environmental law’, Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, “Textbook of Environmental Studies”, Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, “Environmental Science”, Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press, 2005.

GE8261 ENGINEERING PRACTICES LABORATORY

L T P C	
0 0 4 2	

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

EE8261	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems.

LIST OF EXPERIMENTS

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Superposition theorem.

5. Simulation and experimental verification of Maximum Power transfer Theorem.

6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transience.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

TOTAL: 60 PERIODS

OUTCOMES:

- Understand and apply circuit theorems and concepts in engineering applications.
- Simulate electric circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1 Regulated Power Supply: 0 – 15 V D.C - 10 Nos / Distributed Power Source.
2 Function Generator (1 MHz) - 10 Nos.
3 Single Phase Energy Meter - 1 No.
4 Oscilloscope (20 MHz) - 10 Nos.
5 Digital Storage Oscilloscope (20 MHz) – 1 No.
6 10 Nos of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / Matlab /other Equivalent software Package) and Printer (1 No.)
7 AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.) 8 Single Phase Wattmeter – 3 Nos.
9 Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box Each - 6 Nos.
10 Circuit Connection Boards - 10 Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

OBJECTIVES :

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

6. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

EC8353 ELECTRON DEVICES AND CIRCUITS L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diodecharacteristics- Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain the structure and working operation of basic electronic devices.
- Able to identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS:
1. . David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press

REFERENCES:
1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

EE8351	DIGITAL LOGIC CIRCUITS	L	T	P	C
		2	2	0	3

OBJECTIVES:
- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 6+6

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 6+6

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 6+6

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 6+6

Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL 6+6

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to design combinational and sequential Circuits.
- Ability to simulate using software package.
- Ability to study various number systems and simplify the logical expressions using Boolean functions
- Ability to design various synchronous and asynchronous circuits.
- Ability to introduce asynchronous sequential circuits and PLDs
- Ability to introduce digital simulation for development of application oriented logic circuits.

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCES

1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

EI8351 ELECTRICAL MEASUREMENTS L T P C
2 2 0 3

OBJECTIVES:

- To introduce the meters used to measure current & voltage.
- To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included.
- To provide Elaborate discussion about potentiometer & instrument transformers.
- To provide Detailed study of resistance measuring methods.
- To provide Detailed study of inductance and capacitance measurement.

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT 6+6

Galvanometers: – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

UNIT II MEASUREMENT OF POWER AND ENERGY 6+6

Electrodynamometer type wattmeter: – Theory & its errors – Methods of correction – LPF wattmeter– Phantom loading – Induction type kWh meter – Induction type energy meter – Calibration of wattmeter and Energy meter.

UNIT III POTENTIOMETERS & INSTRUMENT TRANSFORMERS 6+6

DC potentiometer:– Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer:-Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Instrument Transformer:-C.T and P.T construction, theory, operation and characteristics.

UNIT IV RESISTANCE MEASUREMENT 6+6

Measurement of low, medium & high resistance: – Ammeter, voltmeter method – Wheatstone bridge– Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement :-Loss of charge method, Megohm bridge method –Megger – Direct deflection methods – Price's guard-wiremethod – Earth resistance measurement.

UNIT V IMPEDANCE MEASUREMENT 6+6

A.C bridges:– Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge– Schering bridge – Anderson bridge –Hay's bridge- Campbell bridge to measure mutual inductance – Errors in A.C. bridge methods and their compensation – Detectors – Excited field – A.C. galvanometer– Vibration galvanometer.

TOTAL:60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

1. Ability to measure current and voltage,
2. Ability to understand AC and DC measurements.
3. Ability to measure power and calibration of energy meters.
4. Ability to measure current and voltage using potentiometric method.
5. Ability to understand the resistance measurement
6. Ability to use bridge circuit to measure resistance, inductance and capacitance.

TEXT BOOKS

1. E.W. Golding &F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001
2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010

REFERENCES

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2010.
2. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
3. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation',S.K.Kataria& Sons, Delhi, 2003.
4. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
5. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
6. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", Prentice Hall India, NewDelhi, 2009.
7. J.J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

EI8352 TRANSDUCERS ENGINEERING

L T P C
3 0 0 3

COURSE OBJECTIVES

- Get to know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451).

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the ability:

1. Ability to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.

2. Ability to analyze the problems related to sensors & transducers.
3. Ability to select the right sensor/transducer for a given application.
4. Ability to determine the static and dynamic characteristics of transducers using software packages.
5. Ability to understand fiber optic sensor and applications.
6. Ability to understand smart traducer and its standard.

TEXT BOOKS

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003

REFERENCES

1. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
3. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
4. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
5. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.

CS8392 OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.

UNIT II INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, ArrayLists - Strings

UNIT III EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

TEXT BOOKS

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.
3. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

EI8361	MEASUREMENTS AND TRANSDUCERS LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students to analyze step response of RTD
- To the student to measure resistance using bridge circuits
- To make the students to calibrate the electrical instruments

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4. Characteristics of LDR, thermistor and thermocouple (J, K, E types).
5. Step response characteristic of RTD and thermocouple.
6. Temperature measurements using RTD with three and four leads.
7. Wheatstone and Kelvin's bridge for measurement of resistance.
8. Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
9. Measurement of Angular displacement using resistive and Capacitive transducer.
10. Calibration of Single-phase Energy meter and wattmeter.
11. Calibration of Ammeter and Voltmeter using Shunt type potentiometer.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Understand the concepts of measurement, error and uncertainty.
2. Understand the static and dynamic characteristics of measuring instruments.
3. Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
4. Acquire knowledge of analyzing different stages of signal conditioning units.
5. Ability to interpret the results and draw meaningful conclusions.
6. Ability to work as a member of a team while carrying out experiments.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Experimental setup for
Measurement of Linear displacement using Potentiometer
Strain gauge and Load cell characterisation and application
LVDT characterisation and application
Hall Effect characterisation and application
Measurement of Angular displacement
Muffle furnace
Thermistor characterisation and application
Various types of Thermocouple and RTD characterisation and application
Measurement of power and energy
Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.

CS8383 OBJECT ORIENTED PROGRAMMING LABORATORY **LT P C 0 0 4 2**

COURSE OBJECTIVES

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

List of experiments

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection(i.e domestic or commercial). Compute the bill amount using the following tariff.
   If the type of the EB connection is domestic, calculate the amount to be paid as follows:
   - First 100 units - Rs. 1 per unit
   - 101-200 units - Rs. 2.50 per unit
   - 201 -500 units - Rs. 4 per unit
   - > 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:
   - First 100 units - Rs. 2 per unit
   - 101-200 units - Rs. 4.50 per unit
   - 201 -500 units - Rs. 6 per unit
   - > 501 units - Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following

   a. Append - add at end
   b. Insert – add at particular index
   c. Search
   d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.

9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.

    a) Decimal manipulations
    b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

TOTAL : 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java programs with arraylist, exception handling and multithreading .
- Design applications using file processing, generic programming and event handling.

MA8491	NUMERICAL METHODS	L	T	P	C
		4	0	0	4

OBJECTIVES :

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

EI8451 **ELECTRICAL MACHINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the principles of operations of DC machines as motor and generator
- To introduce the principles of operations of Transformers
- To introduce the principles of operations of Induction machines
- To introduce the principles of operations of Synchronous machines
- To introduce other special machines

UNIT I D.C. MACHINES 9

D.C. Machines: – Principle of operation and construction of motor and generator – torque equation – Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control of D.C. Motor.

UNIT II TRANSFORMERS 9

Principle, Construction and Types of Transformer - EMF equation - Phasor diagrams - Regulation and efficiency of a transformer-Introduction to three phase transformer Connection. Applications of Current and Potential Transformer.

UNIT III SYNCHRONOUS MACHINES 9

Principle of Operation, type - EMF Equation and Phasor diagrams - Synchronous motor- Rotating Magnetic field Starting Methods , Torque V- Curves, inverted – V curves.

UNIT IV THREE PHASE INDUCTION MOTORS 9

Induction motor-principle of operation, Types - Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Types of single phase induction motors –Double field revolving theory- Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor - Switched reluctance motor – Brushless D.C motor.-Stepper motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

1. Ability to acquire knowledge to solve problems associated with DC and AC Machines.
2. Ability to test and control different machines based on the familiarity of basic concepts and working principle.
3. Ability to choose appropriate machines for a given application while carrying out projects.
4. Ability to apply the knowledge gained to choose appropriate machines for specific application useful for the society.
5. Ability to know about the latest developments related to machines and to learn their concepts even after the completion of the course.
6. Ability to acquire knowledge of stepper motor.

TEXT BOOKS

1. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., "Electric Machinery", McGraw-Hill, 2002.
2. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand and Co., New Delhi, 2007.

REFERENCES

1. Abhijit Chakrabarti and Sudipta Debnath, "Electrical Machines", McGraw- Hill Education, 2015.
2. Deshpande M. V., "Electrical Machines" PHI Learning Pvt. Ltd., New Delhi, 2011
3. B.S.Guru and H.R.Hiziroglu, "Electric Machinery and Transformer', Oxford university Press 2007
4. Del Toro, V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 1995.
5. Nagrath I. J and Kothari D. P. 'Electric Machines', Fourth Edition, McGraw Hill Education, 2010.
6. C.A.Gross, "Electric Machines", CRC Press 2010.
7. NPTEL Video Lecture series on "Electrical Machines I" and "Electrical Machines II" by Dr. Krishna Vasudevan, IIT Madras.

EI8452	**INDUSTRIAL INSTRUMENTATION - I**	**LT P C**
		3 0 0 3

COURSE OBJECTIVES

- To introduce the measurement techniques of force, torque and speed.
- To introduce the measurement techniques of acceleration, Vibration and density
- To introduce the measurement Viscosity, Humidity and moisture.
- To introduce the temperature measurement techniques
- To introduce the pressure measurement techniques

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED 8

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 8

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

8

UNIT III MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

UNIT IV TEMPERATURE MEASUREMENT 12

Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple – Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two color radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration.

UNIT V PRESSURE MEASUREMENT 9

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Iionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will have the:

1. Ability to understand the construction and working of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature.
2. Ability to select instruments according to the application.
3. Ability to understand the concept of calibration of instruments and gain knowledge about temperature measurement devices.
4. Ability to design signal conditioning circuits and compensation schemes for temperature measuring instruments.
5. Ability to understand the working of instruments used for measurement of pressure.
6. Ability to measure fiber optic sensor to measure temperature.

TEXT BOOKS

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw-Hill Education Pvt. Ltd, 2011.
2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017.
3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990.
4. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.

5. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.
6. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.
7. A.K. Sawhney, “A Course in Electronic Measurements and Instrumentation ”, Dhanpat Rai & Co. (P) Limited, 2015.

EE8451	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following topics

- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters.

UNIT III APPLICATIONS OF OPAMP 9

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using opamps.

UNIT IV SPECIAL ICs 9

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V APPLICATION ICs 9

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variable voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to acquire knowledge in IC fabrication procedure
- Ability to analyze the characteristics of Op-Amp
- To understand the importance of Signal analysis using Op-amp based circuits.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- To understand and acquire knowledge on the Applications of Op-amp
- Ability to understand and analyse, linear integrated circuits their Fabrication and Application.

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2000.

REFERENCES

1. Fiore,"Opamps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', Mc Graw Hill, 2016.
6. Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2011.

IC8451	**CONTROL SYSTEMS**	**LT P C**
		3 2 0 4

COURSE OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems

UNIT I SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag-lead compensator using bode plots.

UNIT V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL (L: 45+T:30): 75 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the :

- Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Ability to do time domain and frequency domain analysis of various models of linear system.
- Ability to interpret characteristics of the system to develop mathematical model.
- Ability to design appropriate compensator for the given specifications.
- Ability to come out with solution for complex control problem.
- Ability to understand use of PID controller in closed loop system.

TEXT BOOKS

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

REFERENCES

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. Rames C.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

EC8395 COMMUNICATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

UNITII PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007
2. S. Haykin “Digital Communications” John Wiley 2005

REFERENCES:

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications” 2/e Pearson Education 2007.

EI8461 DEVICES AND MACHINES LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES

1. To facilitate the students to study the characteristics of various semiconductor devices.
2. To provide practical knowledge on the analysis of regulators, amplifiers and oscillators.
3. To obtain the no load and load characteristics of D.C machines.
4. To obtain the speed characteristics of D.C motor.
5. To find out regulation characteristics of Transformer.

LIST OF EXPERIMENTS FOR DEVICES LAB

1. Simulation and experimental Characterisation of Semiconductor diode and Zener diode.
2. Simulation and experimental Characterisation of a NPN Transistor under common emitter configurations.
3. Simulation and experimental Characterisation of FET and JFET(Draw the equivalent circuit)
4. Simulation and experimental Characterisation of UJT and generation of saw tooth waveforms
5. Simulation and experimental Characterisation of RC and LC phase shift oscillators.
6. Simulation and experimental Characterisation of Monostable and Astable multivibrators.
7. Simulation of passive filters.
8. Simulation of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Characteristics of SCR and application as a controlled rectifier.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

LIST OF EXPERIMENTS FOR MACHINES LAB

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Speed control of D.C. shunt motor.
5. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
6. Load test on single phase induction motor.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1 Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.
2 Get hands-on experience in studying the characteristics of semiconductor devices.
3 Ability to analyze various electronic circuits such as voltage regulators, transistor amplifiers and oscillators.
4 Ability to make use of basic concepts to obtain the no load and load characteristics of D.C machines.
5 Analyze and draw conclusion from the characteristics obtained by conducting experiments on machines.
6 Ability to carry out the Experiments in batches to motivate the Team work.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
FOR DEVICES LAB:

S.No	Name of the Equipment / Components
1.	Circuit Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC.
2.	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.
3.	Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, and UJT.

FOR MACHINES LAB:

S.No	Name of the Equipment / Components	Quantity Required
1.	DC Shunt Motor with Loading Arrangement	3
2.	Single Phase Transformer	3
3.	Single Phase Induction Motor with Loading Arrangement	1
4.	Single Phase Auto Transformer	3
5.	Single Phase Resistive Loading Bank	2
6.	Sufficient number of Ammeters, Voltmeters, (or multimeters), switches, tachometers, Wattmeters.	2

EE8461	LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L	T	P	C
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OBJECTIVES:

- To learn design, testing and characterizing of circuit behavior with digital and analog ICs.

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking

4. Encoders and Decoders
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/ SE 566 IC.
11. Variability Voltage Regulator using IC LM317.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should have the :

- Ability to understand and implement Boolean Functions.
- Ability to understand the importance of code conversion
- Ability to Design and implement 4-bit shift registers
- Ability to acquire knowledge on Application of Op-Amp
- Ability to Design and implement counters using specific counter IC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 per Batch)

S.No	Name of the equipments / Components	Quantity Required	Remarks
1	Dual ,(0-30V) variability Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1 MHz
5	IC Tester (Analog)	2	
6	Bread board	10	
7	Computer (PSPICE installed)	1	
	Consumabilitys (sufficient quantity)		
1	IC 741/ IC NE555/566/565		
2	Digital IC types		
3	LED		
4	LM317		
5	LM723		
6	ICSG3524 / SG3525		
7	Transistor – 2N3391		

8	Diodes, IN4001,BY126
9	Zener diodes
10	Potentiometer
11	Step-down transformer 230V/12-0-12V
12	Capacitor
13	Resistors 1/4 Watt Assorted
14	Single Strand Wire

EI8551 ANALYTICAL INSTRUMENTS LT P C
3 0 0 3

COURSE OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY 9

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

UNIT II CHROMATOGRAPHY 9

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.
Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV pH METERS AND DISSOLVED COMPONENT ANALYZERS 9

Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
2. Ability to assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
3. Ability to critically evaluate the strengths and limitations of the various instrumental methods.
4. Ability to develop critical thinking for interpreting analytical data.
5. Ability to understand the working principle, types and applications of NMR and Mass spectroscopy

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCES:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd.,2nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.
4. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

EI8552 INDUSTRIAL INSTRUMENTATION - II **LT P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce variable head type flow meters
- To introduce quantity meters, air flow meters and mass flow meters
- To educate on electrical type flow meters
- To educate on the level measurement techniques
- To educate on Viscosity, Humidity and Moisture content

UNIT I VARIABLE HEAD TYPE FLOWMETERS 9

Expression for flow rate through restriction(compressible and incompressible flow) -Orifice plate**:** different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube**:** combined pitot tube, averaging pitot tube – Installation and applications of head flow meters

UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 9

Positive displacement flow meters**:**

Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter – Turbine flow meter – Variable Area flow meter: Rotameter –theory, characteristics, installation and applications – Mass flow meter :– Angular momentum – Thermal, Coriolis type mass flow meters – Calibration of flow meters: – Dynamic weighing method

UNIT III ELECTRICAL TYPE FLOW METERS 9

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement

UNIT IV LEVEL MEASUREMENT 9

Level measurement**:** Float gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement.

UNIT V TRANSMITTERS 9

Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course, the student will have the:

1. Ability to understand the construction, installation and working of different variable head type flow meters.
2. Able to understand the construction, working and calibration of different quantity flow meters, variable area flow meters, mass flow meters, electrical type, open channel and solid flow meters.
3. Ability to gain knowledge about the construction, working and calibration of different type of transmitters.
4. Ability to choose appropriate flow meters or level sensor for an application.

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., "Measurement systems Application and Design", 5th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2007.

2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

REFERENCES:

1. Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.

2. Singh,S.K., Industrial Instrumentation and Control, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.

3. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

4. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.

EI8553 PROCESS CONTROL LT P C
2 2 0 3

COURSE OBJECTIVES

- To introduce technical terms and nomenclature associated with Process control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I PROCESS MODELLING AND DYNAMICS 6+6

Need for process control – Mathematical Modeling of Processes**:** Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT II FINAL CONTROL ELEMENTS 6+6

Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection

UNIT III CONTROL ACTIONS 6+6

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.

UNIT IV PID CONTROLLER TUNING 6+6

PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control

UNIT V MODEL BASED CONTROL SCHEMES 6+6

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three-element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger - P&ID diagram.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand technical terms and nomenclature associated with Process control domain.
- Ability to build models using first principles approach as well as analyze models.
- Ability to Design, tune and implement PID Controllers to achieve desired
- performance for various processes
- Ability to Analyze Systems and design & implement control Schemes for various Processes.
- Ability to Identify, formulate and solve problems in the Process Control Domain.

TEXT BOOKS:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.

2. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.

3. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCES:

1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Edition,2004.

2. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2006.

3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.

4. Bela.G.Liptak., “Process Control and Optimization”., Instrument Engineers’ Handbook., volume 2, CRC press and ISA, 2005.

5. Ramesh C. Panda., T.Thyagarajan., “An Introduction to Process Modelling Identification and Control for Engineers” Narosa Publishing house Pvt. Ltd, 2017.

EE8551	MICROPROCESSOR AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Architecture of µP8085 & µC 8051
- Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Simple applications development with programming 8085 & 8051

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises- key board and display interface –Control of servo motor- stepper motor control- Application to automation systems.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- Ability to need & use of Interrupt structure 8085 & 8051.
- Ability to understand the importance of Interfacing
- Ability to explain the architecture of Microprocessor and Microcontroller.
- Ability to write the assembly language programme.
- Ability to develop the Microprocessor and Microcontroller based applications.

TEXT BOOKS:

1. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.

2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.

3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCES

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu,2016.

EI8093 UNIT OPERATION AND CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

- Study the unit operations involved for transportation, mixing and separation of solids.
- Study the unit operations involved for transportation, mixing and separation of fluids.
- Understand the basic operations involved with heat exchangers, Distillation and chemical reactions.
- Gain knowledge about the operations of evaporators and crystallizers, drying and cooling towers.
- Gain knowledge on the operation of dryers, distillation column, refrigerators and chemical reactors.

UNIT I MECHANICAL OPERATIONS- I 9

OPERATIONS ON SOLIDS: General Characteristics of solids; Storage and conveying of solids:bunkers, silos, bins and hoppers, transport of solids in bulk, conveyor selection, different types of conveyors; Estimation of particle size;Screening methods and equipment; Adjusting particle size:methods of size reduction, classification of equipment, crushers, grinders; size enlargement; Principle of granulation, briquetting, pelletisation and flocculation; Mixing: mixing of powders; Separation: Electrostatic and magnetic separators, applications.

UNIT II MECHANICAL OPERATIONS-II 9

OPERATIONS ON FLUIDS: Transport of fluids; Mixing and agitation: Mixing of liquids, selection of suitable mixers; Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation; Cyclones - Operation, equipment, control and applications.

UNIT III HEAT TRANSFER- I AND ITS APPLICATIONS 9

Heat exchangers: Single pass and multi pass heat exchangers, condensers, reboilers Combustion process in thermal power plant; Distillation: Binary distillation, Batch distillation, controls and operations, Chemical reactors.

UNIT IV HEAT TRANSFER- II 9

Theory of evaporation; single effect and multiple effect evaporators; Crystallization; nucleation and growth, classification of crystallizers; Drying: classification of Dryers, batch and continuous dryers, dryers for solids and slurries and cooling Towers, Refrigeration.

UNIT V CASE STUDY 9

Unit Operations and Control schemes applied to Thermal Power plant, Steel Industry, Paper and Pulp Industry, Leather Industry.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Apply the knowledge on solids & fluids to handle the raw materials.
2. Select and apply relevant handling techniques to convert the solids and fluids for specificapplications.
3. Come out with solutions for simple/complex problems in heat transfer and design the heatexchange
   equipment for different applications such as distillation, boilers.
4. Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
5. Gain ability for lifelong learning of new techniques and developments in various types of unit operations in industries.

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., “ Process Control structures and applications”, Van Nostrand Reinhold Co., New York, 1988.
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, “Unit Operations of Chemical Engineering”, McGraw-Hill International Edition, New York, Sixth Edition, 2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, “Chemical Process Equipment :Selection and Design”, Gulf Professional Publishing, 2010.

REFERENCES:

1. Waddams, A.L., “Chemicals from petroleum”, Butler and Taner Ltd., UK, 1968.
2. Liptak, B.G., “Process measurement and analysis”, Chilton Book Company, USA, 1995.
3. Luyben W.C., “Process Modeling, Simulation and Control for Chemical Engineers”, McGraw-Hill International edition, USA, 1989.

EI8561 INDUSTRIAL INSTRUMENTATION LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To impart an adequate knowledge and expertise to handle equipment generally available in an industry
2. To make the students aware about calibration of meters, sensors and transmitters.
3. To make the students conscious about the working and operation of different types of analytical Instruments.
4. To identify, formulate, and analyze problems regarding sensors and transmitter

LIST OF EXPERIMENTS

1. Measurement of speed, torque and vibration
2. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator
3. Calibration of pressure gauge using dead weight tester.
4. Measurement of level using d/p transmitter and fibre optics system.
5. Measurement of flow using
   a) Discharge coefficient of orifice plate

b) Calibration of Rotameter.
6. Design and Testing of Electromagnetic Flow meters.
7. Measurement of temperature using IR thermometer and IC sensor
8. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
9. Measurement of Conductivity, Moisture and Viscosity of test solutions.
10. Standardization and measurement of pH values of different solutions
11. Measurement and analysis of ECG and pulse rate.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)
1. Ability to experimentally measure industrial process parameters such as flow, level, temperature, pressure and viscosity.
2. Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
3. Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Orifice plate	1
2.	Dead weight tester with pressure gauge	1
3.	Torque trainer	1
4.	Saybolt Viscometer	1
5.	Vacuum gauge	1
6.	DP transmitter	1
7.	UV – Visible spectrophotometer	1
9.	pH meter	1
10.	Conductivity meter	1
11.	ECG trainer	1
12.	Pulse rate trainer	1
13.	tacho meter	

EE8681	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:
- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS
1 Simple arithmetic operations: addition / subtraction / multiplication / division.
2 Programming with control instructions:
 (i) Ascending / Descending order, Maximum / Minimum of numbers.
 (ii) Programs using Rotate instructions.
 (iii) Hex / ASCII / BCD code conversions.

3 Interface Experiments: with 8085
(i) A/D Interfacing. & D/A Interfacing.
4 Traffic light controller.
5 I/O Port / Serial communication
6 Programming Practices with Simulators/Emulators/open source
7 Read a key ,interface display
8 Demonstration of basic instructions with 8051 Micro controller execution, including:
(i) Conditional jumps & looping
(ii) Calling subroutines.
9 Programming I/O Port and timer of 8051
(i) study on interface with A/D & D/A
(ii) Study on interface with DC & AC motors
10 Application hardware development using embedded processors.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to understand and apply computing platform and software for engineering problems.
- Ability to programming logics for code conversion.
- Ability to acquire knowledge on A/D and D/A.
- Ability to understand basics of serial communication.
- Ability to understand and impart knowledge in DC and AC motor interfacing.
- Ability to understand basics of software simulators.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface boards	5
4.	8251 Interface boards	5
5.	8259 Interface boards	5
6.	8279 Keyboard / Display Interface boards	5
7.	8254 timer/ counters	5
8.	ADC and DAC cards	5
9.	AC & DC motor with Controller s	5
10.	Traffic Light Control Systems	5

IC8651 ADVANCED CONTROL SYSTEM LT P C
2 2 0 3

OBJECTIVES:

i. To provide knowledge on design state feedback control and state observer.
ii. To provide knowledge in phase plane analysis.
iii. To give basic knowledge in describing function analysis.
iv. To study the design of optimal controller.
v. To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE ANALYSIS 6+6
Introduction- concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation- solution of state equations- Concepts of controllability and observability.

UNIT II STATE VARIABLE DESIGN 6+6
Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design Design of state observers- Separation principle- Design of servo systems: State feedback with integral control.

UNIT III SAMPLED DATA ANALYSIS 6+6
Introduction spectrum analysis of sampling process signal reconstruction difference equations The Z transform function, the inverse Z transform function, response of Linear discrete system, the Z transform analysis of sampled data control systems, response between sampling instants, the Z and S domain relationship. Stability analysis and compensation techniques.

UNIT IV NON LINEAR SYSTEMS 6+6
Introduction, common physical nonlinearites, The phase plane method: concepts, singular points, stability of non linear systems, construction of phase trajectories system analysis by phase plane method. The describing function method, stability analysis by describing function method, Jump resonance.

UNIT V OPTIMAL CONTROL 6+6
Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

TOTAL: 60 PERIODS

OUTCOMES:

i. Able to design state feedback controller and state observer.
ii. Able to understand and analyse linear and nonlinear systems using phase plane method.
iii. Able to understand and analyse nonlinear systems using describing function method.
iv. Able to understand and design optimal controller.
v. Able to understand optimal estimator including Kalman Filter.
vi. Ability to apply advanced control strategies to practical engineering problems.

TEXT BOOKS:

1. M.Gopal, “Digital Control and State Variable Methods”, 4^{th} edition, Mc Graw Hill India, 2012
2. K. Ogata, ‘Modern Control Engineering’, 5th Edition, Pearson, 2012.
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

REFERENCES:

1. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

EI8651 LOGIC AND DISTRIBUTED CONTROL SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries.
- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs.
SCADA: Remote terminal units- Master station - Communication architectures.

UNIT II BASICS OF PLC PROGRAMMING(LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.

UNIT III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.

UNIT V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand all the important components such as PLC, SCADA, DCS,I/O modules and field devices of an industrial automation system.
- Ability to develop PLC program in different languages for industrial sequential

applications.

- Able to select and use most appropriate automation technologies for a given application.
- Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:

1. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5th Edition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

CS8391	**DATA STRUCTURES**	**LT P C**
		3 0 0 3

OBJECTIVES:

- To understand the concepts of ADTs
- To Learn linear data structures – lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

UNIT I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Implement abstract data types for linear data structures.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,1997.
2. Reema Thareja, "Data Structures Using C", Second Edition , Oxford University Press, 2011

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983.
3. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

EI8092 THERMAL POWER PLANT INSTRUMENTATION **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make the students familiarize about various power generation methods.
- To identify various parameters in thermal power plant
- To impart knowledge about the different types of controls and control loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT I POWER GENERATION METHODS 9

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration.

UNIT II MEASUREMENTS IN POWER PLANTS 9

Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.

UNIT III FURNACE CONTROL 9

Coal handling: Pulverizers - Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.

UNIT IV BOILER CONTROL 9

Boiler metal temperature measurement, pressure measuring devices – Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE CONTROL 9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL : 45 PERIODS

COURSE OUTCOME:

1. Understanding various power generation process.
2. Identify important parameter to be monitored and controlled in thermal power plant.
3. Knowledge about various building blocks and instruments involved in thermal power plant and its controlling process.

TEXT BOOKS

1. Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES

1. Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013
2. Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
3. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008

CS8381 DATA STRUCTURES LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms

1. Array implementation of Stack and Queue ADTs
2. Array implementation of List ADT
3. Linked list implementation of List, Stack and Queue ADTs
4. Applications of List, Stack and Queue ADTs
5. Implementation of Binary Trees and operations of Binary Trees
6. Implementation of Binary Search Trees

7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms
10. Applications of Graphs
11. Implementation of searching and sorting algorithms
12. Hashing – any two collision techniques

TOTAL : 60 PERIODS

OUTCOMES

At the end of the course, the students will be able to:

- Write functions to implement linear and non-linear data structure operations
- Suggest appropriate linear / non-linear data structure operations for solving a given problem
- Appropriately use the linear / non-linear data structure operations for a given problem
- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

EI8661 PROCESS CONTROL LABORATORY L T P C
0 0 4 2

OBJECTIVES:

1. To experimentally verify the process control concepts on the selected process control loops.
2. To impart theoretical and practical skills in process identification and PID controller tuning
3. To make the students aware of basic and advanced control schemes

LIST OF EXPERIMENTS:

Simulation Based Experiments

1. Simulation of lumped /distributed parameter system
2. Mathematical model of a typical industrial process using nonparametric identification methods
3. Tuning of PID Controller for mathematically described processes
4. PID Enhancements (Cascade and Feed-forward Control Schemes)
5. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
6. Study of AC and DC drives.

Hardware based experiments

1. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
2. Study and control of flow process using Compact Flow Control Unit.
3. Control of Level and Pressure using Process Control Training Plant.
4. Design and implementation of ON/OFF Controller for the Temperature Process.
5. Design and implementation of Interacting and non-interacting system
6. Design and implementation of adaptive or model predictive control schemes

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

OUTCOMES:

1. Ability to understand and analyze process control engineering problems.
2. Be able to build dynamic models using input – output data of a process
3. Ability to working with real time control loops(flow/level/temperature/pressure)
4. Get exposed to simulation tools such as MATLAB/LABVIEW/ASPEN
5. Ability to learn and implement simple adaptive and model based control schemes

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Flow process station with all accessories
2. Analog / Digital PID controller
3. Control valve setup (with position for varying ΔP across the valve)
4. Flow meter
5. Level process station with all accessories
6. Temperature process station with all accessories
7. Pressure process station with all accessories
7. Personal computer-15 nos
8. MATLAB software
9. Two tank system with following accessories.

HS8581	**PROFESSIONAL COMMUNICATION**	**L T P C**
		0 0 2 1

OBJECTIVES: The course aims to:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice–– presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes.

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software

1. Open Source Software
2. Win English

REFERENCES:

1. Butterfield, Jeff **Soft Skills for Everyone.** Cengage Learning: New Delhi, 2015
2. **Interact** English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. **Communication for Professional Success.** Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. **Professional Communication**. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. **Soft Skills**. MJP Publishers: Chennai, 2010.

EI8751 INDUSTRIAL DATA NETWORKS **LT P C 3 0 0 3**

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

UNIT I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

UNIT II INTERNET WORKING and RS 232, RS485 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet

UNIT III HART AND FIELD BUS 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

UNIT IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway

UNIT V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL : 45 PERIODS

OUTCOMES: Students will have the

- Ability to define basic concepts of data communication and its importance.
- Ability to explain the various internetworking devices involved in industrial networks
- Ability to explain the various serial communication used in process industries.
- Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.
- Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.
- Ability to explain and adopt the different Industrial Ethernet protocol and usage of wireless communication in process applications.

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. BehrouzForouzan ,Data Communications & Networking ,3RD edition, Tata McGraw hill,2006.

REFERENCES

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

TOTAL :45. PERIODS

EI8091 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To introduce the students the method of oil recovery and the steps involved in oil gas production process.
- To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model.
- To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
- To provide information about the most important derivatives obtained from petroleum products.
- To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT I OIL EXTRACTION AND OIL GAS PRODUCTION 9
Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT II IMPORTANT UNIT OPERATIONS IN REFINERY 9
Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.

UNIT III DERIVATIVES FROM PETROLEUM 9
Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene ––Derivatives from ethylene – Derivatives from propylene.

UNIT IV IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9
BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT V SAFETY IN INSTRUMENTATION SYSTEMS 9
Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Gain knowledge on oil gas production process and important unit operations in a refinery
2. Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes.
3. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.
4. Gain knowledge on the most important chemical derivatives obtained from petroleum products. 5. Understand safety instrumentation followed in process industries.

TEXT BOOKS:

1. Waddams, A.L., “Chemicals from Petroleum”, Wiley, 1973. (digitized in 2007).
2. Balchen, J.G., and Mumme K.I., “Process Control Structures and Applications”, Von Nostrand Reinhold Company, New York, 1988.

REFERENCES:

1. Liptak, B.G., “Instrumentation in Process Industries”, Chilton Book Company, 2005. (Digitized in 2008.)
2. Austin, G.T. and Shreeves, A.G.T., “Chemical Process industries”, McGraw-Hill, 2012.
3. HavardDevold, “Oil and Gas Production Handbook”, ABB, 2006.
4. Paul Gruhn and Harry Cheddie, “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA Press, 2006.

EC8093 DIGITAL IMAGE PROCESSING LT P C
3 0 0 3

OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION **9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION **9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

OUTCOMES:

At the end of the course, the students should be able to:

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

EI8761 **INDUSTRIAL AUTOMATION LABORATORY** **LT P C**
0 0 4 2

OBJECTIVES:

To impart practical skills in

1. Programming of PLC and DCS.
2. Sensor data acquisition, data processing and visualization
3. Interfacing the various field devices with PLC

LIST OF EXPERIMENTS:

1. Study of PLC field device interface modules (AI,AO,DI,DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations in PLC
4. Programming Jump-to-subroutine & return operations in PLC
5. PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
6. PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7. PC based control of Level Process
8. On-line Monitoring and Control of a Pilot plant using DCS
9. PLC based Control of Flow Process
10. Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

TOTAL: 60 PERIODS

OUTCOMES:

1. Ability to understand and Programming of PLC, SCADA and DCS

2. Ability to working with industrial automation system

3. Be able to design and implement control schemes in PLC & DCS

4. Ability to interface field devices with PLC & DCS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Programmable Logic controller 5 Nos.
2. Programmable Logic controller Software 10 User License
3. DAQ card 2 Nos.
4. Filling /Draining System 1 No.
5. Traffic Light Controller 2 Nos
6. DC Motor 5 Nos
7. Personal computer- 10 Nos
8. DCS along with Interface modules 1 set
9. Thermal Process, Level Process & Flow Process stations – 1 set each
10. Smart Transmitter - 1 No.

EI8762 INSTRUMENTATION SYSTEM DESIGN LABORATORY LT P C
0 0 4 2

OBJECTIVES:

1. To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.
2. To impart design knowledge of controller, control valve and transmitter.
3. To acquire the knowledge of piping diagram of industrial standard
4. To make the students aware of industry project, planning and scheduling.

LIST OF EXPERIMENTS:

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF
3. Design of regulated power supply and design of V/I and I/V converters.
4. Design of linearizing circuits and cold–junction compensation circuit for thermocouples.
5. Design of signal conditioning circuit for strain gauge and RTD.
6. Design of orifice plate and rotameter.
7. Design of Control valve (sizing and flow-lift characteristics)
8. Design of PID controller (using operational amplifier and microprocessor)
9. Design of a multi-channel data acquisition system
10. Design of multi range DP transmitter
11. Piping and Instrumentation Diagram – case study.
12. Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS

OUTCOMES:

1. Ability to understand design of signal conditioning circuits and instrumentation systems.
2. Ability to design controller, control valve and transmitter.
3. Be able to design and draw the piping diagram for industrial application projects.
4. Be able to design the multi-channel data acquisition system and transmitter

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Expt. No.	List of equipments
1.	Sufficient number of Monolithic Instrumentation amplifier , Operational amplifiers,IC 7805 and resistors, diodes, capacitors
2	Linear control valve, ON/OFF control valve, Air regulator, Rotameter, Pump
3	Sufficient number of IC 741, CRO, Bread board, Signal generator (PID) Microprocessor kit with ADC and DAC section
4	Any Process station (Temperature or Level) with Corresponding sensors, Data acquisition card, and Storage device (microcontroller/microprocessor)
5.	Flow process station with DP transmitter
6	Loop analyzer
7	Thermocouple & RTD
8	Bonded strain gauge, Loads,
9	orifice plate

IC8811 PROJECT WORK L T P C
0 0 20 10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

EE8072 MEMS AND NANO SCIENCE LT P C
3 0 0 3

COURSE OBJECTIVES

- To provide wide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of Micro fabrication techniques
- To educate on applications of MEMS
- To provide wide information dealing with nano material and its necessity
- To analyze methods involving preparation of nano scale devices

UNIT I OVERVIEW OF MEMS AND MICROSYSTEMS 9
Introduction to MEMS and Microsystems, Need for Miniaturization, MEMS and Microsystem products: Micro gears - Micro turbines – Micromotors - Micro optical devices. Microsystems and Microelectronics, Application of Microsystems in Automotive Industries: Safety - Engine and power trains - Comfort and convenience, Microactuation: Actuation using thermal forces - actuation using shape memory alloys - Actuation using piezoelectric effect - Actuation using Electrostatic forces.

UNIT II MICROSYSTEM FABRICATION PROCESS 9
Photolithography, Ion Implantation, Diffusion, Oxidation: Thermal oxidation-Oxidation by color, Chemical Vapour Depostion, Physical Vapour Deposition: Sputtering, Etching: Chemical- Plasma, Micromaching: Bulk Micromachining - Surface Micromachining.

UNIT III POLYMERS AND OPTICAL MEMS 9
Polymers in MEMS : Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon, Optical MEMS : Lenses and Mirrors – Actuators for Active Optical MEMS, Assembly of 3D MEMS – Foundry process.

UNIT IV INTRODUCTION TO NANOSCALE ENGINEERING 9
General Principle of Nano Fabrication, Nano products, Applications of Nano products, Quantum physics, Fluid flow in submicrometers and nanoscales : Rarefied Gas – Knudsen and match numbers – Modleing of micro and nanoscale gas flow, Heat Conduction at Nanoscale, Challenges in Nanoscale Engineering, New materials for NEMS.

UNIT V PATTERNING AND PREPARATION METHODS 9
Bottom up Synthesis – Top down Approach : Precipitation, Mechanical Milling, Colloidal routes, Self assembly, Vapour phase deposition, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE, Patterning : Introduction to optical/UV electron beam and X-ray Lithography systems and processes. Clean rooms: specifications and design, air and water purity, requirements for particular processes.

TOTAL :45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the operation of micro devices, micro systems and their applications.
2. Ability to design the micro devices, micro systems using the MEMS fabrication process.
3. Ability to understand the operation of nao devices, nano systems and their applications.

4. Ability to design nano devices, nano systems using the preparation methods.

TEXT BOOKS:

1. Tai Ran Hsu "MEMS and Microsystems Design : Manufacture and Nano Scale Engineering", John Wiely & Sons, INC., 2nd Edition, 2008.
2. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996).

REFERENCES:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000..
4. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.
5. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

EI8077 POWER ELECTRONICS AND DRIVES **LT P C**
3 0 0 3

COURSE OBJECTIVES

- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- Detailed knowledge on Classifications, structure, operating principle of dc choppers
- Introduction to different types of Inverters , their principle of operation and waveform control
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9
Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation – Simulation tools.

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 9
Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cycloconverters, Matrix converters.

UNIT III DC TO DC CONVERTERS 9
Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT IV INVERTERS 9
Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNIT V DRIVES AND CONTROL 9

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Control rectifier, chopper and inverter.
3. Will have ability to apply power electronic circuits for the control of popular applications.
4. Exposure to design and analyze PE circuit using simulation software.

TEXT BOOKS:

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York, 1995.

REFERENCES:

1. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education, 2002.
3. Bimbra, P.S., "Power Electronics", Khanna Publishers, 2006.
4. Moorthi, V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford University Press, 2005.
5. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay.

IC8072 SYSTEM IDENTIFICATION LT P C
2 2 0 3

COURSE OBJECTIVES

- To understand the mathematical modelling of systems.
- To observe systems by their behaviour using Parametric Identification methods using online and offline Data's
- To observe systems by their behaviour using Nonparametric Identification Methods using Online and Offline Data's
- To estimate and validate the data's using parametric and recursive estimation methods
- To perform case studies on electromechanical and process control systems

UNIT I NONPARAMETRIC IDENTIFICATION 6+6

Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.

UNIT II PARAMETRIC INDENTIFICATION 6+6

Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures (ARX, ARMAX, Box-Jenkins, FIR, Output Error models), Input signals: commonly used signals, spectral properties, and persistent excitation, Residual analysis for determining adequacy of the estimated models.

UNIT III PARAMETRIC ESTIMATION 6+6

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, relation between minimizing the prediction error and the MLE, MAP, Convergence and consistency, asymptotic distribution of parameter estimates, Instrumental Variable Method.

UNIT IV RECURSIVE ESTIMATION 6+6

Forgetting Factor method, Kalman Filter interpretation Identification in practice: Aliasing due to sampling, closed loop data, model order estimation, robustness considerations, model validation.

UNITV CASE STUDIES 6+6

Electro Mechanical Systems, Process Control Systems using Matlab/Equivalent System Identification Toolbox.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

1. Be familiar with different model structures, parameterization, identifiability, structure determination and order estimation
2. Be able to perform parameter estimation using different identification techniques
3. Be able to identify plants online using recursive estimation methods
4. Be able to set up an experiment, identify a nominal model, assess the accuracy and precision of this model,
5. Be appropriate design choices to arrive at a validated model.

REFERENCES:

1. jung, L. System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999, ISBN 0-13-656695-2.
2. Torsten Soderstrom, PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
3. Karel J. Keesman, System Identification, An introduction, Springer, 2011.
4. Zhu, Y. Multivariable System Identification for Process Control, Pergamon, 2001.
5. Landan ID, "System Identification and Control Design," Prentice Hall
6. ArunK.Tangirala,Principles of System Identification: Theory and Practice,CRC Press,2014.

EI8074 COMPUTER NETWORKS L T P C
2 2 0 3

OBJECTIVES:

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

- Understand the flow of traditional and Ongoing applications.

UNIT I FUNDAMENTALS & LINK LAYER 6+6
Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control

UNIT II MEDIA ACCESS & INTERNETWORKING 6+6
Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP,ICMP)

UNIT III ROUTING 6+6
Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

UNIT IV TRANSPORT LAYER 6+6
Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management – Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

UNIT V APPLICATION LAYER 6+6
Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network
- Identify the congestion control and Avoidance
- Learn the tradition applications and web services

TEXT BOOK:
1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition, Tata McGraw – Hill, 2011.

GE8075 INTELLECTUAL PROPERTY RIGHTS **L T P C**
3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL:45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

EI8071 **ADAPTIVE CONTROL** **LT P C**
2 2 0 3

OBJECTIVE

- To study the definition of adaptive control and methods of adaptation.
- To study the parameter identification of systems.
- To study the self-tuning of PID controllers based on parameter identification.
- To study the model reference adaptive control.
- To study the practical application through case studies.

UNIT I INTRODUCTION 6+6

Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method.

UNIT II PARAMETRIC IDENTIFICATION 6+6

Linear in parameter models - ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation – Introduction to non-linear systems identification - Pseudo random binary sequence.

UNIT III SELF-TUNING REGULATOR 6+6

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators -Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.

UNIT IV MODEL REFERENCE ADAPTIVE CONTROLLER 6+6

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.

UNIT V TUNING OF CONTROLLERS AND CASE STUDIES 6+6

Design of gain scheduling controller - Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Understand the effect of parameter variation and principle of adaptive control schemes.
2. Distinguish different parametric identification methods.
3. Understand Deterministic and Stochastic Self Tuning Regulators.
4. Design of model reference adaptive controller
5. Design gain scheduling controller and apply adaptive control schemes for industrial processes.

TEXT BOOKS:

1. Karl J. Astrom & Bjorn Wittenmark, ‘Adaptive Control’, Pearson Education (Singapore), Second Edition, 2003.
2. Shankar Sastry and Marc Bodson, ‘Adaptive Control: Stability, Convergence, and Robustness’, Prentice-Hall, 1994.
3. I. D. Landau, R. Lozano, and M. M’Saad, ‘Adaptive Control’, NY: Springer-Verlag, 1998.

REFERENCES:

1. Chalam, ‘Adaptive Control Systems: Techniques and Applications’, CRC Press, 1987.
2. Landau, I.D., Lozano, R., M'Saad, M., Karimi, A, ‘Adaptive Control Algorithms, Analysis and Applications’, 2nd edition, Springer, 2011

3. T. C.H.A. Hsia, ‘System Identification’, Lexington books, 1974.
4. Stephanopoulis G. ‘Chemical Process Control’, Prentice Hall of India, New Delhi, 1990.
5. Miroslav Krstic, Ioannis Kanellakopoulos, Petar V. Kokotovic, ‘Nonlinear and Adaptive Control Design’, 1st Edition, Wiley, 1995.
6. Gang Tao, ’Adaptive Control Design and Analysis’, Wiley-IEEE Press, 2003,
7. Kumpati S. Narendra, Anuradha M. Annaswamy, ‘Stable Adaptive Control Systems’, Prentice Hall, 1989.

EI8072 ADVANCED INSTRUMENTATION SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES

- To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.
- To make the students to understand the requirement of safety instrumented system, standards and risk analysis techniques
- To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84 and ISA 88.
- To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments, Process Flow diagrams, Instrument Loop diagrams, Instrument Hookup diagrams and Piping and Instrumentation Diagrams.

UNIT I MEASUREMENT OF PROCESS PARAMETERS 9
Review the various Measurement techniques of temperature, pressure, flow and level – application - selection of sensors– calibration methods.

UNIT II INSTRUMENTS FOR ANALYSIS 9
Ion selective electrodes : Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO, CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring.

UNIT III SAFETY INSTRUMENTATION 9
Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.

UNIT IV INSTRUMENTATION STANDARDS 9
Instrumentation Standards - significance of codes and standards – overview of various types - Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.

UNIT V DOCUMENTATION IN PROCESS INDUSTRIES 9
Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems - Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) -Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams – Location Plans for Instruments - Cable Routing Diagrams – Typical Control / Rack Rooms Layout – Vendors Documents and Drawings

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able to

- understand the instrumentation behind flow, level, temperature and pressure measurement
- Acquire basic knowledge on the various types of analyzers used in typical industries.
- Understand the role of Safety instrumented system in the industry.
- Explain Standards for applying Instrumentation in Hazards Locations.
- Design, develop, and interpret the documents used to define instruments and control
- Systems for a typical project, including P&IDs, loop diagrams, specification forms,
- Instrument lists, logic diagrams, installation details, and location plans

TEXT BOOKS

1. B.G.Liptak, "Instrumentation Engineers Handbook (Process Measurement & Analysis)", Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCE BOOKS

1. Swapan Basu, "Plant Hazard analysis and Safety Instrumentation systems" Academic Press, 2016
2. Al.Sutko,Jerry.D.Faulk, "Industrial Instrumentation", Delmar publishers, 1996.
3. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., "Safety Instrumented Systems: Design, Analysis, and Justification", 2^{nd} Edition, ISA 2006.
4. Safety - ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative.
5. Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves; ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011.
6. Documentation Standards - ANSI/ISA5.4-1991 - Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 - Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-1981 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

EE8071	APPLIED SOFT COMPUTING	LT P C
		3 0 0 3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuuzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT I ARCHITECTURES – ANN 9

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL 9

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS 9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 3rd Edition , 2010..
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.
3. M.Gen and R,Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press 2011.

EI8075 **FIBRE OPTICS AND LASER INSTRUMENTS** **LT P C**
3 0 0 3

AIM:
To contribute to the knowledge of Fibre optics and Laser Instrumentation and its Industrial and Medical Application.

COURSE OBJECTIVES
- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9
Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibrecharacteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9
Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacementsensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9
Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9
Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9
Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of

Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs):

1. Understand the principle, transmission, dispersion and attenuation characteristics of opticalfibers
2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3. Understand laser theory and laser generation system.
4. Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India,1985.
2. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
   http://nptel.ac.in/courses/117101002/

EE8391	ELECTROMAGNETIC THEORY	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - ✓ Electrostatic fields, electrical potential, energy density and their applications.
  - ✓ Magneto static fields, magnetic flux density, vector potential and its applications.
  - ✓ Different methods of emf generation and Maxwell's equations
  - ✓ Electromagnetic waves and characterizing parameters

UNIT I ELECTROSTATICS – I 6+6

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II ELECTROSTATICS – II 6+6

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and

Laplace's equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS 6+6

Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS 6+6

Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V ELECTROMAGNETIC WAVES 6+6

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to understand the basic mathematical concepts related to electromagnetic vector fields.
- Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
- Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
- Ability to understand the different methods of emf generation and Maxwell's equations
- Ability to understand the basic concepts electromagnetic waves and characterizing parameters
- Ability to understand and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015

GE8071 DISASTER MANAGEMENT LT P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society

- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE8074 HUMAN RIGHTS LT P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO’s, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

MG8491	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS 15

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005
2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:
1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 2009.
2. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 1994.
5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

GE8072	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

EI8691 COMPUTER CONTROL OF PROCESSES LT P C
3 0 0 3

COURSE OBJECTIVES

- **To represent the linear time invariant System in discrete State Space form.**
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE 9
State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system.

UNIT II SYSTEM IDENTIFICATION 9
Identification of Non Parametric Input-Output Models:-Transient analysis–Frequency analysis–Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models:-Least Squares Method – Recursive Least Square Method.

UNIT III DIGITAL CONTROLLER DESIGN 9
Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.

UNIT IV MULTI-LOOP REGULATORY CONTROL 9
Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs – The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT V MULTIVARIABLE REGULATORY CONTROL 9
Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to analyze the discrete time systems
2. Ability to build models from input-output data
3. Ability to design a digital controller
4. Ability to design multi-loop controller and multivariable controller for multi-variable systems.

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005.

REFERENCES:

1. Gopal, M., “Digital Control and State Variable Methods”, Tata Mc Graw Hill, 2003.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics and Control”, Wiley John and Sons, 3rd Edition, 2010.
3. P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2006.
4. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2008.
5. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000.

EI8692	**ELECTRONIC INSTRUMENTATION**	**LT P C**
		3 0 0 3

COURSE OBJECTIVES

- To introduce different types of electronic voltmeters and their applications.
- To provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
- To introduce different types of waveform generators and analyzers and their applications.
- To educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
- To give exposure to telemetry, modulation techniques and multiplexing.

UNIT I ELECTRONIC INSTRUMENTS 9

Electronic Voltmeter and their advantages – Types, Differential amplifier, source follower, rectifier – Truerms reading voltmeter – Electronic multimeter and ohmmeter – Current measurement – Power measurement - Microprocessor based DMM with auto ranging and self diagnostic features.

UNIT II CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS 9

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

UNIT III WAVEFORM GENERATORS 9

Wien’s bridge and phase shift oscillators – Hartley and crystal oscillators – Square wave and pulse generators – Triangular wave-shape generator - Signal and function generators – Q meter – Electronic Counters.

UNIT IV VIRTUAL INSTRUMENTATION 9

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture of virtual instruments – Virtual instruments versus traditional instruments – Software in virtual instrumentation - VI programming techniques – DAQ cards for VI applications – DAQ modules with serial communication.

UNIT V TELEMETRY 9

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, 2010.
2. David A Bell, " Electronic Instrumentation and Measurements", Ox for University Press, 2013.
3. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi,2010.

REFERENCES:

1. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.
2. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.
3. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.
4. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.

EI8076 OPTIMAL CONTROL L T P C
2 2 0 3

OBJECTIVES:

- To understand the optimal control concepts and its importance
- To study the important optimal control methods existing in the industries in order obtain the required level of control
- To introduce the concept of optimal control in various system
- To help the learners in the design and the implementation of the concept of optimal control
- To study, analyze and implement discrete-Time optimal control system

UNIT I INTRODUCTION 6+6

Introduction to Optimal control – Comparison between the Conventional control and optimal control procedures - Statement of optimal control problem – Problem formulation and forms of optimal Control – Selection of performance measures. Necessary conditions for optimal control.

UNIT II MATHEMATICAL EVALUATION 6+6

Introduction and Performance Index - Basic Concept of calculus of variation- The basic variational problem - Fixed end point problem - Free end point problem - Variational Approach to Optimal Control Systems.

UNIT III CONTROL STRATEGY 6+6

Introduction - Time varying optimal control – LQR steady state optimal control – Frequency Domain Interpretation of LQR (LTI system) - Solution of Ricatti'sequation – Application examples.

UNIT IV PROBLEM FORMATION 6+6

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum/Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation and its solution.

UNIT V ADVANCED SYSTEMS 6+6

Discrete-Time Optimal Control Systems - Matrix Discrete Riccati Equation - Analytical Solution of Matrix Difference Riccati Equation - Optimal Control Using Dynamic Programming - The Hamilton-Jacobi-Bellman (HJB) Equation - LQR System HJB Equation-Time Optimal Control System.

TOTAL : 60 PERIODS

OUTCOMES:

1. Problem formulation, forms of optimal control and its necessary conditions.
2. Solving the algebraic equations to design the controller and to study about various problems
3. Designing optimal controllers using a class of procedures
4. Predict the system dynamic behavior through solution of ODEs and formation of optimal control problem
5. Solve equations to design the controllers in discrete methods representing spatial and temporal variations in physical systems through numerical methods.
6. Implementing the Optimal control methodology for the benchmark /real time systems.

TEXT BOOKS:

1. Kirk, D.E., Optimal Control Theory, Dover Publications, 2004.
2. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.
3. Astrom, K.J. Intro. Stochastic Control Theory, Dover Publications, 2006.

REFERENCES:

1. Gopal M, "Digital Control and State Variable Methods," Tata McGraw-Hill
2. F.L.Lewis,OptimalControl,JohnWiley&Sons,Inc.,NewYork,NY,1986
3. M.Gopal,ModernControlSystemTheory,NewAgeInternational
4. SageA.P.&WhiteC.C.,Optimum Systems Control, PrenticeHall
5. http://nptel.ac.in/courses/108105019/

TL8071	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation

UNIT I INTRODUCTION TO RADAR EQUATION 9

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar

Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise-Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters-System losses – Other Radar Equation Considerations.

UNIT II MTI AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).

UNIT III DETECTION OF SIGNALS IN NOISE 9

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays

Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter.**-** The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

UNIT IV RADIO DIRECTION AND RANGES 9

Introduction - Four methods of Navigation .**-** The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders **-** The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments.

Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System.

UNIT V SATELLITE NAVIGATION SYSTEM 9

Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment **-** Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation **-** Principles of Operation - Navigation Over the Earth– Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning System (GPS).

TOTAL: 45 PERIODS

OUTCOMES:

After studying this course, Students will be able to

- Explain principles of navigation, in addition to approach and landing aids as related to navigation
- Derive and discuss the Range equation and the nature of detection.
- Describe about the navigation systems using the satellite.

TEXT BOOKS:

1. Merrill I. Skolnik ," Introduction to Radar Systems", 3rd Edition Tata Mc Graw-Hill 2003.. (For unit-1&2)
2. N.S.Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, TMH, 2000. (For unit-3,4&5)

REFERENCES

1. Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004
2. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

GE8077	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

EC8095	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Nonideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmmit Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures.
Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL : 45 PERIODS

OUTCOMES:
UPON COMPLETION OF THE COURSE, STUDENTS SHOULD ABLE TO

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Design and construct Sequential Circuits and Timing systems.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4^{th} Edition, Pearson , 2017.(UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits:A Design perspective”, Second Edition , Pearson , 2016. . (UNIT III,IV)

REFERENCES

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits:Analysis & Design”,4^{th} edition McGraw Hill Education,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

EE8691	**EMBEDDED SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:
To impart knowledge on the following Topics

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9
Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter

Integrated Circuits (I^2C) –need for device drivers.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze Embedded systems.
- Ability to suggest an embedded system for a given application.
- Ability to operate various Embedded Development Strategies
- Ability to study about the bus Communication in processors.
- Ability to acquire knowledge on various processor scheduling algorithms.
- Ability to understand basics of Real time operating system.

TEXT BOOKS:

1. Peckol, "Embedded system Design", John Wiley & Sons,2010
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
3. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2017.

REFERENCES

1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
4. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

EI8073 BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course students will have the

- Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
- Ability to provide latest ideas on devices of non-electrical devices.
- Ability to gain knowledge on various sensing and measurement devices of electrical origin.
- Ability to understand the analysis systems of various organ types.

- Ability to bring out the important and modern methods of imaging techniques and their analysis.
- Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2^{nd} edition, 2003
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4^{th} edition, 2012

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

EE8591	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

OBJECTIVES: To impart knowledge about the following topics:

- Signals and systems & their mathematical representation.
- Discrete time systems.
- Transformation techniques & their computation.
- Filters and their design for digital implementation.
- Programmability digital signal processor & quantization effects.

UNIT I INTRODUCTION 6+6

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 6+6

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 6+6

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 6+6

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS 6+6

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

TOTAL : 60 PERIODS

OUTCOMES:

1. Ability to understand the importance of Fourier transform, digital filters and DS Processors.
2. Ability to acquire knowledge on Signals and systems & their mathematical representation.
3. Ability to understand and analyze the discrete time systems.
4. Ability to analyze the transformation techniques & their computation.
5. Ability to understand the types of filters and their design for digital implementation.
6. Ability to acquire knowledge on programmability digital signal processor & quantization effects.

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003.

2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.

3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCES

1. Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.

2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.

3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.

4. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013

5. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012

GE8076 PROFESSIONAL ETHICS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

MG8591 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 7th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

EI8078	**PROJECT MANAGEMENT AND FINANCE**	**LT P C**
		3 0 0 3

COURSE OBJECTIVES

- To understand what are the objectives of project management.
- To outline the principles followed in carrying out a project.
- To demonstrate knowledge and understanding of engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.
- To understand the concepts of finance and accounts carried out in project management.

UNIT I PROJECT MANAGEMENT,PROJECT SELECTION AND PROJECT 9

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques: PERT,CPM, Government regulations and statutory for various projects:

UNIT II PROJECT IMPLIMENTATION,MONITORING AND CONTROL 9

Project representation: Role of project managers ,relevance with objective of organization, preliminary manipulations ,Basic Scheduling concepts :Resource levelling ,Resource allocation ,Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

UNIT III PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT 9

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

UNIT IV WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING 9

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

UNIT V FINANCE AND ACCOUNTING 9

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles:

Preparation and Interpretation of balance sheets, profit and loss statements , Fixed Assets, Current assets, Depreciation methods :Break even analysis:

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to study the current market trends and choose projects.
2. Ability to prepare project feasibility reports.
3. Ability to implement the project effectively meeting government norms and conditions.
4. Ability to understand the role and responsibility of the Professional Engineer.
5. Be able to assess social, health, safety issues based on the reasoning received from the contextual knowledge.
6. Ability to choose projects which benefit the society and organization.

TEXT BOOKS:

1. Project Management Institute “A Guide to the Project Management Body of Knowledge” PMBOK® Guide (Sixth Edition), Sept 2017
2. James C.Van Horne, “Fundamentals of Financial Management”, Person Education 2004.

REFERENCES:

1. **Küster** J., **Huber**, E., **Lippmann**, R., **Schmid**, A., **Schneider**, E., **Witschi**, U., **Wüst**, R.” Project Management Handbook”,2015
2. Khanna, R.B.,“Project Management”, PHI 2011.
3. Prasanna Chandra, “Financial Management”, Tata McGraw-Hill,2008.
4. By Carl S. Warren, James M. Reeve, Jonathan Duchac.”Financial & Managerial Accounting”,2016
5. PaneerSelvam, R., and Senthilkumar, P., “Project Management”, PHI, 2011.

IC8071 ADVANCED PROCESS CONTROL LT P C
2 2 0 3

COURSE OBJECTIVES

- To teach students to build and analyze models for time-varying systems and non-linear systems.
- To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications
- To make the students learn to formulate optimal control schemes
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems
- To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

UNIT I CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS 6+6

Models for Time-varying and Nonlinear systems – Input signal design for Identification –Realtime parameter estimation – Model Validation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Control of Hammerstein and Wiener Systems.

UNIT II OPTIMAL CONTROL & FILTERING 6+6

Introduction – Performance Measure for optimal control problem – Dynamic Programming – Computational Procedure for solving Control Problem – LQR – Introduction to Optimal Filtering – Discrete Kalman Filter – Linear Quadratic Gaussian (LQG)

UNIT III FRACTIONAL ORDER SYSTEM & CONTROLLER 6+6

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional-Order Linear Systems - Filter Approximations to Fractional-Order Differentiations – Model reduction Techniques for Fractional Order Systems –Controller Design Studies for Fractional Order.

UNIT IV H-INFINITY CONTROLLER 6+6

Introduction – Norms for Signals – Robust Stability – Robust Performance – Small Gain Theorem – Optimal H2 Controller Design - H-Infinity Controller Design — Effects of Weighting Functions in H-Infinity Control.

UNIT V FAULT DIAGNOSIS AND FAULT-TOLERANT CONTROL 6+6

Process Monitoring - Introduction – Statistical Process Control – Fault Detection with Principal Component Analysis – Fault Detection with State Observers – Fault Detection with signal models - Fault Detection of Control Loops- Sensor and Actuator Fault-Tolerant Control Design.

TOTAL: 60 PERIODS

COURSE OUTCOMES

- Ability to Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
- Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
- Ability to Identify, formulate, and solve optimal controller
- Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
- Ability to design and implement H2 and H-infinity Controllers
- Ability to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

REFERENCE BOOKS

1 K.J. Astrom and B.J.Wittenmark, “Adaptive Control”, Pearson Education, Second Edition, 2008.
2 Donald E.Kirk, "Optimal Control Theory – An Introduction", Dover Publications, Inc. Mineola, New York, 2012
3 D.Xue, Y.Q.Chen, D.P.Atherton, "Linear Feedback Control Analysis and Design with MATLAB, Advances In Design and Control", Society for Industrial and Applied Mathematics, 2008.
4 R. Isermann, "Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance", Springer, 2006.

EI8079 ROBOTICS AND AUTOMATION L T P C
3 0 0 3

AIM

To provide comprehensive knowledge of robotics in the design, analysis and control point of view.

COURSE OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and controlissues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist andarm singularity - Static analysis - Force and moment BalanceSolution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulatorcontrol problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to:

- Understand the evolution of robot technology and mathematically represent different types of robot.
- Get exposed to the case studies and design of robot machine interface.
- Familiarize various control schemes of Robotics control

TEXT BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2. Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications Prentice Hall, 3 edition 2104.

REFERENCES

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005
5. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
6. Issac Asimov I Robot, Ballantine Books, New York, 1986.

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVES:
To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

FACULTY OF ELECTRICAL ENGINEERING

REGULATION - 2021

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING

Choice Based Credit System (CBCS)

I - VIII Semesters

CURRICULUM AND SYLLABUS

FOR THE STUDENTS ADMITTED IN THE

ACADEMIC YEAR 2021 - 2022

Vision of the department

- To make every student of the Department irrespective of his/her social, cultural background and learning abilities gets a fair chance in mastering the various fields of Electronics and Instrumentation Engineering to become a proficient individual for the empowerment of society

Mission of the department

The Department strives:

- Professional: To prepare students to understand recent technologies in Electronics and Instrumentation Engineering effectively and adapt themselves in an ever-changing environment.
- Technical Proficiency: To impart excellent computing knowledge to students by providing well equipped facilities and state of the art systems.
- Social Competency: To prepare students with excellent leadership skills, management capabilities and ethical understanding for successful career.

Program Education Objectives (PEOs)

PEO 1	To prepare the students have successful career in industry and motivate for higher education.
PEO 2	To provide strong foundation in basic science and mathematics necessary to formulate, solve and analyse Electronics and Instrumentation problems.
PEO 3	To provide strong foundation in circuit theory, control theory and signal processing concepts and to provide good knowledge of Instrumentation systems and their applications.
PEO 4	To provide knowledge on basic electronics and their applications in Instrumentation engineering and provide an opportunity to work in interdisciplinary groups.
PEO 5	To promote student awareness for lifelong learning and inculcate professional ethics by providing necessary foundation on computational platforms and software applications related to the respective field of Engineering.

Program Specific Outcomes (PSOs)

Our Graduate will be able to:

PSO1: Relate the rudiments of mathematics, science and engineering knowledge to classify, formulate, plan and explore compound engineering problems of electric circuits, analog and digital electronic circuits, process control and instrumentation field along with computational skills.

PSO2: Relate and apply suitable techniques for designing engineering hardware and software tools to assist in design, implement & evaluate the control, measurement, process and instrumentation systems to engross for a life- long learning and thereby work effectually as an distinct individual and also in a multidisciplinary team.

PSO3: Comprehend the influence of Professional performance and ethics, communicate commendably with Electronics and Instrumentation Engineering community and establish a better environment for the society with continual growth.

Program Outcomes (POs):

a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d) **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- **h) Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **i) Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **j) Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **k) Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **l) Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PEO / PO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

PO / UNDER GRADUATE SUBJECTS MAPPING

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
SEM I	**THEORY**												
	Communicative English									✓	✓		✓
	Engineering Mathematics- I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Engineering Graphics			✓	✓								
	Problem solving and Python Programming	✓	✓	✓	✓	✓							
	PRACTICALS												
	Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
SEM II	**THEORY**												
	Professional English									✓	✓		✓
	Engineering Mathematics – II	✓	✓	✓		✓							✓
	Physics for Electronics	✓	✓	✓		✓		✓					✓

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	Engineering												
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Principles of Electrical, Electronics and Communication Engineering	✓	✓	✓	✓	✓							✓
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Principles of Electrical and Electronic devices Laboratory	✓	✓	✓	✓	✓							✓
SEM III	**THEORY**												
	Transform and Partial Differential Equations	✓	✓			✓							✓
	Electrical and Electronic Measurements	✓	✓	✓	✓	✓					✓		✓
	Transducer Engineering	✓	✓	✓	✓	✓							✓
	Electric Circuit Analysis	✓	✓	✓	✓	✓							✓
	Analog Electronics	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	PRACTICALS												
	Analog and Digital Electronics Laboratory	✓	✓	✓	✓	✓							✓
	Electrical and Electronics measurement Laboratory	✓			✓	✓						✓	✓
	Technical Seminar									✓	✓	✓	
SEM IV	**THEORY**												
	Statistics & Numerical Methods	✓	✓	✓									✓
	Industrial Instrumentation-I	✓	✓	✓	✓	✓					✓		
	Electrical Machines	✓	✓	✓	✓	✓		✓					✓
	Communication Engineering	✓	✓	✓	✓	✓							✓
	Control Systems			✓	✓	✓							✓
	Fundamentals of Data Structures in C (Lab Integrated)			✓	✓	✓							✓
	PRACTICALS												
	Machines and Control Laboratory	✓			✓	✓						✓	✓
	Measurements and Transducers Laboratory			✓	✓	✓	✓			✓	✓		
	Professional Skills Lab									✓	✓	✓	
SEM V	**THEORY**												
	Power Electronics	✓	✓	✓	✓	✓		✓					✓
	Microprocessors and Microcontrollers	✓	✓	✓	✓	✓		✓					
	Biomedical Instrumentation	✓		✓		✓			✓	✓		✓	✓
	Industrial Instrumentation-II	✓	✓	✓	✓	✓		✓					✓
	Open Elective-I	✓		✓	✓						✓	✓	✓
	Professional Elective- I												

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	Audit course												
	PRACTICALS												
	Microprocessors and Microcontrollers Laboratory	✓		✓	✓						✓	✓	✓
	Industrial Instrumentation Laboratory	✓		✓	✓						✓	✓	✓
SEM VI	**THEORY**												
	Industrial Internet of Things	✓	✓	✓	✓	✓		✓					✓
	Process Control	✓	✓	✓	✓	✓		✓					✓
	Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Embedded Systems (Lab Integrated)	✓		✓		✓			✓	✓		✓	✓
	Object Oriented Programming Systems (Integrated Lab)			✓	✓	✓							✓
	Professional Elective II												
	PRACTICALS												
	Instrumentation System Design Lab	✓		✓	✓						✓	✓	✓
	Process Control Laboratory	✓		✓	✓						✓	✓	✓
SEM VII	**THEORY**												
	Computer Control of Processes	✓	✓	✓	✓	✓		✓					
	Applied Soft Computing	✓	✓	✓	✓	✓		✓					✓
	Industrial Data Network	✓		✓		✓	✓					✓	✓
	Professional Elective- III	✓	✓	✓	✓	✓		✓					✓
	Professional Elective- IV												
	Open Elective – II												
	PRACTICALS												
	Industrial Automation Laboratory	✓		✓	✓						✓	✓	✓
	Project Work- Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VIII	**THEORY**												
	Professional Elective- V												
	Professional Elective- VI												
	PRACTICALS												
	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVES

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
ELECTIVE I	Computer Networks	✓		✓	✓	✓		✓					
	MEMS and NEMS	✓		✓	✓	✓		✓					
	Electric and Hybrid Vehicles	✓	✓		✓	✓							
	Analytical Instrumentation												
	Modern Control Theory								✓		✓		✓
	Intellectual Property Rights			✓	✓	✓	✓						
ELECTIVE II	Unit Operation and Control	✓		✓	✓	✓			✓				
	System Identification and Adaptive Control	✓		✓	✓	✓			✓				✓
	Advanced Instrumentation Systems	✓		✓	✓	✓			✓				✓
	Microcontroller Based System Design				✓	✓							
	Digital Image Processing	✓		✓	✓	✓			✓				✓
	Fibre Optics and Laser Instrumentation	✓		✓		✓							
	Fundamental of Operation System	✓			✓	✓			✓				✓
ELECTIVE III	Optimal Control	✓	✓	✓	✓	✓		✓					✓
	Logic and Distributed Control System		✓		✓	✓							
	Advanced Topics in PID Control	✓		✓		✓							
	Model Predictive Control	✓		✓		✓							
	Fault Detection and Diagnosis	✓	✓	✓			✓	✓					
	Safety Instrumental System		✓	✓					✓	✓			
ELECTIVE IV	Advanced Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Radar and Navigational Aids	✓	✓	✓		✓					✓		✓
	CMOS VLSI Design												
	Thermal Power Plant Instrumentation												
	Mechatronics System Design	✓		✓		✓							
	Advanced Process Control	✓	✓		✓			✓				✓	✓
ELECTIVE V	Instrumentation Standards		✓			✓	✓	✓	✓	✓	✓		
	Professional Ethics in Engineering	✓	✓	✓					✓	✓			✓
	Principles of Management	✓	✓	✓					✓	✓			✓
	Disaster Management	✓	✓	✓					✓	✓			✓
	Principles of Operational Research					✓	✓			✓			
	Human Rights	✓	✓	✓					✓	✓			✓
ELECTIVE VI	Fundamentals of Nano Science	✓	✓	✓					✓	✓			✓
	Non-Linear Control Systems	✓	✓	✓					✓	✓			✓
	Process Data Analytics	✓		✓	✓	✓	✓						
	Cyber Security for Industrial Automation	✓	✓	✓					✓	✓			✓
	Robotics and Automation	✓	✓	✓					✓	✓			✓
	Instrumentation in Petrochemical Industries	✓		✓		✓							

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA & SYLLABI

FOR THE STUDENTS ADMITTED IN THE ACADEMIC YEAR 2021 – 2022

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**30**	**18**	**0**	**12**	**24**
Induction Training			MAC	2 Weeks				

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	3	1	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6.	EE1271	Principles of Electrical, Electronics and Communication Engineering	PCC	3	3	0	0	3
PRACTICALS								
7.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8.	EE1278	Principles of Electrical and Electronic devices Laboratory	PCC	4	0	0	4	2
TOTAL				**27**	**19**	**0**	**8**	**23**
Personality & Character Development			**MAC**	**1 Week**				

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1301	Transform and Partial Differential Equations	BSC	4	3	1	0	4
2.	EI1301	Electrical and Electronic Measurements	PCC	4	3	0	0	3
3.	EI1302	Transducer Engineering	PCC	4	3	0	0	3
4.	EE1371	Electric Circuit Analysis	PCC	3	2	1	0	3
5.	EE1372	Analog Electronics	PCC	3	3	0	0	3
6.	EE1373	Digital Logic Circuits	PCC	3	2	1	0	3
PRACTICALS								
7.	EE1391	Analog and Digital Electronics Laboratory	PCC	4	0	0	4	2
8.	EI1308	Electrical and Electronics measurement Laboratory	PCC	4	0	0	4	2
TOTAL				**29**	**16**	**3**	**8**	**23**
Career Competency Development I- BEC Training				**1 Week**				

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1401	Statistics & Numerical Methods	BSC	4	3	1	0	4
2.	EI1401	Industrial Instrumentation-I	PCC	4	3	0	0	3
3.	EE1451	Electrical Machines	PCC	3	3	0	0	3
4.	EI1402	Communication Engineering	ESC	3	3	0	0	3
5.	EE1471	Control Systems	PCC	3	2	1	0	3
6.	CS1406	Fundamentals of Data Structures in C (Lab Integrated)	ESC	5	3	0	2	4
PRACTICALS								
7.	EI1408	Machines and Control Laboratory	**ESC**	4	0	0	4	2
8.	EI1409	Measurements and Transducers Laboratory	PCC	4	0	0	4	2
9.	HS1310	Professional Skills Lab	HSC	2	0	0	2	1
TOTAL				**34**	**17**	**2**	**12**	**25**
Career Competency Development II: C Programming				**1 Week**				

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1571	Power Electronics	PCC	3	3	0	0	3
2.	EE1572	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
3.	EI1501	Biomedical Instrumentation	PCC	3	3	0	0	3
4.	EI1502	Industrial Instrumentation-II	PCC	3	3	0	0	3
5.		Open Elective-I	OEC	3	3	0	0	3
6.		Professional Elective- I	PEC	3	3	0	0	3
7.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
PRACTICALS								
8.	EE1591	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
9.	EI1507	Industrial Instrumentation Laboratory	PCC	4	0	0	4	2
TOTAL				**28**	**20**	**0**	**8**	**22**
Career Competency Development- III (Advanced C Programming)				**1 Week**				

***Audit course is a Non-credit Course (Student shall select one course from the list given under AC)**

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI1601	Industrial Internet of Things	PCC	3	3	0	0	3
2.	EI1602	Process Control	PCC	4	3	0	0	3
3.	EE1671	Digital Signal Processing	PCC	3	2	1	0	3
4.	EE1672	Embedded Systems (Lab Integrated)	ESC	5	3	0	2	4
5.	DS1302	Object Oriented Programming (Lab Integrated)	ESC	5	3	0	2	4
6.		Professional Elective II	PCC	3	3	0	0	3
PRACTICALS								
7.	EI1608	Instrumentation System Design Lab	PCC	4	0	0	4	2
8.	EI1609	Process Control Laboratory	PCC	4	0	0	4	2
TOTAL				**29**	**17**	**1**	**12**	**24**
Career Competency Development-IV (Aptitude & Data Structures)				**4 Weeks**				
Value Added Course (EEC)**				**1 Week 2 Credits**				

****Students have to undergo Value added Course(VAC) during VI Semester and the credits earned through VAC shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree.**

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI1701	Computer Control of Processes	PCC	3	3	0	0	3
2.	EI1702	Applied Soft Computing	PCC	3	3	0	0	3
3.	EI1703	Industrial Data Network	PCC	3	3	0	0	3
4.		Professional Elective- III	PEC	3	3	0	0	3
5.		Professional Elective- IV	PEC	3	3	0	0	3
6.		Open Elective – II	OEC	3	3	0	0	3
PRACTICALS								
7.	EI1708	Industrial Automation Laboratory	PCC	4	0	0	4	2
8.	EI1709	Project Work- Phase I	EEC	4	0	0	4	2
9.	EI1710	Internship –I# (2 weeks)	EEC					1
TOTAL				**26**	**18**	**0**	**8**	**23**
Career Competency Development V: (Company specific Training)				**1 Week**				

#Students should undergo 2 Weeks Internship during VII Semester summer vacation

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective- V	PEC	3	3	0	0	3
2.		Professional Elective- VI	PEC	3	3	0	0	3
PRACTICALS								
3.	EI1801	Project Phase II	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL CREDITS= 180

PROFESSIONAL ELECTIVE – I (V SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CS1520	Computer Networks	PE	3	3	0	0	3
2.	EC1009	MEMS and NEMS	PE	3	3	0	0	3
3.	EE1552	Electric and Hybrid Vehicles	PE	3	3	0	0	3
4.	EI1511	Analytical Instrumentation	PE	3	3	0	0	3
5.	EI1512	Modern Control Theory	PE	3	3	0	0	3
6.	GE1001	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1621	Unit Operation and Control	PE	3	3	0	0	3
2.	EE1731	System Identification and Adaptive Control	PE	3	3	0	0	3
3.	EI1622	Advanced Instrumentation Systems	PE	3	3	0	0	3
4.	EE1853	Microcontroller Based System Design	PE	3	3	0	0	3
5.	EI1623	Digital Image Processing	PE	3	3	0	0	3
6.	EI1624	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
7.	CS1671	Fundamental of Operation System	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

S.NO	COURS ECODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1731	Optimal Control	PE	3	3	0	0	3
2.	EI1732	Logic and Distributed Control System	PE	3	3	0	0	3
3.	EI1733	Advanced Topics in PID Control	PE	3	3	0	0	3
4.	EI1734	Model Predictive Control	PE	3	3	0	0	3
5.	EI1735	Fault Detection and Diagnosis	PE	3	3	0	0	3
6.	EI1736	Safety Instrumental System	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1008	Advanced Digital Signal Processing	PE	3	3	0	0	3
2.	EC1040	Radar and Navigational Aids	PE	3	3	0	0	3
3.	EC1731	CMOS VLSI Design	PE	3	3	0	0	3
4.	EI1741	Thermal Power Plant Instrumentation	PE	3	3	0	0	3
5.	EI1742	Mechatronics System Design	PE	3	3	0	0	3
6.	EI1743	Advanced Process Control	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1851	Instrumentation Standards	PE	3	3	0	0	3
2.	GE1003	Professional Ethics in Engineering	PE	3	3	0	0	3
3.	MG1001	Principles of Management	PE	3	3	0	0	3
4.	CE1025	Disaster Management	PE	3	3	0	0	3
5.	MG1002	Principles of Operational Research	PE	3	3	0	0	3
6.	GE1002	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIIISEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1004	Fundamentals of Nano Science	PE	3	3	0	0	3
2.	EI1861	Non-Linear Control Systems	PE	3	3	0	0	3
3.	EI1862	Process Data Analytics	PE	3	3	0	0	3
4.	EI1863	Cyber Security for Industrial Automation	PE	3	3	0	0	3
5.	EI1864	Robotics and Automation	PE	3	3	0	0	3
6.	EI1865	Instrumentation in Petrochemical Industries	PE	3	3	0	0	3

OPEN ELECTIVE -I (V SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCS103	Introduction to Cloud Computing	OE	3	3	0	0	3
2.	OCS109	Fundamentals of Database Management Systems	OE	3	3	0	0	3
3.	OME106	Testing of Materials	OE	3	3	0	0	3
4.	OBT104	Biosensors	OE	3	3	0	0	3
5.	OEE107	Solar and Wind Energy systems	OE	3	3	0	0	3
6.	OME104	Industrial Safety Engineering	OE	3	3	0	0	3
7.	OCE101	Air Pollution and Control	OE	3	3	0	0	3

OPEN ELECTIVE -II (VII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCS105	Data Analytics with R Programming	OE	3	3	0	0	3
2.	OME102	Design of Experiments	OE	3	3	0	0	3
3.	OME105	Product Design and Development	OE	3	3	0	0	3
4.	OME107	Vibration and Noise Control	OE	3	3	0	0	3
5.	OEC101	Introduction to Signals and Systems	OE	3	3	0	0	3
6.	OCH102	Process Modelling and Simulation	OE	3	3	0	0	3
7.	OMB104	Quality for Management Science	OE	3	3	0	0	3

AUDIT COURSE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	3	2	0	0	0
2.	AD1002	Value Education	AC	3	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	3	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	3	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	3	2	0	0	0
6.	AD1006	Unnati Bharat Abhiyan	AC	3	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	3	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	3	2	0	0	0

SUMMARY

S.No	Subject Area	Credits per semester								Credit Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	**HSMC**	**3**	**6**	**--**	**1**	**--**	**--**	**--**	**--**	**10**	**5.55**
2.	**BSC**	**12**	**7**	**4**	**4**	**--**	**--**	**--**	**--**	**27**	**15**
3.	**ESC**	**9**	**5**	**--**	**9**	**--**	**8**	**--**	**--**	**31**	**17.22**
4.	**PCC**	**--**	**5**	**19**	**11**	**16**	**16**	**11**	**6**	**84**	**46.66**
5.	**PEC**	**--**	**--**	**--**	**--**	**3**	**--**	**6**	**--**	**9**	**5**
6.	**OEC**	**--**	**--**	**--**	**--**	**3**	**--**	**3**	**--**	**6**	**3.33**
7.	**EEC**	**--**	**--**	**--**	**--**	**--**	**--**	**3**	**10**	**13**	**7.22**
8.	**AC**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
	Total	**24**	**23**	**23**	**25**	**22**	**24**	**23**	**16**	**180**	**100**

Board Chairman
Dr.Jayarama Pradeep

Dean-Academic
Dr.G.Sreekumar

Principal
Dr.Vaddi Seshagiri Rao

SEMESTER I

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9

Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.

UNIT II	GENERAL READING AND FREE WRITING	9

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.

UNIT III	GRAMMAR AND LANGUAGE DEVELOPMENT	9

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays -asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.

UNIT IV	READING AND LANGUAGE DEVELOPMENT	9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous-conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.

UNIT V	EXTENDED WRITING	9

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	J	k	l	1	2	3
CO1	0	0	0	0	0	0	0	0	2	3	0	0	0	0	3
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	0	0
CO3	0	2	0	3	0	0	0	0	0	2	0	0	3	0	1
CO4	0	0	0	0	0	0	0	0	2	2	0	0	1	0	2
C05	0	2	1	1	2	0	2	0	0	3	0	0	1	0	1

MA1102	**ENGINEERING MATHEMATICS –I**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	1	0	4

Objectives

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	**MATRICES**	**12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II	**CALCULUS OF ONE VARIABLE**	**12**

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.

UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.

UNIT IV	**INTEGRAL CALCULUS**	**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V	**MULTIPLE INTEGRALS**	**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids.	
TOTAL : 60 PERIODS	
TEXT BOOKS	
1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014. 2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].	
REFERENCE BOOKS	
1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016. 2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007. 3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007. 4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015. 5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied

	in engineering field.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	1	2	3	0	0	3	2	3	3	2	2	1
CO2	3	3	3	2	2	1	0	0	0	0	1	2	2	2	1
CO3	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1
CO4	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1
C05	3	3	3	2	1	1	0	0	0	0	1	2	2	1	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I	PROPERTIES OF MATTER	9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.

UNIT II	LASER AND FIBER OPTICS	9

Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement- Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.

UNIT III	**THERMAL PHYSICS**	**9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity – Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.

UNIT IV	**QUANTUM PHYSICS**	**9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.

UNIT V	**CRYSTAL PHYSICS**	**9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2019.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.

CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
C05	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I — WATER AND ITS TREATMENT — 9

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.

UNIT II — SURFACE CHEMISTRY AND CATALYSIS — 9

Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich’s adsorption isotherm – Langmuir’s adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC.

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT III	PHASE RULE AND ALLOYS	9
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **Alloys**: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **Combustion of fuels**: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		
UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17^{th} Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media. New Delhi. (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	1	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	1	2	2
C05	3	2	3	3	3	3	3	2	2	2	2	2	3	3	2

GE1105	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	**ALGORITHMIC PROBLEM SOLVING**	**9**

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II	INTRODUCTION TO PYTHON	9
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, ―Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2

GE1106	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	2	0	4	4

Objectives

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)	**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.		
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		
		TOTAL : 90 PERIODS
TEXT BOOKS		
1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016 2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.		
REFERENCE BOOKS		
1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019. 2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008. 3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore,		

2018.

4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	1	2	1	1	0	0	3	3	2	3	1	1	0
CO2	3	1	2	2	1	1	0	0	3	3	2	3	1	1	0
CO3	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0
CO4	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0
CO5	3	1	2	3	1	1	0	0	3	3	2	3	1	1	0

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	0	0	4	2

Objectives

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical

problems	
3. Scientific problem-solving using decision making and looping. Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	
11. Demonstrate Exceptions in Python.	
12. Applications: Implementing GUI using turtle, pygame.	
TOTAL: 60 PERIODS	
REFERENCE BOOKS	
1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019 2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. 3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013. 4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009. 5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)	
WEB REFERENCES	
1. http://www.edx.org	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Implement Python programs with conditionals and loops.
CO4	Read and write data from/to files in Python and applications of python.
CO5	Develop Python programs step-wise by defining functions and calling them.

MAPPING OF COs WITH POs AND PSOs															
Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2

BS1108	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

Objectives

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pH metry

LIST OF EXPERIMENTS– PHYSICS

A minimum of 5 experiments to be performed from the given list)	
1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	**CO1**
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO1**
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	
4. Determination of dispersive power of prism using Spectrometer.	**CO2**
5. (a) Determination of wavelength and particle size using a laser.	**CO2**
(b) Determination of numerical aperture and acceptance angle of an optical fibre.	**CO2**
(c) Determination of width of the groove of compact disc using laser	**CO1**
6. Determination of Young's modulus of the material of the given beam by uniform bending method.	
7. Determination of energy band gap of the semiconductor.	**CO2**

8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc. **DEMONSTRATION EXPERIMENT** Determination of thickness of a thin sheet / wire – Air wedge method	**CO2** **CO1**
LIST OF EXPERIMENTS – CHEMISTRY	
(A minimum of 6 experiments to be performed from the given list) 1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample. 2.Determination of total, temporary & permanent hardness of water by EDTA method. 3.Determination of DO content of water sample by Winkler's method. 4.Determination of chloride content of water sample by argentometric method. 5.Estimation of copper content of the given solution by Iodometry. 6.Determination of strength of given hydrochloric acid using pH meter. 7.Determination of strength of acids in a mixture of acids using conductivity meter. 8.Estimation of iron content of the given solution using potentiometer. 9.Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer. 10. Conductometric titration of strong acid vs strong base. **DEMONSTRATION EXPERIMENTS** 1. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method). 2. Estimation of sodium and potassium present in water using flame photometer.	**CO5** **CO5** **CO5** **CO3** **CO3** **CO3** **CO4** **CO4** **CO4** **CO4** **CO3** **CO5**
	TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students should be

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of

	water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	1
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	1	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	2	2

SEMESTER II

HS1201	**PROFESSIONAL ENGLISH**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	**READING AND STUDY SKILLS**	**9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.

UNIT II	**READING AND STUDY SKILLS**	**9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily

confused words Language Development- impersonal passive voice, numerical adjectives.		
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		
UNIT IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		
UNIT V	**GROUP DISCUSSION AND JOB APPLICATIONS**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking – participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press: 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press: 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	0	0	0	0	0	1	2	3	0	0	0	0	1
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	1	2
CO3	0	2	0	3	0	0	0	0	1	2	0	0	0	1	2
CO4	0	0	0	0	1	0	0	0	2	2	0	0	0	2	1
C05	0	2	1	1	2	0	2	0	0	3	0	0	3	3	3

MA1202	**ENGINEERING MATHEMATICS - II**	**L**	**T**	**P**	**C**
(Common for all branches of B.E. / B. Tech Programmes Except AI-DS & AI-ML)		3	1	0	4

Objectives

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients.

UNIT II	**VECTOR CALCULUS**	**12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III	**COMPLEX VARIABLES**	**12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions w = Z + C, CZ, 1/Z - Bilinear transformation.		
UNIT IV	**COMPLEX INTEGRATION**	**12**
Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour(excluding poles on the real line).		
UNIT V	**LAPLACE TRANSFORMS**	**12**
Existence conditions – Transforms of elementary functions –Basic properties – Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals — Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCE BOOKS

1. G Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., ― Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O‘Neil, P.V. ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, ―Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., ―Advanced Engineering Mathematics ―Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply various techniques in solving differential equations
CO2	Gradient, divergence and curl of a vector point function and related identities
CO3	Evaluation of line, surface and volume integrals using Gauss, Stokes and Green‘s theorems and their verification
CO4	Analytic functions, conformal mapping and complex integration

CO5	Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	1	0	0	0	0	1	2	2	1	1
CO2	3	3	3	1	1	1	0	0	0	0	2	1	2	1	1
CO3	3	3	3	2	1	1	0	1	0	0	1	1	1	1	1
CO4	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1
C05	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1

PH1253	**PHYSICS FOR ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	(Common to EEE, ECE, EIE)	3	0	0	3

Objectives

- Understand the transport properties of conducting materials and their modelling using classical and quantum theories,
- Comprehend the origin of magnetic and superconducting properties in different materials and their engineering applications,
- Grasp the principles of dielectric materials and its applications.
- Understand the key factors for effective design of an optoelectronic device by its energy efficiency, and
- Analyze the structure-property of nano materials and their applications.

UNIT - I	**CONDUCTING MATERIALS**	**9**

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT - II	**PHYSICS OF SEMICONDUCTOR DEVICES**	**9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N- type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport -Einstein’s relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions – Zener diode as voltage regulator- Ohmic contacts – tunnel diode - Schottky diode- MOS Capacitor.

UNIT - III	MAGNETIC AND DIELECTRIC MATERIALS	9

Origin of magnetic moment – Bohr magneton – Microscopic and macroscopic classification of magnetic materials : comparison of diamagnetism , para magnetism and ferro magnetism – Domain theory – Hysteresis (based on domain theory) – soft and hard magnetic materials – Ferrites – applications. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation-dielectric breakdown.

UNIT - IV	OPTICAL MATERIALS	9

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – excitons - quantum confined Stark effect – Quantum dot laser, Quantum well laser.

UNIT - V	NANODEVICES	9

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – resonant tunneling – quantum interference effects –mesoscopic structures – Coulomb blockade effects- Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics, Spintronic Devices : Spin Valve - Spin FET, Carbon nanotubes: Types ,Preparation- CVD, Properties and applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design",Springer, 2008
2. Adaptation by Balasubramanian, R, Callister "Material Science and Engineering", Wiley India Pvt. Ltd., 2nd Edition, 2014.
3. Mani.P , "Physics for Electronics Engineering", Dhanam Publishers , 2017.
4. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.

REFERENCE BOOKS

1. Traugott Fischer , "Materials Science for Engineering Students" ,Ist Edition,Elsevier , 2009
2. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2009.
3. Rogers, B., Adams, J.& Pennathur, S."Nanotechnology: Understanding Small Systems". CRC Press,2014
4. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education,2009
5. Kwok Ng, Simon Sze, and Yiming Li," Physics of Semiconductor Devices", 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on classical and quantum free electron theories and formation of energy

	band structures.
CO2	Gain knowledge on semiconducting devices and its applications.
CO3	Acquire knowledge on magnetic and superconducting materials and their applications.
CO4	Understand the relationship of optoelectronic materials and their applications in various domains.
CO5	Acquire knowledge about the nano structures and its applications

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	3	3	2
CO3	3	3	1	1	2	2	1	1	1	1	1	2	3	3	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	2
C05	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**9**

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local

levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity.		
UNIT II	**ENVIRONMENTAL POLLUTION**	**9**
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		
UNIT III	**NATURAL RESOURCES**	**9**
Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		
UNIT IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**9**
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies.		
		TOTAL : 45 PERIODS
TEXT BOOKS		

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd, Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	1	1	1	1	2	1	2	1	2	1	3	2	2	2
CO2	1	2	3	3	1	3	3	2	1	2	1	3	2	2	1
CO3	2	2	2	1	2	2	1	2	1	2	1	3	2	2	3
CO4	1	1	3	2	2	2	3	3	2	2	1	2	1	2	2
C05	2	2	3	2	1	2	2	1	2	1	2	3	3	3	1

GE1205	**BASIC CIVIL AND MECHANICAL ENGINEERING**	**L**	**T**	**P**	**C**
	(Common to BioTech, CHEMICAL, EEE, EIE)	3	0	0	3
Objectives					

• The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System		
UNIT – I	**SCOPE OF CIVIL AND MECHANICAL ENGINEERING**	**6**
Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering **Overview of Mechanical Engineering** - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.		
UNIT - II	**SURVEYING AND CIVIL ENGINEERING MATERIALS**	**9**
Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples. **Civil Engineering Materials:** Bricks – stones – sand – cement – concrete – steel - timber - modern materials.		
UNIT - III	**BUILDING COMPONENTS AND STRUCTURES**	**12**
Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations. **Civil Engineering Structures:** Brick masonry – stonemasonry – beams – columns – lintels – roofing flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.		
UNIT - IV	**INTERNAL COMBUSTION ENGINES AND POWERPLANTS**	**12**
Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.		
UNIT - V	**REFRIGERATION AND AIR CONDITIONING SYSTEM**	**6**
Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.		
		TOTAL : 45 PERIODS
TEXT BOOKS		
1. Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., NewDelhi, 1996.		
REFERENCE BOOKS		
1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010. 2. Ramamrutham S.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999. 3. Seetharaman S.,“BasicCivil Engineering”,AnuradhaAgencies,2005. 4. ShanthaKumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000. 5. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam, 2000.		
COURSE OUTCOMES		

Upon completion of the course, students will be able to	
CO1	To impart basic knowledge on Civil and Mechanical Engineering.
CO2	To familiarize the materials and measurements used in Civil Engineering.
CO3	To provide the exposure on the fundamental elements of civil engineering structures.
CO4	To enable the students to distinguish the components and working principle of power plant, IC engines
CO5	To provide the exposure on the fundamental elements of R & AC system.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	2	3	3	3	-	3	2	2	3	3	2	2
CO2	3	2	3	3	3	3	2	-	2	1	1	3	3	2	1
CO3	3	2	3	3	2	3	2	-	3	2	1	3	3	2	1
CO4	3	2	3	2	2	3	2	-	3	2	2	3	3	3	2
C05	3	2	3	2	2	3	2	-	2	2	1	3	2	3	2

EE1271	PRINCIPLES OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING	L	T	P	C
	(Common to EEE & EIE)	3	0	0	3

Objectives

To understand the basic concepts of electric circuits and wiring practices.

To study about the three phase system and magnetic circuits

To understand the working principle of electronic devices.

To study the working of current controlled and voltage controlled devices.

To understand the basic concepts of communication systems.

UNIT I — BASIC ELECTRIC CIRCUITS AND DOMESTIC WIRING — 9

Electrical circuit elements (R, L and C)-Dependent and independent sources - Ohm's Law, Kirchhoff's laws - Single phase AC circuits: Phasor – RMS and Average values-sinusoidal steady state response of simple RLC circuits - Types of wiring- Domestic wiring - Electrical Safety - Protective devices and Earthing.

UNIT II — THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS — 9

Evolution of Three phase circuits from single phase circuits – Star connection – Delta connection – Balanced and Unbalanced Loads- Power in three-phase circuits -Magnetic circuits- Definitions-MMF,

Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.		
UNIT III	**BASICS OF ELECTRONICS**	**9**
P-N junction diode - VI Characteristics, static and dynamic resistance, Diffusion and drift current densities, transition & diffusion capacitance - Zener diode - VI Characteristics, Zener and avanlache Breakdown, Zener Voltage Regulator. Diode Rectifier & Filter circuits – LC Filters-PIN and Photo Diode, Photo Transistor.		
UNIT IV	**CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES**	**9**
Current controlled devices: Construction, operation and characteristics of BJT, UJT, and SCR. Voltage controlled devices: Construction, operation and characteristics of JFET and MOSFET.		
UNIT V	**FUNDAMENTAL OF COMMUNICATION ENGINEERING**	**9**
Introduction – Elements of communication systems – Modulation and Demodulation: principle pf amplitude and frequency modulation. Digital communication - Nyquist Sampling Theorem, Pulse Code Modulation, Delta Modulation, BPSK, QPSK(Qualitative Approach)- Communication systems: Radio Antenna, TV, satellite and optical fibre (Block diagram approach only).		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, New Delhi, 2015.
3. John Bird, "Electrical Circuit theory and technology", Routledge; 5th edition, 2013.

REFERENCE BOOKS

1. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
2. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7thedition, 2017.
3. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", McGraw Hill, 2010.
4. Muhammad H.Rashid, "Spice for Circuits and electronics", 4th edition. Cengage 2019.
5. V.K. Mehta and Rohit Mehta, 'Principles of Power System', S.Chand Publishers, Reprint Edition 2019.
6. Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill 4th edition 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To be able to understand the concepts related with electrical circuits and wiring practices.
CO2	To be able to study the different three phase connections and the concepts of magnetic circuits.

CO3	To be able to understand the working principle of electronic devices such as diode and zener diode.
CO4	To be able to understand the characteristics and working of current controlled and voltage controlled devices.
CO5	To be able to understand the basic concepts of communication systems.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	2	3	3	2	1	3	2	2	3	3	2	2
CO2	3	3	3	2	2	1	3	1	1	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2	1	1	1	2	3	3	2	2
CO4	3	3	3	2	1	2	2	1	1	1	1	2	3	2	2
C05	3	2	1	2	1	1	2	1	1	1	1	2	3	2	2

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GE1207	**ENGINEERING PRACTICES LABORATORY**	**L**	**P**	**T**	**C**
(Common for all branches of B.E. / B. Tech Programmes)		**0**	**0**	**4**	**2**

Objectives

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b)Study of pipe connections requirements for pumps and turbines.

(c)Preparation of plumbing line sketches for water supply and sewage works.

(d)**Hands-on-exercise:**

Basic pipe connections – Mixed pipe material connection – Pipe connections with different

	joining components. (e)Demonstration of plumbing requirements of high-rise buildings. **Carpentry using Power Tools only:** (a)Study of the joints in roofs, doors, windows and furniture. (b)Hands-on-exercise: Wood work, joints by sawing, planing and cutting.
II	**MECHANICAL ENGINEERING PRACTICE 18** **Welding:** (a)Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding. (b)Gas welding practice **Basic Machining:** (a)Simple Turning and Taper turning (b)Drilling Practice **Sheet Metal Work:** (a)Forming & Bending: (b)Model making – Trays and funnels. (c)Different type of joints. **Machine assembly practice:** (a)Study of centrifugal pump (b)Study of air conditioner **Demonstration on:** (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt. (b)Foundry operations like mould preparation for gear and step cone pulley. (c)Fitting – Exercises – Preparation of square fitting and V – fitting models.
	GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit. 5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.		
IV ELECTRONICS ENGINEERING PRACTICE 16 1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.		
TOTAL: 60 PERIODS		
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
S.No.	**Description of Equipment**	**Quantity required**
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**
5.	Centre lathe.	**2 Nos**

6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	**1 each**
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	3	0	0	3	0	0	0	0	0	3	3	2	3
CO2	3	2	3	0	0	3	0	0	0	0	0	3	3	2	2

CO3	3	1	2	0	0	2	0	0	0	0	0	3	3	2	3
CO4	3	2	3	3	1	3	1	1	1	1	2	3	3	3	3
C05	3	2	3	3	1	2	1	1	1	1	2	3	3	3	3

EE1278	**PRINCIPLES OF ELECTRICAL AND ELECTRONIC DEVICES LABORATORY**	**L**	**T**	**P**	**C**
	(Common to EEE & EIE)	0	0	4	2

Objectives

- To provide practical knowledge of fundamental concepts of electrical and electronics engineering through relevant experiments.
- To impart hands on experience in measurement of electric and magnetic circuit parameters.
- To train the students in performing the verification of ohm's law and Kirchhoff's laws.
- To analyse various connections of balanced and unbalanced loads.
- To study the characteristics of electronic semiconductor devices.

LIST OF EXPERIMENTS

1. Measurement of equivalent Resistance in an electric circuit
2. Verification of ohm's law.
3. Verification of Kirchhoff's laws.
4. Measurement of magnetic flux in magnetic circuits.
5. Star and delta connections with balanced and unbalanced loads.
6. V-I characteristics of PN junction and Zener Diode.
7. V-I characteristics of SCR.
8. V-I characteristics of BJT (CE, CB, CC Configuration).
9. V-I characteristics of FET.
10. V-I characteristics of UJT and its application.

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Dual,(0-30V) variability Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos- 1 MHz
4. Digital Multimeter -10 Nos
5. Bread board – 10 Nos
6. Digital Trainer Kit
7. Watt meter-2Nos.
8. Ammeter (0-10A)-10 Nos
9. Voltmeter (0-300V)-10Nos
10. Fluxmeter-2 Nos

11.Load Resistor Box-1Nos.

Consumables Sufficient Quantity

1. Resistor
2. BJT
3. UJT
4. Diodes
5. Zener Diode.
6. FET

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Manipulate simple electric and magnetic circuits.
CO2	Become familiar with the basic ohm's and kirchhoff's law realization.
CO3	Design and Analyse the basic circuit components and connect them to make a real electrical circuit.
CO4	Ability to Design and construct basic load connections of electrical networks
CO5	To study and analyse the characteristics of various electronic semiconductor devices.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2
CO2	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2
CO3	3	3	3	3	3	1	2	1	2	1	2	2	3	2	2
CO4	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2
C05	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2

SEMESTER III

MA1301	TRANSFORM AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
(Common to Civil, EEE, EIE, Mech and Biotech)		3	1	0	4

Objectives

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems?
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT - I	PARTIAL DIFFERENTIAL EQUATIONS	12

Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations (except $f(x^m z^k p, y^n z^k q)=0$) – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT - II	FOURIER SERIES	12

Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT - III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12

Classification of PDE – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT - IV	FOURIER TRANSFORMS	12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT - V	Z – TRANSFORMS AND DIFFERENCE EQUATIONS	12

Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) –Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform.

Total Periods:	**60**

Text Books:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.

Reference Books:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Course Outcomes (CO)

CO1	Understand how to solve the partial differential equations and apply these concepts in the field of engineering.
CO2	Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two Dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.
CO4	Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.
CO5	Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	2	0	2	1	2	0	3	1	1	1
CO2	3	3	2	2	1	2	1	0	1	0	2	0	3	2	1	2
CO3	3	3	2	2	0	1	0	0	1	0	2	0	3	1	1	1
CO4	3	2	1	2	1	0	1	1	0	0	3	0	2	2	2	2
CO5	3	3	2	2	1	0	1	0	2	1	2	0	3	1	2	2

EI1301	ELECTRICAL AND ELECTRONIC MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, power and energy.
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters.
- Elaborate study about various resistance and impedance measurement techniques
- In-depth understanding and idea of analog and digital instruments
- Detailed study of display and recording devices

Unit-I	**MEASUREMENT OF BASIC ELECTRICAL PARAMETERS**	**9**

Galvanometers – D'Arsonval galvanometer – Theory, application –Principle, construction, operation of moving coil, moving iron meters, Electrodynamometer & induction type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter– Induction type energy meter – Phantom loading

Unit-II	**POTENTIOMETERS, INSTRUMENT TRANSFORMERS**	**9**

DC potentiometer – Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Current Transformer and Potential Transformer construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications.

Unit-III	**RESISTANCE AND IMPEDANCE MEASUREMENT**	**9**

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge – Kelvin double bridge – Series and shunt type ohmmeter –High resistance measurement – Megger – Direct deflection methods – guard wire method – Loss of charge method – A.C bridges– Measurement of inductance, capacitance – Maxwell Bridge – Anderson bridge – Hay's bridge – Schering bridge – Wein's bridge – Campbell bridge to measure mutual inductance.

Unit-IV	**ANALOG AND DIGITAL INSTRUMENTS**	**9**

Digital voltmeter- various types, true RMS voltmeter and multi-meter – Microprocessor based DMM - Oscillators – Wien's bridge, RC phase shift, Hartley, Crystal oscillators – Signal and function generators – pulse and square wave generator – Applications –wave analyzer - Harmonic distortion analyzer – Spectrum analyzer – Applications

Unit-V	**DISPLAY DEVICES, VIRTUAL INSTRUMENTATION AND TELEMETRY**	**9**

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD displays – X-Y recorders – Magnetic tape recorders –– Data Loggers – Introduction to Virtual Instrumentation – block diagram - Data acquisition – General Telemetry system – various types.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	An ability to compare the working principles, merits, demerits and errors of different types of electrical instruments and can understand about different instruments that are used for measurement purpose.
CO2	Understanding of how different bridge networks are constructed and balanced for finding out values of resistance, capacitance and inductance

CO3	An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
CO4	Able to understand the principle of various display devices, virtual instrumentation and telemetry.
CO5	Able to apply the principles and practices for instrument design and development to real world problems.

TEXT BOOKS

1.	Kalsi, H.S., " Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2010
2.	Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co., New Delhi, 2010

REFERENCES

1.	Northrop, R.B., "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 2008.
2.	Carr, J.J., "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CO2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0		0	0	0	0	0	0	0	0	0	0

EI1302	**TRANSDUCER ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Get to know the methods of measurement, classification of transducers and to analyze error
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

Unit-I	**SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS**	**9**

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

Unit-II	**CHARACTERISTICS OF TRANSDUCERS**	**9**
Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.		
Unit-III	**VARIABLE RESISTANCE TRANSDUCERS**	**9**
Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.		
Unit-IV	**VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS**	**9**
Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications: - Capacitor microphone, Capacitive pressure sensor, Proximity sensor.		
Unit-V	**OTHER TRANSDUCERS**	**9**
Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fibre optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451), Introduction to Agricultural Sensors- Sensor Fusion		
		TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	To apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications
CO2	To determine the static and dynamic characteristics of transducers using software packages and to analyze the problems related to sensors & transducers.
CO3	To understand about the Principle and constructional details of variable resistance transducer
CO4	To understand about the Principle and constructional details of variable capacitive and inductive transducers.
CO5	To apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications

TEXT BOOKS

3.	Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
4.	Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003

REFERENCES

1.	Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2.	D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.

3.	John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
4.	Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2003.
5.	W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006
6.	Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
7.	Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	2	2
CO3	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO4	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO5	2	2	2	1	1	-	-	-	-	-	-	2	3	2	2

EE1371	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
	Common to EEE and EIE	2	1	0	3

Objectives

- To determine the response of electric circuits using basic analysis methods.
- To impart knowledge on solving circuit equations using network theorems.
- To Analyse the transient behaviour of electric circuits with different types of source.
- To understand the concepts of resonance and coupled circuits.
- To Compute and analyse the two-port network and its parameters.

UNIT - I ANALYSIS OF ELECTRIC CIRCUITS & NETWORK TOPOLOGY 9

Mesh Analysis - Analysis with independent and dependent voltage sources, Supermesh Analysis. Node Analysis - Analysis with independent and dependent current sources, Supernodal Analysis. Introduction to graph theory - Network terminology. Duality and dual networks.

UNIT - II NETWORK THEOREMS FOR DC AND AC CIRCUITS 9

Network reduction: voltage and current division, source transformation, star delta conversion. Applications of: Superposition theorem, Thevenin’s theorem, Norton’s theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Mill man’s theorem.

UNIT - III TRANSIENT RESPONSE ANALYSIS 9

Transient response: Natural response & Forced response of RL, RC and RLC circuits using Laplace transform for DC input and AC sinusoidal input.

UNIT - IV RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance: Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Mutual coupled circuits: Self and mutual inductance – Coefficient of coupling – Dot Convention in coupled circuits. Ideal Transformer. Tuned circuits – single tuned circuits.

UNIT - V	**TWO PORT NETWORK AND NETWORK FUNCTIONS**	**9**

Two Port Networks, terminal pairs, relationship of two port variables, impedance(Z) parameters, admittance(Y) parameters, transmission parameters (ABCD) and hybrid parameters(H), interconnections of two port networks.

Total Periods: 45

Text Books:

1. M Nahvi I J A Edminster “Electric Circuits”; Schaum's outline series, Tata Mcgraw Hill companies, 4th Edition, 2019.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Fifth Edition, McGraw Hill, 2020.
3. David A Bell,” Electric circuits “, Oxford University Press, 2019.

Reference Books:

1. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 2017.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,Tata McGraw Hill publishers, New Delhi, 2019.
3. Sudhakar. A, Shyammohan. S.P “Circuits and Networks-Analysis and Synthesis”. Tata McGraw Hill publishers, 2018.
4. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2020.
5. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 2018.

Course Outcomes (CO)

CO1	Able to Determine the response of Electric circuits using basic analysis methods and network topology
CO2	Able to Compute the response of electric circuits using network theorem in real time applications.
CO3	Able to Apply Laplace transform techniques for solving problems and discuss the complete response of circuits.
CO4	Able to Design and analyse resonance and coupled circuits.
CO5	Able to Evaluate and analyse two port networks and its parameters.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
C05	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2

EE1372	ANALOG ELECTRONICS	L	T	P	C
	(Common to EEE and EIE)	3	0	0	3

Objectives

- To be familiar with the biasing of BJT and its amplifier circuits
- To analyse the operation of feedback amplifiers and oscillators
- To study the characteristics of Op-Amp.
- To design and construct application circuits with Op-amp IC's
- To study the functional blocks and the applications of special ICs like 555, 565 and 566 and voltage regulator ICs

UNIT - I	BIASING METHODS AND AMPLIFIER CIRCUITS	9

PN diode : Intrinsic and Extrinsic semiconductors – Formation of PN junction – biasing- VI characteristics of diode -BJT -Need for biasing, DC Load Line and Bias Point, Various biasing methods of BJT, BJT small signal model, Analysis of CE amplifier, Gain and Frequency response, Differential Amplifier - Common mode and Differential mode analysis - Multi-stage amplifier.

UNIT - II	FEEDBACK AMPLIFIERS AND OSCILLATORS	9

Feedback Concepts, gain with feedback, effect of feedback on gain stability, distortion, bandwidth, input and output impedances. Topologies of feedback amplifiers - analysis of series-series, shunt-shunt, series-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation. Barkhausen criterion for oscillation, Types of oscillators –RC, LC and crystal oscillators.

UNIT - III	OP-AMP CHARACTERISTICS AND ITS BASIC APPLICATIONS	9

Basic introduction to IC fabrication. Op-Amp characteristics: DC characteristics, AC characteristics. Basic applications: Inverting, Non-inverting, Adder, Subtractor, Differential amplifier, Instrumentation amplifier, Differentiator, Integrator circuit and Comparators.

UNIT - IV	APPLICATIONS OF OP-AMP	9

V to I, I to V converter, Multi-vibrators, Triangular wave generators, Precision rectifier, Clippers and Clampers, Peak detector, Sample and hold Circuit. First-order and Second order active filters, A/D converters: Flash, Dual slope and Successive Approximation type. D/A converters: Weighted resistance type and R-2R ladder type.

UNIT - V	SPECIAL ICS	9

555-Timer circuit, Functional block diagram, characteristics & applications, Astable and Monostable multivibrator, 566-Voltage Controlled Oscillator circuit, 565-Phase Locked Loop and its applications, IC8038-Function generator, Linear Voltage regulators: Functional Block diagram : 78XX, 79XX, LM317, IC723 general purpose regulator - SMPS.

Total Periods:	**45**

Text Books:

1. David A bell, "Electronic circuits", Oxford University Press, 2011.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', Fourth edition, New Age, 2012.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2015.

Reference Books:

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2008.

2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition, 2012.
5. Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
6. Floyd, Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.

Course Outcomes (CO): At the end of the course students will have the,

CO1	Ability to understand the biasing concepts of BJT and its amplifier circuits.
CO2	Ability to design circuits employing amplifier and oscillator circuits.
CO3	Ability to analyse, comprehend and design of analog electronic circuits involving Op-Amp
CO4	Ability to analyse and design applications using IC741 operational amplifier.
CO5	Ability to design analog integrated circuits using 555 timer, PLL, VCO, voltage regulator and other special ICs.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	3	3	1	1	1	3	2	2	3	3
CO2	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO3	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO4	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO5	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3

EE1373	DIGITAL LOGIC CIRCUITS	L	T	P	C
	(Common to EEE, EIE)	2	1	0	3

Objectives

•To study number systems and the performance characteristics of digital logic families like DTL, TTL, ECL and CMOS.
•To study combinational circuits and implement it.
•To design synchronous sequential circuits.
•To introduce asynchronous sequential circuits and PLDs
•To gain knowledge on VHDL coding style.

UNIT - I	NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES	9

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT - II	COMBINATIONAL CIRCUITS	9
Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic: multiplexers and de multiplexers -code converters- adders-subtractors, Encoders and Decoders.		

UNIT - III	SYNCHRONOUS SEQUENTIAL CIRCUITS	9
Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram, state reduction, state assignment.		

UNIT - IV	ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES	9
Asynchronous sequential logic circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits- analysis of asynchronous sequential logic circuits. Introduction to Programmability Logic Devices: PROM , PLA ,PAL, CPLD-FPGA		

UNIT - V	VHDL	9
RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & Demultiplexers).		

Total Periods:	**45**

Text Books:

1. James W. Bignel, ‘Digital Electronics’, Cengage learning, 5thEdition, 2007.
2. M. Morris Mano, ‘Digital Design with an introduction to the VHDL’, Pearson Education, 2013.
3. Comer ‘Digital Logic & State Machine Design’, Oxford, 2012.

Reference Books:

1. Mandal ‘Digital Electronics Principles and Application’, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L. Floyd, ‘Digital Fundamentals’, 11th edition, Pearson Education, 2015.
4. Charles H. Roth, Jr, Lizy Lizy Kurian John, ‘Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari, J.S.Dhillon, ‘Digital circuits and Design’, Pearson Education, 2016.

Course Outcomes (CO) : At the end of the course students will have the,

CO1	Ability to compare the performance characteristics of various digital logic families like DTL, TTL, ECL, CMOS.
CO2	Ability to design and implement digital circuits using combinational circuits.
CO3	Ability to design sequential circuits
CO4	Ability to design asynchronous sequential circuits and PLDs
CO5	Ability to simulate using software package for development of real time logic circuits.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	3	2	-	-	-	-	-	-	-	-	1	3	-	-
CO2	1	3	2	-	-	-	1	-	-	-	-	1	3	-	-
CO3	3	2	1	-	-	-	1	-	-	-	-	1	3	-	-
CO4	3	2	1	-	-	-	1	-	-	-	-	1	3	-	-
CO5	1	3	2	-	1	-	1	-	-	-	-	1	2	1	-

EE1391	ANALOG AND DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To be exposed to the operation and application of electronic devices and their circuits
- To analyze operation using Op-amp IC's.
- To design and construct application circuits with ICs as Op-amp, 555, etc.
- To learn design, testing and characterizing of circuit behaviour with digital ICs
- To impart the analysis of sequential and combinational circuit.

LIST OF EXPERIMENTS

1. Frequency response of CE Amplifier.
2. Design of an Oscillator- RC and LC oscillator using BJT.
3. Applications of Op-Amp: inverting, non-inverting amplifier, Adder, Comparator and differential amplifier
4. Design of Integrator, Differentiator, Clipper and Clamper
5. IC 555 Timer applications – Astable and Monostable operation
6. Design of Linear Voltage regulator
7. Implementation of Boolean Functions, Adder/ Subtractor circuits.
8. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
9. Encoders and Decoders
10. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
11. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
12. Implementation of multiplexer and demultiplexer.

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Dual (0-30V) Variable Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos.- 1 MHz
4. Digital Multimeter -10 Nos
5. IC Tester (Analog)- 2 Nos
6. Bread board – 10 Nos
7. Digital Trainer Kit

Consumables Sufficient Quantity

1. IC 741/ IC NE555

2. Digital IC types
3. LM317
4. Transistor – 2N3391, BC107, BC147
5. Diodes - IN4001, BY126
6. DIB, DCB
7. Capacitor
8. Resistors 1/4 Watt Assorted
9. Single Strand Wire
10.Potentiometer 10K
11.Step Down Transformer -230V to 12 V
12.Rectifier IC W10

Course Outcomes (CO)

CO1	Ability to understand the operation and application of electronic devices and their circuits.
CO2	Ability to analyse, comprehend and design of analog electronic circuits involving OP-AMP
CO3	Ability to analyse, comprehend and design of analog electronic circuits involving timer 555
CO4	Ability to learn, design, test and analyse digital ICs
CO5	Ability to analyse the sequential and combinational circuit

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	3	3	1	3	1	3	1	2	3	3
CO2	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO3	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO4	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO5	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3

EI1308	ELECTRICAL AND ELECTRONICS MEASUREMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- Simulate, understand and experimentally verify the electric circuit laws
- Simulate, identify network theorems and their application to network reduction techniques
- To be familiar with the structure of basic electronic devices
- To be exposed to the operation and application of electronic devices and their circuits
- To analyze circuit characteristics with signal analysis using Op-amp Ics.

S. NO	LIST OF EXPERIMENTS
1.	Simulation and experimental verification of electrical circuit problems using Thevenin’s and Norton’s theorem.
2.	Simulation and experimental verification of electrical circuit problems using Superposition theorem.
3.	Simulation and experimental verification of Maximum Power transfer Theorem.
4.	Study of CRO and measurement of sinusoidal voltage, frequency and power factor

5.	Simulation and Experimental validation of RC and RLC electric circuit transients.
6.	Design and Simulation of series and parallel resonance circuit.
7.	Displacement versus output voltage characteristics of a potentiometric transducer.
8.	Wheatstone and Kelvin's bridge for measurement of resistance.
9.	Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
10.	Calibration of Ammeter and Voltmeter using Shunt type potentiometer.
11.	Calibration of Single-phase wattmeter.
12.	Calibration of Single-phase Energy meter
	TOTAL :60 PERIODS
	LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS
1.	Regulated Power Supply: 0 – 15 V D.C - 10 Nos / Distributed Power Source.
2.	Function Generator (1 MHz) - 10 Nos.
3.	Single Phase Energy Meter - 1 No.
4.	Oscilloscope (20 MHz) - 10 Nos.
5.	Digital Storage Oscilloscope (20 MHz) – 1 No.
6.	10 Nos. of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / MATLAB /other Equivalent software Package) and Printer (1 No.)
7.	AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.)
8.	Single Phase Wattmeter – 3 Nos.
9.	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box - 6 Nos each. Circuit Connection Boards - 10 Nos. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand and simulate the electric circuit laws
CO2	Ability to understand and simulate the network theorems and their application to network reduction techniques
CO3	Ability to understand the structure and underlying semiconductor physics concepts.
CO4	Ability to design circuits employing electronic devices.
CO5	Analyze, comprehend and design of analog electronic circuits involving OP-AMP

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO2	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO3	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO4	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO5	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-

SEMESTER IV

MA1401	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	(Common to MECH, EEE & EIE)	3	1	0	4

Objectives

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the Interpolation operators and numerical techniques of interpolation in various intervals, numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT – I	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit

UNIT – II	DESIGN OF EXPERIMENTS	12

One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT – III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method.

UNIT – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12

Interpolation operators (Forward, Backward, shifting operators and its Properties) -– Newton's forward and backward difference interpolation for equal intervals – Lagrange's and Newton's divided difference interpolations for unequal intervals - Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT – V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	12

Finite difference methods for solving second order two - point linear boundary value problems Single step methods: Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams- Bash forth predictor corrector methods for solving first order equations.

Total Periods: 60

Text Books:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.

2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and scientists" 8th edition, Pearson Education, Asia, 2007.

Course Outcomes (CO)

CO1	Students will gain knowledge on Large Samples and Small Samples. These concepts are very useful in Biological, Electric power management, Social experiments and also in all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO2	ANOVA's statistical significance result is independent of constant bias and scaling of errors. It is used in testing the difference between several treatments in the Design of experiments. It checks the impact of one or more factors in any experiment in Engineering.
CO3	Students will learn on nonlinear (algebraic or transcendental) equations and linear equations. Students learn to solve the Eigen value problem of a matrix numerically when analytical methods tend to fail to give solution and apply all these in the fields like Vibrating systems, fluid dynamics.
CO4	Students will learn to construct approximate polynomials that can be used in data representation using interpolation techniques to find the intermediate values. In particular, interpolation methods are extensively applied in the models of the different phenomena where experimental data must be used in computer studies where expressions of those data are required. The learners are introduced to numerical differentiation and integration techniques. The techniques are useful when the function in the analytical form is complicated.
CO5	Students get an insight on ordinary differential equations which will be useful in solving engineering problems. Students learn about the different methods for solving first order and second order differential equations. It will be useful in attempting any engineering problems. ODE is applied in specific mathematical fields like Electrical, Geometry, Analytical mechanics, Celestial mechanics and Weather modelling.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	2	3	3	3	2	3	2	-	2	-	2	2	2	2	1	2
CO2	2	3	3	3	3	2	2	-	2	-	2	2	2	1	1	2
CO3	2	3	2	2	1	-	-	-	-	-	-	2	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	1	2	1
CO5	3	3	2	1	2	1	-	-	-	-	-	2	2	2	2	1

EI1401	INDUSTRIAL INSTRUMENTATION - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the measurement techniques of force, torque and speed.
- To introduce the measurement techniques of acceleration, Vibration and density
- To introduce the measurement Viscosity, Humidity and moisture.
- To introduce the temperature measurement techniques
- To introduce the pressure measurement techniques

Unit-I	MEASUREMENT OF FORCE, TORQUE AND SPEED	8

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.

Unit-II	MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY	8

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

Unit-III	MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE	8

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids**.**

Unit-IV	TEMPERATURE MEASUREMENT	12

Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple – Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two colour radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration- Smart Temperature transmitter.

Unit-V	PRESSURE MEASUREMENT	9

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, Iionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester- Smart Pressure transmitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES At the end of the course, the student will have the:	
CO1	Understand the construction and working principle of various types of transducers/sensor to measure physical quantities such as force, torque and speed.
CO2	Understand the construction and working principle of various types of transducers/sensor to measure physical quantities such as acceleration, vibration and density.
CO3	Understand the construction and working principle of measuring Viscosity, Humidity and moisture
CO4	Understand working of different types of temperature measuring instruments like RTD, Thermistor.
C05	Understand working of additional types of temperature measuring instruments like thermocouple and radiation pyrometer.

TEXT BOOKS

1. Doebelin, E.O. and Manik, D.N., “Measurement systems Application and Design”, 6th McGraw-Hill Education Pvt. Ltd, 2011.
2. Jones, B.E., “Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES

1. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005.
2. Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, McGraw-Hill Education, 2017.
3. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 1990
4. Singh,S.K., “Industrial Instrumentation and Control”, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.
5. Alok Barua, “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Kharagpur.
6. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.
7. A.K. Sawhney, “A Course in Electronic Measurements and Instrumentation ”, Dhanpat Rai & Co. (P) Limited, 2015.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO2	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO3	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO4	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO5	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-

EE1451	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce about D.C Machines and Transformers
- To introduce and educate about Synchronous Machines
- To introduce and Educate about Three Phase Induction Motors
- To introduce and educate about Single Phase Induction Motors
- To introduce and educate about special electrical machines

UNIT I	D.C.MACHINES	9

D.C. Machines: – Principle of operation and construction of motor and generator – torque equation – Armature Reaction-Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control of D.C. Motor. Applications of DC Motor and Generator

UNIT II	TRANSFORMERS	9

Principle, Construction and Types of Transformer - EMF equation - Phasor diagrams - Regulation and efficiency of a transformer-Introduction to three phase transformer Connection. Applications of Current and Potential Transformer.

UNIT III	SYNCHRONOUS MACHINES	9

Principle of Operation, type - EMF Equation and Phasor diagrams - Synchronous motor- Rotating Magnetic field Starting Methods , Torque V- Curves, inverted – V curves

UNIT IV	THREE PHASE INDUCTION MOTORS	9

Induction motor-principle of operation, Types – Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT V	SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	9

Types of single phase induction motors –Double field revolving theory- Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor – Switched reluctance motor – Brushless D.C motor.-Stepper motor.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand about D.C Machines
CO2	Ability to understand about Transformers
CO3	Ability to understand about Synchronous Machines
CO4	Ability to understand about Single Phase Induction Motors
CO5	Ability to understand about special electrical machines

TEXT BOOKS

1.	Theraja, B.L., “A Text book of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007
2.	Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., “Electric Machinery”, McGraw-Hill, 2002.

REFERENCES

1.	Abhijit Chakrabarti and Sudipta Debnath, “Electrical Machines”, McGraw- Hill

	Education, 2015.
2.	Deshpande M. V., “Electrical Machines” PHI Learning Pvt. Ltd., New Delhi, 2011
3.	B.S.Guru and H.R.Hiziroglu, “Electric Machinery and Transformer’, Oxford university Press 2007.
4.	Del Toro, V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi,1995.
5.	Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, McGraw Hill Education, 2010.
6.	NPTEL Video Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr. Krishna Vasudevan, IIT Madras.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	1	-	-	-	-	1	2	2	-
CO2	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-
CO3	3	3	3	3	2	-	1	-	-	-	-	1	2	2	-
CO4	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-
CO5	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-

EI1402	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To study the various analog and digital modulation techniques.
- To study the various transmission techniques.
- To study the principles behind information theory and coding.
- To study the various digital communication techniques.

UNIT I	ANALOG COMMUNICATION	9
Amplitude Modulation - Generation & Detection methods of AM, DSBSC - Generation & Detection methods of SSBSC, VSB - PSD, modulators and demodulators - Angle modulation - FM modulators and demodulators - PM modulators and demodulators , FM and PM – frequency spectrum - power relations : NBFM & WBFM - Nonlinear Effects in FM Systems - Armstrong method & Reactance modulation.		
UNIT II	**PULSE MODULATION**	**9**
Low pass sampling theorem – Quantization – PAM - Line coding - PCM, DPCM,DM, ADPCM and ADM - Channel Vocoder - Time Division Multiplexing - Frequency Division Multiplexing		
UNIT III	**DIGITAL MODULATION AND TRANSMISSION**	**9**

Phase shift keying - BPSK, DPSK, QPSK - Principles of M-ary signalling M-ary PSK -QAM Comparison, ISI - Pulse shaping - Duo binary encoding - Cosine filters - Eye pattern -Equalizers.		
UNIT IV	**INFORMATION THEORY & CODING**	**9**
Measure of information & Entropy - Source coding theorem - Shannon-Fano coding - Huffman coding- LZ coding - Channel capacity, Shannon-Hartley law, Shannon's limit - Error control codes - cyclic codes - Syndrome calculation - Convolutional Coding - Sequential decoding - Viterbi decoding.		
UNIT V	**SPREAD SPECTRUM & MULTIPLE ACCESS**	**9**
PN sequences - properties - m-sequence - DSSS - Processing gain, Jamming - Frequency domain representation of Noise - Mathematical Representation of Noise.- FHSS - Synchronisation and tracking Multiple Access - FDMA, TDMA, CDMA.		
TOTAL (L: 45+T: 0): 45 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the Ability:

CO1	Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2	To use data and pulse communication techniques
CO3	Apply digital communication techniques
CO4	Analyze Source and Error control coding
CO5	An in- depth knowledge of Spread Spectrum and Multiple Access Techniques

TEXT BOOKS

1.	H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007.
2.	S. Haykin “Digital Communications” John Wiley 2005

REFERENCES

1.	B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd edition, Oxford University Press, 2007
2.	H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
3.	B.Sklar, Digital Communications Fundamentals and Applications” 2/e Pearson Education 2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO2	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO3	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO4	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO5	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0

EE1471	CONTROL SYSTEMS	L	T	P	C
	(Common to EEE and EIE)	2	1	0	3

Objectives

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems

UNIT – I	SYSTEMS AND REPRESENTATION	9

Basic elements in control systems: – Open and closed loop systems -Feed forward and Feedback control theory – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT – II	TIME RESPONSE	9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction. Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT – III	FREQUENCY RESPONSE	9

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

UNIT – IV	STABILITY AND COMPENSATOR DESIGN	9

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag- lead compensator using bode plots.

UNIT – V	STATE VARIABLE ANALYSIS	9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability -Control Design Using State feedback.

Total Periods:	**45**

Text Books:

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

Reference Books:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, PearsonEducation, 2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint2009.
4. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

Course Outcomes (CO)	
CO1	Ability to develop various representations of system and to reduce the complex systems into simpler system in transfer function.
CO2	Ability to do time domain analysis of various models of linear system and understand the use of controllers in closed loop system
CO3	Ability to do frequency domain analysis of various models of linear system
CO4	Infer the stability of systems and ability to design appropriate compensator for the given specifications
CO5	Ability to represent the system in state variable forms

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO2	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO4	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO5	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (LAB INTEGRATED)	L	T	P	C
	(Common to EEE & EIE)	**3**	**0**	**2**	**4**

OBJECTIVES

- To learn the features of C
- To learn the linear and non-linear data structures
- To explore the applications of linear and non-linear data structures
- To learn to represent data using Trees and graph data structure
- To learn the basic sorting, searching, and Hashing Algorithm

UNIT I **C PROGRAMMING BASICS** **9 +6**

Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. Strings- String operations – String Arrays. Simple programs – matrix operations.

Lab Component

- **IMPLEMENTATION OF BASIC C PROGRAMS**
  Basic C Programs – looping, data manipulations and arrays.
- **IMPLEMENTATION OF STRING HANDLING FUNCTIONS**
  Programs using strings – string function implementation.

UNIT II	FUNCTIONS, POINTERS, STRUCTURES AND UNIONS	9 + 6

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

Lab Component

- **IMPLEMENTATION OF USER DEFINED DATA TYPES**
  a. Programs using structures and pointers.
  b. Programs involving dynamic memory allocations.

UNIT III	LINEAR DATA STRUCTURES	9 + 6

Arrays and its representations – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

Lab Component

- **IMPLIMENTATION OF LINKED LIST**
  Write a C program to Design and implement Singly Linked List.
- **IMPLEMENTATION OF STACK AND QUEUE**
  Write a C program to implement the following
  a. Stack and its operations using Array and List
  b. Queue and its operations using Array and List.
- **APPLICATIONS OF LINEAR DATA STRUCTURES**
  a. Write a C program to design and implement polynomial addition using list.
  b. Write a C program to evaluate arithmetic expression.

UNIT IV	NON-LINEAR DATA STRUCTURES	9 + 6

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort –Applications of graphs.

Lab Component

- **IMPLEMENTATION OF TREE**
  Write a C program to implement the following
  a. Construct binary search tree.
  b. Traverse the binary search tree recursively in pre-order, post-order and in-order.
  c. Count the number of nodes in the binary search tree
- **GRAPH TRAVERSAL**
  Write a C program to implement the following algorithms
  a. Depth first search.
  b. Breadth first search.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9 + 6

Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort - Hash tables – Overflow handling.

Lab Component

- **SORTING &SEARCHING**
  Write a C program to implement the following sorting techniques to arrange a list of integers in ascending order.

a. Quick sort
b. Merge sort
c. Linear Search
d. Binary Search

- **IMPLEMENTATION OF HASHING TECHNIQUES**
  Write a C program to Implement the following techniques
  a. Linear Probing
  b. Quadratic Probing
  c. Double Hashing

PRACTICALS: 30 PERIODS THEORY: 45 PERIODS TOTAL : 75 PERIODS

TEXT BOOKS

1. Reema Thareja, ―Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

CO1	To know the basic concepts of C
CO2	Suggest appropriate linear data structure for any given data set.
CO3	To learn the concepts of non-linear data Structures
CO4	Modify or suggest new data structure for an application
CO5	Appropriately choose the sorting, Searching, Hashing algorithm for an application.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3

EI1408	**MACHINES AND CONTROL LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

- To obtain the no load and load characteristics of D.C machines.
- To obtain the speed characteristics of D.C motor.
- To find out regulation characteristics of Transformer.
- To calculate the steady state error of a system for standard input signals.

•	To analyse the stability of the system using time and frequency domain.

S.NO	LIST OF EXPERIMENTS
1.	Open circuit characteristics of D.C. shunt generator.
2.	Load characteristics of D.C. shunt generator.
3.	Break test on D.C. shunt motor.
4.	Speed control of D.C. shunt motor.
5.	Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
6.	Load test on single phase induction motor.
7.	Simulation and experimental verification of First order system
8.	Simulation of Second order system
9.	Compute the impulse, step, ramp and parabolic responses of the given system and calculate the steady state error.
10.	Determine the stability of the unity feedback system for the given open loop transfer function using bode, Nyquist and root locus.
11.	Determine the system controllability and observability and comment

Course Outcome:

On completion of this Course, the students will be able to

CO1	Ability to make use of basic concepts to obtain the no load and load characteristics of D.C machines.
CO2	Analyze and draw conclusion from the characteristics obtained by conducting experiments on machines.
CO3	Ability to interpret characteristics of the system to develop mathematical model.
CO4	Ability to do time domain and frequency domain analysis of various models of linearsystem.
CO5	Ability to come out with solution for complex control problem.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO2	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO3	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO4	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO5	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1.	DC Shunt Motor with Loading Arrangement

2.	Single Phase Transformer
3.	Single Phase Induction Motor with Loading Arrangement
4.	Single Phase Auto Transformer
5.	Single Phase Resistive Loading Bank setup
6.	Sufficient number of Ammeters, Voltmeters, (or Multimeters), Switches, tachometers, Wattmeter.
7.	Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC.

EI1409	MEASUREMENTS AND TRANSDUCERS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

•	To make the students aware of basic concepts of measurement and operation of different types of transducers.
•	To make the students conscious about static and dynamic characteristics of different types of transducer.
•	To make the students to analyze step response of RTD
•	To make the student to study the Synchros and Proximity sensor
•	To make the students to study the digital transducer

S.NO	LIST OF EXPERIMENTS
1.	Displacement versus output voltage characteristics of a potentiometric transducer.
2.	Characteristics of Strain gauge and Load cell transducer.
3.	Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4.	Characteristics of LDR, thermistor transducer.
5.	Step response characteristic of RTD and thermocouple transducers.
6.	Temperature measurements using RTD with three and four leads.
7.	Measurement of Angular displacement using resistive and Capacitive transducer.
8.	Characteristics of Synchros and Proximity sensor
9.	Level measurement using Ultrasonic transducer.
10.	Measurement of temperature using IR thermometer and IC sensor
11.	Study of Digital transducer
12.	Study of Smart transducers
	TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

S.NO	LIST OF EXPERIMENTS
CO1	Understand the concepts of measurement, error and uncertainty.
CO2	Understand the static and dynamic characteristics of measuring instruments.
CO3	Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
CO4	Acquire knowledge of analyzing different stages of signal conditioning units.
CO5	. Acquire knowledge of advancement of digital transducers

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Strain gauge and Load cell trainer -1
2.	LVDT trainer -1
3.	Hall Effect transducer trainer -1
4.	Photoelectric tachometer tachometer -1
5.	LDR Trainer -1
6.	Thermistor, Thermocouple J and K type -1
7.	RTD 3 wire and 4 wire -1
8.	Synchros and Proximity sensor trainer -1
9.	Ultrasonic transducer setup -1
10.	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO2	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO3	2	2	2	1	-	2	-	-	1	-	-	1	2	2	1
CO4	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO5	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1

HS1310	**PROFESSIONAL SKILLS LAB**	**L**	**P**	**T**	**C**
	(Common to CSE, EEE, CHEM, EIE,CIVIL, AI & DS)	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.

UNIT II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language

UNIT III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD;

Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc.

UNIT IV	**6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

UNIT V	**6**

Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes.

TOTAL : 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

One Server

30 Desktop Computers

One Hand Mike

One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,.OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	2	0	2	1	0	0	0	2	3	0	0	2	2	0
CO2	0	2	0	2	0	0	0	0	2	3	0	0	2	0	0
CO3	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0
CO5	0	2	1	1	2	0	2	0	2	3	0	2	2	2	0

SEMESTER V

EE1571	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Objectives

- To impart knowledge on different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of uncontrolled and controlled rectifiers.
- To learn the Operation, switching techniques and basics topologies of DC-DC switching regulators.
- To Compute and analyse the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To understand the operation of AC to AC converter.

UNIT - I	**POWER SEMI-CONDUCTOR DEVICES**	**9**

Study of switching devices - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT. Static characteristics: SCR, MOSFET and IGBT. Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.

UNIT - II	**UNCONTROLLED AND PHASE-CONTROLLED CONVERTERS**	**9**

Uncontrolled converters- half bridge and full bridge converters. Controlled converters: 2-pulse, 3-pulse and 6-pulse converters – performance parameters. Effect of source inductance. Firing Schemes for converter. Dual converters. Applications-light dimmer, Excitation system.

UNIT - III	**DC TO DC CONVERTERS**	**9**

Step-down and step-up chopper: control strategy. Introduction to types of choppers: A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator. Introduction to Resonant Converters. Applications-Battery operated vehicles and Solar PV systems.

UNIT - IV	**INVERTERS**	**9**

Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode): Voltage& harmonic control- PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM. Introduction to space vector modulation. Current source inverter - Applications-Induction heating, UPS.

UNIT - V	**AC TO AC CONVERTERS**	**9**

Single phase and Three phase AC voltage controllers: Control strategy- Power Factor Control – Multistage sequence control. -Single phase and three phase cyclo - converters. Introduction to Matrix converters. Applications –welding.

Total Periods: 45

Text Books:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, third Edition, New Delhi, 2019.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2019.
3. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2018.

Reference Books:

1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2019.
2. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2019 Edition.
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2020.
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters,

5. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2018.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2017.
7. JP Agarwal," Power Electronic Systems: Theory and Design" Pearson Education, 2019.

Course Outcomes (CO)

CO1	Ability to understand the operation of semiconductor devices and its dynamic characteristics.
CO2	Ability to analyse and choose the Uncontrolled and controlled converters for real time applications.
CO3	Ability to analyse the operation of DC- DC converter and its applications.
CO4	Able to Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5	Able to Understand the operation of AC voltage controllers and its applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2

EE1572	**MICROPROCESSORS AND MICROCONTROLLERS**	**L**	**T**	**P**	**C**
	(Common to EEE and EIE)	**3**	**0**	**0**	**3**

Objectives

- To study the architecture, pin diagram, memory organisation and interrupts of 8085 microprocessors and 8051 microcontrollers.
- To study the addressing modes & instruction sets of 8085 and 8051.
- To develop skills in simple programming writing using assembly languages.
- To introduce commonly used peripherals/ interfacing ICs.
- To study and understand typical applications using 8085 and 8051.

UNIT – I	**8085 PROCESSOR**	**9**
Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Interrupts.		**CO1**

UNIT – II	**PROGRAMMING OF 8085 PROCESSOR**	**9**
Instruction format and addressing modes – Assembly language format – Data transfer, data Manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions – stack, Timing diagram of instructions.		**CO2**

UNIT – III	**PERIPHERAL INTERFACING**	**9**
Study on need, architecture, configuration and interfacing, with ICs: 8251, 8253/8254, 8255, 8259, 8279, A/D and D/A converters & its Interfacing with 8085.		**CO3**

UNIT - IV	8051 MICRO CONTROLLER	9
Hardware Architecture, Pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timers-serial communication; Interrupts, Instruction sets- Data Transfer, Manipulation, Control Algorithms & I/O instructions; Addressing modes; Timing Diagram; Comparison to Programming concepts with 8085.		**CO4**

UNIT – V	MICRO CONTROLLER PROGRAMMING & APPLICATIONS	9
Simple programming exercises; Key board and display interface; Control of servo motor, Stepper motor control, Application to automation systems.		**CO5**
	Total Periods:	**45**

Text Books:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application' with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
3. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 6th Indian reprint, 2013.

Reference Books:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2nd edition, 2013.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, "Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051", McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu, 2016.
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu, 2016.

Course Outcomes (CO)

CO1	Ability to explain the architecture, memory organisation and interrupt structures of 8085 Microprocessor.
CO2	Ability to acquire knowledge in Addressing modes, instruction sets, timing diagram and to write the assembly language program of 8085 Microprocessor.
CO3	Ability to understand the importance of Interfacing with microprocessors and microcontrollers.
CO4	Ability to explain the architecture of Microcontroller, addressing modes & instruction sets of 8051.
CO5	Ability to develop the Microprocessor and Microcontroller based applications.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	3	2	2	1	1	1	1	2	1	1	1	1	3	2	2	1
CO2	3	3	2	1	3	3	1	2	1	1	3	1	3	3	2	1
CO3	3	2	2	1	1	1	1	2	1	1	1	1	3	3	2	1
CO4	3	2	2	1	1	2	1	2	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	3	1	2	1	1	3	1	3	2	2	1

EI1501	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce fundamentals of biomedical engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oximeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radiographic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopaedic prostheses fixation.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course students will have the

CO1	Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
CO2	Ability to provide latest ideas on devices of non-electrical devices.
CO3	Ability to gain knowledge on various sensing and measurement devices of electrical origin.
CO4	Ability to bring out the important and modern methods of imaging techniques and their analysis.
CO5	Ability to explain the medical assistance/techniques, robotic and therapeutic equipment.

TEXT BOOKS:

1.	Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2.	Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003.
3.	Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012.

REFERENCES

1.	John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2.	Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3.	Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4.	Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5.	M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

MAPPING BETWEEN CO, PO AND PSO WITH CORRELATION LEVEL 1/2/3

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO2	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO3	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO4	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO5	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-

EI1502	**INDUSTRIAL INSTRUMENTATION-II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce variable head type flow meters
- To introduce quantity meters, air flow meters and mass flow meters
- To educate on electrical type flow meters
- To educate on the level measurement techniques
- To educate on Viscosity, Humidity and Moisture content

UNIT I	**VARIABLE HEAD TYPE FLOWMETERS**	**9**

Expression for flow rate through restriction (compressible and incompressible flow) – Head type flowmeter – Principle, Construction and operations of Orifice plate and its different types, Venturi tube – Flow nozzle – Dall tube – Pitot tube: **:** combined pitot tube, averaging pitot tube, Cd variation – pressure tappings – Installation and applications of head flow meters

Unit-II	**QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS**	**9**
Positive displacement flow meters**:** Principle, Construction and operation of Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter – Turbine flow meter – Variable Area flow meter: Rotameter –theory, characteristics, installation and applications – Mass flow meters:– Angular momentum – Thermal, Coriolis type mass flow meters – Calibration of flow meters: Dry and wet type, Dynamic weighing method.		
Unit-III	**ELECTRICAL TYPE FLOW METERS**	**9**
Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.		
Unit-IV	**LEVEL MEASUREMENT**	**9**
Level measurement**:** Sight glass, Float gauges - Displacer type – D/P methods - Bubbler System-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement: – Differential pressure method and Hydrastep method - Solid level measurement.		
Unit-V	**TRANSMITTERS**	**9**
Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.		
		TOTAL (L: 45+T: 30):75 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand the construction, installation and working of different variable head type flow meters.
CO2	To educate variable area flow meters, mass flow meters, electrical type, open channel and solid flow meters.
CO3	Able to understand the construction, working and calibration of different quantity flow meters,
CO4	Ability to gain knowledge about the construction, working and calibration of different type of transmitters.
CO5	Ability to choose appropriate flow meters or level sensor for an application.

TEXT BOOKS

1.	Doebellin, E.O. and Manik D.N., “Measurement systems Application and Design”, 5th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2007.
2.	Patranabis, D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

REFERENCES

1.	Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.
2.	Singh,S.K., Industrial Instrumentation and Control, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.

3.	Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	3	2	2	0	1	0	0	0	0	0	2	1	0
CO2	0	0	0	3	2	2	1	0	0	0	0	0	2	1	0
CO3	0	0	1	3	2	1	1	0	0	0	0	0	2	1	0
CO4	0	0	1	2	3	1	1	0	0	0	0	0	2	1	0
CO5	0	0	0	2	1	3	2	0	0	0	0	0	1	2	0

EE1591	**MICROPROCESSORS AND MICROCONTROLLERS LABORATORY**	**L**	**T**	**P**	**C**
		0	0	4	2

Objectives

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Read a key, interface display
7. Interface 8253 timer and perform mode-2 and mode-3 operation.
8. Demonstration of basic instructions with 8051 Micro controller
   (i) Conditional jumps & looping
   (ii) Calling subroutines.
9. Programming timer of 8051
10. Programming I/O Port of 8051 for
    (i) Interfacing of A/D & D/A
    (ii) Interfacing of DC & AC motors
11. Programming Practices with Simulators/Emulators/open source
12. Application hardware development using embedded processors.

Total Periods:	**60**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No.	Description of Equipment	Quantity required
1	8085 Microprocessor Trainer with Power Supply	15
2	8051 Micro Controller Trainer Kit with power Supply	15
3	8255 Interface boards	5
4	8251 Interface boards	5
5	8259 Interface boards	5
6	8279 Keyboard / Display Interface boards	5
7	8253/8254 timer/ counters	5
8	ADC and DAC cards	5
9	AC & DC motor with Controllers	5
10	Traffic Light Control Systems	5

Course Outcomes (CO)

CO1	Ability to perform basic programming using 8085 and 8051
CO2	Ability to perform interfacing of various peripheral ICs using 8085 & 8051
CO3	Ability to program basic interfacing applications.
CO4	Ability to use basic Simulators/Emulators/open source related to 8085 & 8051.
CO5	Ability to design and develop a simple application using any embedded processors.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	1	1	1	1	1	1	1	1	1	3	2	2	1
CO2	3	2	2	2	2	2	2	1	1	1	1	3	2	3	2
CO3	3	2	3	2	2	1	2	1	1	1	1	3	2	3	2
CO4	3	2	2	2	3	2	1	1	1	1	1	3	2	3	2
CO5	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3

EI1507	INDUSTRIAL INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To impart an adequate knowledge and expertise to handle equipment generally available in an industry
- To make the students aware about calibration of meters, sensors and transmitters.
- To make the students conscious about the working and operation of different types of analytical Instruments.
- To identify, formulate, and analyze problems regarding sensors and transmitter

LIST OF EXPERIMENTS

1. Measurement of speed, torque and vibration parameters.

2.	Calibration of pressure gauge using dead weight tester.
3.	Measurement of level using Differential Pressure Transmitter
4.	Measurement of flow using a. Discharge coefficient of orifice plate b. Calibration of Rotameter
5.	Design and Testing of Electromagnetic Flow meters.
6.	Measurement of Conductivity, Moisture and Viscosity of test solutions.
7.	Standardization and measurement of pH values of different solutions
8.	Measurement and analysis of ECG signals.
9.	Vacuum pressure measurement
10.	Pulse rate measurement
11.	Measurement of Absorbance and Transmittance of Test solutions using IR-spectrometer.
12.	Measurement of Absorbance and Transmittance of Test solutions using UV-spectrometer.
	TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Orifice plate 1
2.	Dead weight tester with pressure gauge 1
3.	Torque trainer 1
4.	Saybolt Viscometer 1
5.	Vacuum gauge 1
6.	DP transmitter 1
7.	UV – Visible spectrophotometer 1
8.	IR – Visible spectrophotometer 1
9.	pH meter 1
10.	Conductivity meter 1
11.	ECG trainer 1
12.	Pulse rate trainer 1
13.	Tacho meter-1

COURSE OUTCOMES (COs)

1.	Ability to experimentally measure industrial process parameters such as flow, level
2.	Ability to experimentally measure industrial process parameters such as temperature, pressure
3.	Ability to experimentally measure industrial process parameters such as viscosity.
4.	Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
5.	Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0
CO2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO3	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0

CO4	0	0	0	0		0	0	0	0	0	0	0	0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SEMESTER VI

EI1601	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To educate various embedded processors.
•	To impart an adequate knowledge of timers and interrupts.
•	To learn embedded C programs.
•	To learn simple embedded applications.
•	To learn IoT using Arduino/Raspberry Pi /open platform

UNIT I	**8-BIT EMBEDDED CONTROLLERS AND C PROGRAMMING**	**9**
8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt handling – Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Priority Based Scheduling Policies.		
UNIT II	**IOT AND ARDUINO PROGRAMMING**	**9**
ARM Processor – Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.		
UNIT III	**BUILDING IoT WITH RASPBERRY PI**	**9**
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		
UNIT IV	**IOT COMMUNICATION AND OPEN PLATFORMS**	**9**
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud		
UNIT V	**INDUSTRIAL IOT AND SECURITY**	**9**
Introduction to the Industrial Internet - Networked Control Systems – Network delay modeling - Architecture and design methodologies for developing IoT application for Networked Control Systems – Example using SCADA system - Software Design Concepts - Middleware IIOT platforms-securing the Industrial Internet- Introduction to Industry 4.0.		
		TOTAL :45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

CO1	Understand and compare various embedded processors.
CO2	Design and deploy timers and interrupts.

CO3	Write embedded C programs.
CO4	Design simple embedded applications.
CO5	Design portable IoT using Arduino/Raspberry Pi /open platform

TEXT BOOKS:

1.	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2.	Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 2014.

REFERENCES:

1.	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
2.	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
3.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", VPT, 2014.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1602	**PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

•	To introduce technical terms and nomenclature associated with Process control domain.
•	To familiarize the students with characteristics, selection, sizing of control valves.
•	To provide an overview of the features associated with Industrial type PID controller
•	To make the students understand the various PID tuning methods.
•	To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I	**PROCESS MODELLING AND DYNAMICS**	**12**
Need for process control – Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.		

UNIT II	FINAL CONTROL ELEMENTS	12
Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing- Standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection.		
UNIT III	**CONTROL ACTIONS**	**12**
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action		
UNIT IV	**PID CONTROLLER TUNING**	**12**
PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control –Ratio control, Split range control.		
UNIT V	**MODEL BASED CONTROL SCHEMES**	**12**
Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three- element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control of Heat Exchanger - Multivariable control strategies-Parametric and Nonparametric Models, State space and Transfer Function Representations and their inter relationships-Case study –Distillation column-P&ID diagram		
TOTAL :60 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand technical terms and nomenclature associated with Process control domain.
CO2	Ability to build models using first principles approach as well as analyze models
CO3	Ability to Design, tune and implement PID Controllers to achieve desired performance for various processes
CO4	Ability to Analyze Systems and design & implement control Schemes for various Processes.
CO5	Ability to Identify, formulate and solve problems in the Process Control Domain.

TEXT BOOKS

1.	Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2 nd Edition, 2003.
2.	Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
3.	Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCES

1.	Coughanowr, D.R., “Process SystemsAnalysis and Control”, McGraw - Hill International Edition, 2004.
2.	Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2006.
3.	Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.

4.	Bela.G.Liptak., "Process Control and Optimization"., Instrument Engineers' Handbook., volume 2, CRC press and ISA, 2005.
5.	Ramesh C. Panda., T.Thyagarajan., "An Introduction to Process Modelling Identification and Control for Engineers" Narosa Publishing house Pvt. Ltd, 2017

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	2	3	1	1	1	0	0	0	0	0	0	2	2	0
CO2	1	1	2	1	1	0	0	0	0	0	0	0	2	2	0
CO3	1	1	2	1	1	0	0	0	0	0	0	0	2	2	0
CO4	1	2	1	1	1	1	0	0	0	0	0	0	2	2	0
CO5	1	1	3	1	1	0	0	0	0	0	0	0	2	2	0

EE1671	DIGITAL SIGNAL PROCESSING	L	T	P	C
	(Common to EEE and EIE)	3	0	0	3

Objectives

- Signals, systems, sampling techniques and their mathematical representation.
- Analysis of Discrete time systems like Z-transforms, Discrete Time Fourier transform and its applications.
- Discrete Fourier Transformation, Fast Fourier Transformation technique and their computation.
- Filters and their design procedure for digital implementation.
- Digital Signal Processor and its addressing modes.

UNIT – I	INTRODUCTION TO SIGNALS AND SYSTEM	9

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance – Classification of signals: continuous and discrete, energy and power, mathematical representation of signals – Spectral density – sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT – II	DISCRETE TIME SYSTEM ANALYSIS	9

Z-transform and its properties, inverse Z-transforms, difference equation – Solution by Z- transform, application to discrete systems – Stability analysis, frequency response – Convolution – Discrete Time Fourier transform, magnitude and phase representation.

UNIT – III	DISCRETE FOURIER TRANSFORM & COMPUTATION	9

Discrete Fourier Transform- properties, magnitude and phase representation – Computation of DFT: using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

UNIT – IV	DESIGN OF DIGITAL FILTERS	9

FIR & IIR filter realization: Parallel & cascade forms – FIR design: Windowing Techniques, Need and choice of windows, Linear phase characteristics – Analog filter design: Butterworth and Chebyshev

approximations – IIR Filters: Digital design using Impulse Invariant and Bilinear Transformation, Warping, pre warping.		
UNIT – V	**DIGITAL SIGNAL PROCESSORS**	**9**
Introduction – Architecture – Features – Instruction Set – Addressing Formats – Functional modes – Introduction to Commercial Digital Signal Processors.		
	Total Periods:	**45**

Text Books:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2012.
2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman , 'Fundamentals of Digital Signal Processing',Wiley,2013.

Reference Books:

1. Poorna Chandra S, Sasikala. B,'Digital Signal Processing', Vijay Nicole/TMH,2013.
2. Robert Schilling & Sandra L.Harris, 'Introduction to Digital Signal Processing using MATAB', Cengage Learning,2014.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010.
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with MatLab', CRC Press, 2009.
5. SenM.Kuo, Woon-Seng S Gan, 'Digital Signal Processors', Architecture, Implementations & Applications', Pearson, 2013.
6. DimitrisG.Manolakis, Vinay K. Ingle, 'Applied Digital Signal Processing', Cambridge, 2012.
7. Emmanuel C. Ifeachor, 'Digital Signal Processing – A Practical Approach', 2nd Edition, Prentice Hall, 2011.

Course Outcomes (CO)

CO1	Acquire knowledge on Signals, systems, sampling techniques & their mathematical representation.
CO2	Understand and analyze the Discrete Time Systems like Z-transforms, Discrete Time Fourier transform and its applications.
CO3	Analyze the transformation techniques & their computation.
CO4	Understand the types of filters and their design procedure for digital implementation.
CO5	Gain knowledge about Digital Signal Processor and its addressing modes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2
CO5	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1

EE1672	**EMBEDDED SYSTEMS (LAB INTEGRATED)**	**L**	**T**	**P**	**C**
	(Common to EIE and EEE)	**3**	**0**	**1**	**4**

COURSE OBJECTIVES

- Building blocks of Embedded System
- Introduction to Embedded processors
- Bus communication in processors, Input/output interfacing

•	Basics of real time operating system
•	Real-time applications of an embedded system

Unit-I	**INTRODUCTION TO EMBEDDED SYSTEMS**	**9+6**
Introduction to Embedded Systems –Building blocks of Embedded System, Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Oscillator and Reset Circuits-Real Time Clock. Introduction to a brief study on a typical embedded processor.		
Unit-II	**INTRODUCTION TO EMBEDDED PROCESSORS**	**9+6**
Introduction to PIC 16F877A microcontroller: architecture and pin diagram, Overview of instruction sets and addressing modes. Introduction to ARM processor: Architecture and pin diagram of CORTEX processor. Micro-C and Keil compilers for programming using embedded C coding.		
Unit-III	**EMBEDDED NETWORKING**	**9+6**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols-RS232 standard – RS422 – RS 485- Inter Integrated Circuits (I2C), Serial Peripheral Interface (SPI), CAN Bus, – USB- Wi-Fi- Bluetooth- Zigbee - need for Device Drivers.		
Unit-IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9+6**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Pre-emptive and non-pre-emptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-Polling and interrupt handling mechanism- Overview and comparison of commercial RTOS:VX works- μC/OS-II.		
Unit-V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**9+6**
Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.		
	TOTAL (L: 45+P: 30):75 PERIODS	

List of Programming exercises:

1. Study of Embedded processors: PIC and ARM
2. Toggle pins and make an LED glow.
3. Buzzer alarm
4. 3 x 3 keypad matrix and display a key
5. Seven-segment Display
6. A/D conversion
7. D/A conversion
8. Generation of a PWM signal
9. Interface a DC motor and stepper motor
10. Interfacing a temperature sensor
11. ESP-8266 wifi MCU for IOT applications.

List of Equipment, software tools and compilers:

1. PIC 16F877a demonstration board with peripherals
2. ARM cortex board with peripherals
3. Desktops with advanced Pentium processors
4. Proteus software tool
5. Micro c -compiler
6. Keil-compiler

TEXT BOOKS	

1.	Peckol, “Embedded system Design”, John Wiley & Sons, 2010.
2.	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
3.	Shibu. K.V, “Introduction to Embedded Systems”, Second Edition, McGraw Hill, 2017.
4.	Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach Paperback – 1 March 2017
5.	PIC microcontroller and Embedded systems Using Assembly and C for PIC18, second edition, 2021.

REFERENCES

1.	Raj Kamal, ‘Embedded Systems-Architecture, Programming, Design’, Second Edition, Mc Graw Hill, 2013.
2.	C.R. Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013
3.	Tammy Noergaard, “Embedded Systems Architecture”, Second Edition, Newnes, 2012.
4.	Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5.	Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

Course Outcomes (CO)

CO1	Ability to understand the basic blocks of an embedded systems.
CO2	Ability to understand the embedded processors and its programming
CO3	Ability to acquire knowledge about the embedded network protocols.
CO4	Ability to understand basics of real time operating system.
CO5	Ability to suggest an embedded system for a given application.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	1	2	1	2	1	1	1	1	1	1	3	1	2	1
CO2	2	1	1	2	3	1	1	1	1	1	1	3	1	2	1
CO3	2	1	2	2	3	1	1	1	3	3	3	3	1	2	1
CO4	2	1	2	3	3	3	2	1	1	1	1	3	2	1	1
CO5	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2

DS1302	OBJECT ORIENTED PROGRAMMING (LAB INTEGRATED)	L	P	T	C
	(Common to EEE, EIE & ICE)	3	0	2	4

Objectives

- To analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- To design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I	JAVA FUNDAMENTALS	9 +6

Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and String Buffer

Lab Component:

1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 - 4ac$ is negative, display a message stating that there are no real solutions.
2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence

UNIT II	OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE	9 + 6

Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes.

Lab Component:

1. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number of Sides ( ) that shows the number of sides in the given geometrical figures
2. Write a Java program that counts the number of objects created by using static variable

UNIT III	EXCEPTIONS, COLLECTIONS AND STREAMS	9 + 6

Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

Lab Component:

1. Write a Java program to make frequency count of words in a given text
2. Write a Java program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).

UNIT IV	CONCURRENT PROGRAMMING AND GUI PROGRAMMING	9 + 6

Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag.

Lab Component:

1. Write a Java program that creates three threads. First thread displays “Good Morning” everyone second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.

2. Write a java Program to create a window when we press

i. M or m the window displays Good Morning

ii. A or a the window displays Good After Noon

iii. E or e the window displays Good Evening N or n the window displays Good Night

UNIT V	JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING	9 + 6

Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams.

Lab Component:

1.Develop a program for executing the remote command using TCP Socket

2. Create a GUI program in java with the following components.

i. A frame with Flow layout.

ii. Add the following components on to the frame.

a) Two Text Field

b) A button with the label display

iii. Allow the user to enter data into the JTextField

iv. When the button is clicked paint the frame by displaying the data entered in the JTextField Allow the user to properly close the frame

TOTAL (L: 45+P: 30):75 PERIODS

TEXT BOOKS

1.	Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2.	Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017.
3.	Paul Deitel, Harvey M. Deitel, “Java How to Program”, 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1.	T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2.	Y. Daniel Liang , “Introduction to Java programming”, 7th Edition, Pearson education, 2010.
3.	C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4.	K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

CO1	Understand the fundamental ideas behind the object-oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification
CO3	Develop and implement java programs with exception handling and various I/O Streams
CO4	A modern coverage of generic programming and concurrent programming that focuses on high-level synchronization constructs
CO5	To know the concept of event handling used in GUI and accessing database using JDBC

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	1	1	2	2	2	1	0	2	1	1	1	2	1	1
CO2	1	1	2	2	1	1	2	0	2	1	1	1	2	1	2
CO3	2	2	2	2	2	2	1	0	2	2	2	1	1	1	2
CO4	1	3	2	2	2	2	1	0	1	1	2	1	3	1	3
C05	2	3	3	2	3	2	1	0	2	1	2	2	1	1	2

EI1608	INSTRUMENTATION SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.
- To impart design knowledge of controller, control valve and transmitter.
- To acquire the knowledge of piping diagram of industrial standard
- To make the students aware of industry project, planning and scheduling.

LIST OF EXPERIMENTS:

1.	Design of Instrumentation amplifier.
2.	Design of active filters – LPF, HPF and BPF
3.	Design of regulated power supply and design of V/I and I/V converters.
4.	Design of linearizing circuits and cold–junction compensation circuit for thermocouples.
5.	Design of signal conditioning circuit for strain gauge and RTD.
6.	Design of orifice plate and rotameter.
7.	Design of Control valve (sizing and flow-lift characteristics)
8.	Design of PID controller (using operational amplifier / microprocessor)
9.	Design of a multi-channel data acquisition system
10.	Design of multi range DP transmitter
11.	Piping and Instrumentation Diagram – case study.
12.	Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).
	TOTAL: 60 PERIODS

OUTCOMES:

CO1	Ability to design of signal conditioning circuits
CO2	Ability to understand instrumentation systems.
CO3	Ability to design controller, control valve and transmitter.
CO4	Be able to design and draw the piping diagram for industrial application projects.
CO5	Be able to design the multi-channel data acquisition system and transmitter

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	3	3	3	0	1	0	0	1	0	0	2	2	2	3
CO2	3	3	3	3	0	1	0	0	1	0	0	2	3	2	3
CO3	3	3	3	3	0	2	0	0	1	0	0	2	3	2	3
CO4	3	3	3	3	0	1	0	0	1	0	0	3	3	3	3
CO5	3	3	3	3	0	1	0	0	1	0	0	3	3	3	3

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.NO	List of Equipment
1.	Sufficient number of Monolithic Instrumentation amplifier , Operational amplifiers, IC 7805 and resistors, diodes, capacitors
2.	Linear control valve, ON/OFF control valve, Air regulator, Rotameter, Pump 1 No. each
3.	Sufficient number of IC 741, CRO, Bread board, Signal generator (PID) Microprocessor kit with ADC and DAC section
4.	Any Process station (Temperature or Level) with Corresponding sensors, Data acquisition card, and Storage device (microcontroller/microprocessor)
5.	Flow process station with DP transmitter
6.	Loop analyzer
7.	Thermocouple & RTD
8.	Bonded strain gauge, Loads
9.	orifice plate

EI1609	PROCESS CONTROL LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To experimentally verify the process control concepts on the selected process control loops.
- To impart theoretical and practical skills in process identification and PID controller tuning
- To make the students aware of basic and advanced control scheme.

LIST OF EXPERIMENTS

1.	Simulation of lumped /distributed parameter system
2.	Mathematical model of a typical industrial process using nonparametric identification methods
3.	Tuning of PID Controller for mathematically described processes
4.	PID Enhancements (Cascade and Feed-forward Control Schemes)
5.	Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
6.	Simulation of PID position and velocity forms

7.	Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
8.	Study and control of flow process using Compact Flow Control Unit.
9.	Control of Level and Pressure using Process Control Training Plant
10.	Design and implementation of ON/OFF Controller for the Temperature Process.
11.	Design and implementation of Interacting and non-interacting system
12.	Analysis of MIMO systems
	TOTAL: 60 PERIODS

OUTCOMES:

CO1	Ability to understand and analyze process control engineering problems.
CO2	Able to build dynamic models using input – output data of a process
CO2	Ability to working with real time control loops (flow/level/temperature/pressure)
CO4	Get exposed to simulation tools such as MATLAB/LABVIEW/ASPEN
CO5	Ability to learn and implement simple adaptive and model based control schemes

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Flow process station with all accessories
2.	Analog / Digital PID controller
3.	Control valve setup (with position for varying ΔP across the valve)
4.	Flow station with all accessories
5.	Level process station with all accessories
6.	Temperature process station with all accessories
7.	Pressure process station with all accessories
8.	Personal computer-15 nos
9.	MATLAB software
10.	Two tank system with following accessories.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	0	3	0	3	0	0	0	0	1	1	1	2	1	3
CO2	2	0	3	0	3	0	0	0	0	1	1	1	3	0	3
CO3	2	0	3	0	3	0	0	0	0	1	1	1	0	3	3
CO4	2	0	3	0	3	0	0	0	0	1	1	1	0	1	1
CO5	2	0	3	0	3	0	0	0	0	1	1	1	3	3	0

SEMESTER VII

EI1701	COMPUTER CONTROL OF PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study about PLC.
- To analyze the controllability, observability and stability of a Discrete timeSystem.
- To Design Digital Controllers
- To Design Multi-loop regulatory control
- To Design Multivariable Controllers for multivariable system

UNIT I	**BASICS OF PLC AND PROGRAMMING (LADDER)**	**9**
PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples		
UNIT II	**DISCRETE STATE-VARIABLE TECHNIQUE**	**9**
State equation of discrete data system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions — State diagrams of discrete data systems — Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system		
UNIT III	**DIGITAL CONTROLLER DESIGN**	**9**
Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.		
UNIT IV	**MULTI-LOOP REGULATORY CONTROL**	**9**
Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs. The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.		
UNIT V	**MULTIVARIABLE REGULATORY CONTROL**	**9**
Introduction to Multivariable control –Multivariable PID Controller – Model predictive controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to program in PLC for industrial automation
CO2	Ability to analyze the discrete time systems
CO3	Ability to design a digital controller
CO4	Ability to design multi-loop controller
CO5	Ability to design multivariable controller for multi-variablesystems.

TEXT BOOKS

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and design", JOHN WILEY & SONS, 2005.

REFERENCES	
1.	Gopal, M., “Digital Control and State Variable Methods”, Tata Mc GrawHill, 2003.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, “Process Dynamics andControl”, Wiley John and Sons, 3rd Edition, 2010.
3.	P. Albertos and A. Sala, “Multivariable Control Systems An Engineering Approach”,Springer Verlag, 2006.
4.	Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall ofIndia, 2008.
5.	Thomas E. Marlin, Process Control — Designing Processes and Controlsystems for Dynamic Performance, Mc-Graw-Hill, 2000.
6.	F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO2	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO3	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO4	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO5	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0

EI1702	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Develop the skills to gain a basic understanding of neural network theory.
- Understand the advanced neural networks and its applications
- Understand fuzzy logic and reasoning to handle and solve engineering problem
- To provide comprehensive knowledge of fuzzy logic control to real time systems
- Introduce bio inspired algorithms from an engineering perspective

UNIT I	ARTIFICIAL NEURAL NETWORK (ANN)	9
Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.		
UNIT II	**NEURAL NETWORKS FOR CONTROL**	**9**
Feedback networks – Discrete time Hopfield networks – Applications of artificial neural network - Neuro controller for inverted pendulum- Introduction to Neural networks in machine learning & Deep learning		
UNIT III	**FUZZY SYSTEMS**	**9**
Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules – Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.		

UNIT IV	APPLICATION OF FUZZY LOGIC SYSTEMS	9
Fuzzy logic control: Home heating system - liquid level control – Washing machine – Automotive – inverted pendulum –fuzzy PID control, Fuzzy based motor control.		
UNIT V	**EVOLUTIONARY COMPUTATION AND SWARM INTELLIGENCE**	**9**
Genetic algorithms: Introduction-genetic algorithm steps-selection, crossover, and mutation, Swarm Intelligence - Particle swarm optimization(PSO) - Firefly algorithm(FA) - Bacterial foraging optimization(BFO)		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the Ability:

CO1	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
CO2	To Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
CO3	To Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
CO4	To apply Fuzzy logic concepts to engineering problems
CO5	To understand basics of Evolution algorithm and swarm intelligence

TEXT BOOKS

1.	Laurance Fausett, Englewood cliffs, N.J., ‘Fundamentals of Neural Networks’,Pearson Education, 1992.
2.	Timothy J. Ross, ‘Fuzzy Logic with Engineering Applications’, Tata McGraw Hill, 1997.
3.	S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES

1.	Simon Haykin, ‘Neural Networks’, Pearson Education, 2003.
2.	John Yen & Reza Langari, ‘Fuzzy Logic – Intelligence Control & Information’, Pearson Education, New Delhi, 2003
3.	M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4.	Hagan, Demuth, Beale, “Neural Network Design”, Cengage Learning, 2012.
5.	N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford, 2013.
6.	William S.Levine, “Control System Advanced Methods,” The Control Handbook CRC Press, 2011.
7.	Kalyanmoy Deb ,”Multi-Objective Optimization using Evolutionary Algorithms" ,Wiley

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes											Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	2	2	1
CO2	3	3	2	2	2	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	1	3	2	1
CO4	2	2	3	3	2	-	-	-	-	-	-	1	3	2	1
CO5	2	2	3	2	2	-	-	-	-	-	-	1	2	2	1

EI1703	INDUSTRIAL DATA NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

Unit-I	DATA NETWORK FUNDAMENTALS	9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

Unit-II	INTERNET WORKING and RS 232, RS485	9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – Interface, Devicenet.

Unit-III	HART AND FIELD BUS	9

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability -Interchangeability - Introduction to OLE for process control (OPC).

Unit-IV	MODBUS AND PROFIBUS PA/DP/FMS AND FF	9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway.

Unit-V	INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION	9

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the

CO1	Ability to define basic concepts of data communication and its importance.
CO2	Ability to explain the various internetworking devices involved in industrial networks
CO3	Ability to explain the various serial communication used in process industries.
CO4	Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.
CO5	Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.

TEXT BOOKS

1.	Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004.
2.	William Buchanan, Computer Buses, CRC Press, 2000.
3.	Behrouz Forouzan, Data Communications & Networking, 3RD edition, Tata McGraw hill, 2006.

REFERENCES

1.	Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2.	Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3.	William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO2	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO3	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO4	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO5	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0

EI1708	INDUSTRIAL AUTOMATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

To impart practical skills in

- Programming of PLC.
- Programming of DCS.
- Sensor data acquisition, data processing and visualization
- Interfacing the various field devices with PLC

LIST OF EXPERIMENTS

1.	Study of PLC field device interface modules (AI,AO,DI,DO modules)
2.	Programming Logic Gates Function in PLC
3.	Implementing Mathematical Operations in PLC
4.	Programming Jump-to-subroutine & return operations in PLC
5.	PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
6.	PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7.	PLC based control of Level Process
8.	On-line Monitoring and Control of a Pilot plant using DCS
9.	PLC based Control of Flow Process
10.	Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter
11.	Simulation and implementation of Fuzzy logic Control
12.	Simulation and implementation of ANN Control

	TOTAL: 60 PERIODS

OUTCOMES:

1.	Ability to understand and Programming of PLC, SCADA and DCS
2.	Ability to working with industrial automation system
3.	Be able to design and implement control schemes in PLC & DCS
4.	Ability to interface field devices with PLC & DCS

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO2	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO3	2	2	2	1	-	2	-	-	2	-	-	2	2	2	1
CO4	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO5	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1

PROFESSIONAL ELECTIVE – I (V SEMESTER)

CS1520	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Objectives

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols.

UNIT - I	**INTRODUCTION AND PHYSICAL LAYER**	**9**
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		
UNIT - II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		
UNIT - III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		
UNIT - IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		
UNIT - V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		
	Total Periods:	**45**

Text Books:

1.	Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the

Internet, Sixth Edition, Pearson Education, 2013.

Course Outcomes (CO)

CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

EC1009	MEMS AND NEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors and micro actuators
- To introduce the concepts of quantum mechanics and nano systems

UNIT I	INTRODUCTION TO MEMS AND NEMS	9
New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.		
UNIT II	**MEMS FABRICATION TECHNOLOGIES**	**9**
Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.		

UNIT III	MICRO SENSORS	9
MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester		
UNIT IV	**MICRO ACTUATORS**	**9**
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.		
UNIT V	**NANO DEVICES**	**9**
Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Marc Madou, ―Fundamentals of Microfabrication, CRC press 1997.
2. Stephen D. Senturia, Micro system Design, Kluwer Academic Publishers, 2001.

REFERENCE BOOKS

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcraw Hill, 2002.
2. Chang Liu, ―Foundations of MEMS‖, Pearson education India limited, 2006,
3. Sergey Edward Lyshevski, ―MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and working principles of micro systems and microelectronics.
CO2	Understand the both micro fabrication and manufacturing techniques.
CO3	Acquire knowledge about micro sensors.
CO4	Study the design and force analysis of micro actuators.
CO5	Study about the basic concepts of nano electronics with various devices and also discusses with its applications.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	2	1	3	2	1	1	1	2	2	3	2	1	2
CO2	2	2	2	1	2	3	2	1	1	1	2	3	3	3	1
CO3	2	3	3	2	2	2	1	1	1	2	3	2	2	2	3
CO4	3	2	3	3	3	1	3	1	1	2	2	2	3	2	2

CO5	2	3	3	2	3	2	2	1	1	1	2	2	2	2	2

EE1552	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To obtain the knowledge about Conventional Electrical Vehicles
- To obtain the knowledge about Hybrid Electric Drive and Trains
- To obtain the knowledge about Electric propulsion Unit
- To obtain the knowledge about Energy storage devices and sizing of the drive system
- To obtain the knowledge about Energy Management Techniques

Unit-I CONVENTIONAL VEHICLES **12**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance

Unit-II HYBRID ELECTRIC DRIVE-TRAINS **12**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit-III ELECTRIC PROPULSION UNIT **12**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit-IV ENERGY STORAGE & SIZING THE DRIVE SYSTEM **12**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit-V ENERGY MANAGEMENT STRATEGIES **12**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV)

TOTAL :60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand about Commercial Vehicles
CO2	Ability to get knowledge about Hybrid and Electric Trains
CO3	Ability to understand about Electric Propulsion Unit
CO4	Ability to understand the principles of Energy storage and drive systems
CO5	Ability to nderstand about Energy Management Techniques

TEXT BOOKS

1.	Iqbal Hussein,,"Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003

REFERENCES

1.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
2.	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3.	Ebrahimi, Kambiz M., Ehsani, Mehrdad, Gao, Yimin, Longo, Stefano, Modern electric, hybrid electric, and fuel cell vehicles,CRC Press,2018

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	1	-	-	-	-	-	-	-	2	2	-
CO5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	-

EI1511	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.

•	To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
•	To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I	**SPECTROPHOTOMETRY**	**9**
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Attenuated total reflectance flame photometers - Atomic absorption spectrophotometry – Fluorescence Spectrophotometer Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.		
UNIT II	**CHROMATOGRAPHY**	**9**
General principles – chromatographic behaviour of solutes – quantitative determination – Techniques by chromatographic bed shape- Column chromatography-Planar Chromatography - Paper Chromatography-Thin layer Chromatography-Applications - Techniques by physical state of mobile phase- Gas chromatography – Sources - Detectors – Liquid chromatographs – sources- detectors- Applications – High-pressure liquid chromatographs – sources-detectors- Applications- Techniques by separation mechanism-Ion exchange chromatography-size-exclusion chromatography-Applications.		
UNIT III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS**	**9**
Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.		
UNIT IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS**	**9**
Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer		
UNIT V	**NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY**	**9**
NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Electron spin Resonance spectroscopy – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
CO2	Ability to assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
CO3	Ability to critically evaluate the strengths and limitations of the various instrumental methods.
CO4	Ability to develop critical thinking for interpreting analytical data.

CO5	Ability to understand the working principle, types and applications of NMR and Mass spectroscopy

TEXT BOOKS

1.	Khandpur, R.S., “Handbook of Analytical Instruments”, Tata McGraw-Hill publishing Co. Ltd., 2nd Edition 2007.
2.	Ewing, G.W., “Instrumental Methods of Chemical Analysis”, McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).
3.	Liptak, B.G., “Process Measurement and Analysis”, CRC Press, 5th Edition, 2015
4.	NPTEL lecture notes on, “Modern Instrumental methods of Analysis” by Dr.J.R. Mudakavi, IISC, Bangalore.

REFERENCES

1.	Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., ”Instrumental methods of analysis”, CBS publishing & distribution, 7th Edition, 2012.
2.	Braun, R.D., “Introduction to Instrumental Analysis”, Pharma Book Syndicate, Singapore, 2006.
3.	Robert E. Sherman., “Analytical Instrumentation”, Instruments Society of America, 1996.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO2	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO3	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO4	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO5	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0

EI1512	MODERN CONTROL THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
•	To explain the concepts of state variables analysis.
•	To study and analyze non-linear systems.
•	To analyze the concept of stability for nonlinear systems and their categorization.

•	To apply the comprehensive knowledge of optimal theory for Control Systems.

UNIT I	**MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS**	**9**
Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models – Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and properties. Complete solution of state space model due to zero input and due to zero state.		
UNIT II	**CONTROLLABILITY AND OBSERVABILITY**	**9**
General concept of controllability – Controllability tests, different state transformations such as diagnolization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.		
UNIT III	**STATE FEEDBACK CONTROLLERS AND OBSERVERS**	**9**
State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.		
UNIT IV	**NON-LINEAR SYSTEMS**	**9**
Introduction – Non Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.		
UNIT V	**STABILITY ANALYSIS**	**9**
Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	To perform state variables analysis for any real time system.
CO2	Apply the concept of optimal control to any system.
CO3	Able to examine a system for its stability, controllability, and observability.
CO4	Implement basic principles and techniques in designing linear control systems.

CO5	Formulate and solve deterministic optimal control problems in terms of performance indices.

TEXT BOOKS

1.	M. Gopal, Modern Control System Theory by – New Age International – 1984
2.	Ogata. K, Modern Control Engineering by– Prentice Hall – 1997
3.	N K Sinha, Control Systems– New Age International – 3rd edition

REFERENCES

1.	Donald E. Kirk, Optimal Control Theory an Introduction, Prentice – Hall Network series – First edition.
2.	William L Brogan, Modern Control theory, Pearson, Third Edition, 1990.
3.	Richard Dorf, Robert Bishop, Modern Control Systems, Pearson, Global Edition, 2017.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	2	1	2	0	0	0	0	1	0	0	2	2	0	1
CO2	1	2	1	1	2	0	0	0	1	0	0	2	2	0	1
CO3	2	2	1	1	1	0	0	0	1	0	0	2	2	0	2
CO4	2	1	1	1	1	0	0	0	1	0	0	2	2	0	2
CO5	1	2	1	1	1	0	0	0	1	0	0	2	2	0	1

GE1001	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

Objectives

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects

- To aware about enforcement in IPR and government steps in fostering IPR

UNIT - I	**INTRODUCTION**	**9**
Introduction to IPRs: Basic concepts and need for Intellectual Property, Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – The way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, Technological Research, Inventions and Innovations – Important examples of IPR.		**CO1**
UNIT - II	**REGISTRATION OF IPRs**	**9**
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad		**CO2**
UNIT - III	**AGREEMENTS AND LEGISLATIONS**	**9**
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.		**CO3**
UNIT - IV	**DIGITAL PRODUCTS AND LAW**	**9**
Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.		**CO4**
UNIT - V	**ENFORCEMENT OF IPRs**	**9**
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.		**CO5**
	Total Periods:	**45**

Text Books:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2003.
3. Ahuja, V K, Law relating to Intellectual Property Rights. India, Lexis Nexis, 2017.

Reference Books:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition,2017.
2. Prabuddha Ganguli, “Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education,2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Course Outcomes (CO)

CO1	Ability to get an adequate knowledge on patent and copyright for their innovative research works
CO2	Ability to get idea about the registration process of IPR
CO3	Ability to study various agreements and Acts regarding IPR
CO4	Ability to inculcate the knowledge on innovations, developments and IP laws

CO5	Ability to aware the knowledge on enforcement and current issues

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO2	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO3	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO4	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO5	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

EI1621	UNIT OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	Study the unit operations involved for transportation, mixing and separation of solids.
•	Study the unit operations involved for transportation, mixing and separation of fluids.
•	Understand the basic operations involved with heat exchangers, Distillation and chemicalreactions.
•	Gain knowledge about the operations of evaporators and crystallizers, drying and coolingtowers.
•	Gain knowledge on the operation of dryers, distillation column, refrigerators and chemicalreactors.

UNIT I	MECHANICAL OPERATIONS- I: OPERATIONS ON SOLIDS	9
General Characteristics of solids; Storage and conveying of solids:bunkers, silos, bins and hoppers, transport of solids in bulk, conveyor selection, different types of conveyors; Estimation of particle size;Screening methods and equipment; Adjusting particle size:methods of size reduction, classification of equipment, crushers, grinders; size enlargement; Principle of granulation, briquetting, pelletisation		

and flocculation; Mixing: mixing of powders; Separation: Electrostatic and magnetic separators, applications.		
UNIT II	**MECHANICAL OPERATIONS-II: OPERATIONS ON FLUIDS**	**9**
Transport of fluids; Mixing and agitation: Mixing of liquids, selection of suitable mixers; Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation; Cyclones - Operation, equipment, control and applications.		
UNIT III	**HEAT TRANSFER- I AND ITS APPLICATIONS**	**9**
Heat exchangers: Single pass and multi pass heat exchangers, condensers, reboilers Combustion process in thermal power plant; Distillation: Binary distillation, Batch distillation, controls and operations, Chemical reactors.		
UNIT IV	**HEAT TRANSFER- II**	**9**
Theory of evaporation; single effect and multiple effect evaporators; Crystallization; nucleation and growth, classification of crystallizers; Drying: classification of Dryers, batch and continuous dryers, dryers for solids and slurries and cooling Towers, Refrigeration.		
UNIT V	**CASE STUDY**	**9**
Unit Operations and Control schemes applied to Thermal Power plant, Steel Industry, Paper and Pulp Industry, Leather Industry.		
TOTAL (L: 45): 45 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Apply the knowledge on solids & fluids to handle the raw materials.
CO2	Select and apply relevant handling techniques to convert the solids and fluids for specific applications.
CO3	Come out with solutions for simple/complex problems in heat transfer and design the heatexchange equipment for different applications such as distillation, boilers.
CO4	Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
CO5	Gain ability for lifelong learning of new techniques and developments in various types of unit operations in industries.

TEXT BOOKS

1.	Balchen, J.G., and Mumme, K.J., “ Process Control structures and applications”, Van Nostrand Reinhold Co., New York, 1988.
2.	Warren L. McCabe, Julian C. Smith and Peter Harriot, “Unit Operations of Chemical Engineering”, McGraw-Hill International Edition, New York, Sixth Edition, 2001.

3.	James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment: Selection and Design", Gulf Professional Publishing, 2010.

REFERENCES

1.	Waddams, A.L., "Chemicals from petroleum", Butler and Taner Ltd., UK, 1968.
2.	Liptak, B.G., "Process measurement and analysis", Chilton Book Company, USA, 1995.
3.	Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers",McGraw-Hill International edition, USA, 1989.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EE1731	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- The concept of system identification and adaptive control.
- Black-box approach based system identification.
- Batch and recursive identification.
- Computer Controlled Systems.
- Design concept for adaptive control schemes.

UNIT - I	NON-PARAMETRIC METHODS	9
Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification.		CO1
UNIT - II	**PARAMETRIC METHODS**	**9**
Least squares estimation - Analysis of the least squares estimate - Best linear unbiased estimate - Model parameterizations - Prediction error methods.		CO2
UNIT - III	**RECURSIVE IDENTIFICATION METHODS**	**9**
The recursive least square method - Model validation - Model structure determination, Introduction to closed loop system identification of the Cell - series and parallel connections,		CO3

maximum power point tracking, Applications.		
UNIT - IV	**ADAPTIVE CONTROL SCHEMES**	**9**
Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling.		**CO4**
UNIT - V	**MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR)**	**9**
STR – Pole placement design – Indirect STR and direct STR, MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR.		**CO5**
	Total Periods:	**45**

Text Books:

1. T. Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1988.
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Addison-Wesley, 2016.

Reference Books:

1. L. Ljung, System Identification - Theory for the User, 2nd Edition, Pearson education, 1999.
2. K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Dover Publications, 2005.
3. H. K. Khalil, Nonlinear Systems, Pearson education, 3rd Edition, 2002.
4. William S.Levine, “Control Systems Advanced Methods, the Control Handbook,2nd Edition, CRC Press, 2010.
5. S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1988.

Course Outcomes (CO)

CO1	Ability to understand various system identification techniques and features of adaptive control like STR and MRAC.
CO2	Ability to understand the concept of system identification and adaptive control.
CO3	Ability to understand about Black-box approach based system identification.
CO4	Ability to get knowledge about batch and recursive identification, Ability to design concept for adaptive control schemes.
CO5	Ability to study about computer controlled systems.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

EI1622	ADVANCED INSTRUMENTATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
•	To explore the various types of analyzers used in industrial applications.
•	To make the students to understand the requirement of safety instrumented system, standards and risk analysis techniques
•	To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84 and ISA 88.
•	To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments, Process Flow diagrams, Instrument Loop diagrams, Instrument Hookup diagrams and Piping and Instrumentation Diagrams.

UNIT I	MEASUREMENT OF PROCESS PARAMETERS	9
Review the various Measurement techniques of temperature, pressure, flow and level – application - selection of sensors– calibration methods.		
UNIT II	**INSTRUMENTS FOR ANALYSIS**	**9**
Ion selective electrodes: Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO, CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring.		
UNIT III	**SAFETY INSTRUMENTATION**	**9**
Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA)– Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.		
UNIT IV	**INSTRUMENTATION STANDARDS**	**9**
Instrumentation Standards - significance of codes and standards – overview of various types - Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.		
UNIT V	**DOCUMENTATION IN PROCESS INDUSTRIES**	**9**
Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems -		

Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) -Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams – Location Plans for Instruments - Cable Routing Diagrams – Typical Control / Rack Rooms Layout – Vendors Documents and Drawings
TOTAL (L: 45): 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Able to understand the instrumentation behind flow, level, temperature and pressure measurement
CO2	Able to acquire basic knowledge on the various types of analyzers used in typical industries.
CO3	Able to understand the role of Safety instrumented system in the industry.
CO4	Able to explain Standards for applying Instrumentation in Hazards Locations.
CO5	Able to design, develop, and interpret the documents used to define instruments and control

TEXT BOOKS

1.	B.G.Liptak, "Instrumentation Engineers Handbook (Process Measurement & Analysis)", Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCES

1.	Swapan Basu, "Plant Hazard analysis and Safety Instrumentation systems" Academic Press, 2016
2.	Al.Sutko,Jerry.D.Faulk, "Industrial Instrumentation", Delmar publishers, 1996.
3.	Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., "Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA 2006.
4.	Safety - ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative.
5.	Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves; ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011
6.	Documentation Standards - ANSI/ISA5.4-1991 - Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 - Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-

	1981 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	0	2	2	0	0	1	0	0	1	1	2	3	1	2
CO2	2	0	2	2	0	0	1	0	1	1	1	2	3	2	1
CO3	2	0	2	2	0	0	1	0	0	1	1	2	3	1	1
CO4	2	0	2	2	0	0	1	1	0	1	1	2	2	3	1
CO5	2	0	2	2	0	0	1	1	1	1	1	2	2	3	1

EE1853	**MICROCONTROLLER BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives

To impart knowledge about the following topics:

- Architecture and programming model of PIC microcontroller.
- Interrupts and timers in PIC microcontroller.
- Various communication buses for data transfer and I/O interfacing.
- Architecture and programming model of ARM processor.
- ARM Organisations and embedded ARM applications.

UNIT - I	**INTRODUCTION TO PIC MICROCONTROLLER**	**9**
Introduction to PIC Microcontroller; PIC 16C6x and PIC16C7x Architecture, Pipelining - Program Memory considerations, Register File Structure, Instruction Set , Addressing modes, Simple Operations.		**CO1**
UNIT - II	**INTERRUPTS AND TIMER**	**9**
PIC micro controller Interrupts; External Interrupts, Interrupt Programming; Loop time subroutine Timers, Timer Programming; Front panel I/O, Soft Keys, State machines and key switches, Display of Constant and Variable strings.		**CO2**
UNIT - III	**PERIPHERALS AND INTERFACING**	**9**
I^2C Bus for Peripherals Chip Access: Bus operation;Bus subroutines; Serial EEPROM; Analog to Digital Converter; Digital to Analog converter; UART- Baud rate selection; Data handling circuit- Initialization; LCD and keyboard Interfacing ; Sensor Interfacing.		**CO3**
UNIT - IV	**INTRODUCTION TO ARM PROCESSOR**	**9**

Architecture, ARM programmer's model, ARM Development tools, Memory Hierarchy ,ARM Assembly Language Programming, Simple Examples, Architectural Support for Operating systems.	**CO4**

UNIT - V	**ARM ORGANIZATION**	**9**
3-Stage Pipeline ARM Organization; 5-Stage Pipeline ARM Organization; ARM Instruction Execution; ARM Implementation; ARM Instruction Set; ARM coprocessor interface; Architectural support for High Level Languages; Embedded ARM Applications.		**CO5**

Total Periods: 45

Text Books:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2nd edition, 2015.

Reference Books:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.

Course Outcomes (CO)

CO1	Ability to understand the concepts of Architecture of PIC microcontroller
CO2	Ability to acquire knowledge on Interrupts and timers.
CO3	Ability to understand the importance of Peripheral devices for data communication and to understand the basics of sensor interfacing
CO4	Ability to acquire knowledge in Architecture of ARM processors
CO5	Ability to acquire knowledge on ARM Organization in embedded ARM application.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	3	3	3	2	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3

EI1623	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To become familiar with digital image fundamentals
•	To get exposed to simple image enhancement techniques in Spatial and Frequency domain
•	To learn concepts of degradation function and restoration techniques
•	To study the image segmentation and representation techniques
•	To become familiar with image compression and recognition methods

UNIT I	DIGITAL IMAGE FUNDAMENTALS	9
Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels -Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D, transforms - DFT, DCT.		
UNIT II	**IMAGE ENHANCEMENT**	**9**
Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.		
UNIT III	**IMAGE RESTORATION**	**9**
Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering		
UNIT IV	**IMAGE SEGMENTATION**	**9**
Edge detection-Gradient methods-I-II order edge detectors, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		
UNIT V	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG & MPEG standard- Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES

At the end of the course, the student should have the Ability:

CO1	Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement.
CO3	Understand the restoration concepts and filtering techniques.

C04	Learn the basics of segmentation, features extraction, compression and recognition methods for color models.
CO5	Understand different methods of compressing an image for effective storage and retrieval

TEXT BOOKS

1.	Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2.	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES

1.	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2.	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3.	D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4.	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5.	Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO2	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO3	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO4	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO5	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1

EI1624	**FIBRE OPTICS AND LASER INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES					
•	To expose the students to the basic concepts of optical fibres and their properties				
•	To provide adequate knowledge about the Industrial applications of optical fibres				
•	To expose the students to the Laser fundamentals				
•	To provide adequate knowledge about Industrial application of lasers				
•	To provide adequate knowledge about holography and Medical applications of Lasers				
Unit-I	**OPTICAL FIBRES AND THEIR PROPERTIES**				**9**

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode		
Unit-II	**INDUSTRIAL APPLICATION OF OPTICAL FIBRES**	**9**
Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain		
Unit-III	**LASER FUNDAMENTALS**	**9**
Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers		
Unit-IV	**INDUSTRIAL APPLICATION OF LASERS**	**9**
Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder,Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal		
Unit-V	**HOLOGRAM AND MEDICAL APPLICATIONS**	**9**
Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology		
		TOTAL :45 PERIODS
COURSE OUTCOMES At the end of the course, the student should have the:		
CO1	Understand the principle, transmission, dispersion and attenuation characteristics of	

	opticalfibers
CO2	Apply the gained knowledge on optical fibers for its use as communication medium
CO3	To educate sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
CO4	Understand laser theory and laser generation system
CO5	Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application

TEXT BOOKS

1.	J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India,1985
2.	J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001
3.	Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011

REFERENCES

1.	G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995
2.	M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002
3.	John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008
4.	Monte Ross, 'Laser Applications', McGraw Hill, 1968
5.	John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002
6.	Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO2	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO3	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO4	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO5	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0

CS1671	FUNDAMENTAL OF OPERATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basics and functions of operating systems.

•	To understand processes and threads	
•	To analyze scheduling algorithms and process synchronization.	
•	To understand the concept of deadlocks.	
•	To analyze various memory management schemes.	
•	To be familiar with I/O management and file systems.	
•	To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.	
Unit-I	**INTRODUCTION**	**9**
Introduction to operating system - Elements and organization; Operating System Overview - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods. Booting process of an Operating System, OS Security & OS Virtualization		
Unit-II	**PROCESS MANAGEMENT AND DEADLOCKS**	**9**
Processes - Process Concept - Process Scheduling - Operations on Processes - Inter-process Communication; CPU Scheduling – Basic concepts - Scheduling criteria - Scheduling algorithms: Threads - Multithread Models – Threading issues; Process Synchronization - Synchronization hardware – Semaphores – Mutex - Classical problems of synchronization - Monitors; Deadlock - Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		
Unit-III	**MEMORY MANAGEMENT**	**9**
Main Memory - Swapping - Paging - Structure of the Page Table - Segmentation,; Virtual Memory - Demand Paging – Hybrid system with Swapping & Demand Paging - Thrashing, Copy on Write - Page Replacement - Allocation of Frames		
Unit-IV	**STORAGE MANAGEMENT**	**9**
Mass Storage system – Disk Structure - Disk Scheduling and Management; File-System Interface - File concept - Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation - File System Structure - Directory implementation - Allocation Methods - Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.		
Unit-V	**VIRTUAL MACHINES AND MOBILE OS**	**9**
Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.		
		TOTAL :45 PERIODS
COURSE OUTCOMES At the end of the course, the student should have the:		
CO1	Analyze various scheduling algorithms and process synchronization.	
CO2	Explain deadlock prevention and avoidance algorithms.	

CO3	Compare and contrast various memory management schemes.
CO4	Explain the functionality of file systems, I/O systems, and Virtualization
CO5	Compare iOS and Android Operating Systems

TEXT BOOKS	
1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10th Edition, John Wiley and Sons Inc., 2018.
2.	Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.
REFERENCES	
1.	Ramaz Elmasri, A. Gil Carrick, David Levine, " Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2.	William Stallings, "Operating Systems: Internals and Design Principles", 7 th Edition, Prentice Hall, 2018.
3.	Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO2	2	2	0	0	0	0	1	1	0	0	1	2	2	0	1
CO3	2	1	0	0	0	0	1	1	0	0	1	2	2	0	1
CO4	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO5	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

EI1731	**OPTIMAL CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

•	To understand the optimal control concepts and its importance.

•	To study the important optimal control methods existing in the industries in order obtain therequired level of control.
•	To introduce the concept of optimal control in various system.
•	To help the learners in the design and the implementation of the concept of optimal control.
•	To study, analyze and implement discrete-Time optimal control system.

UNIT I	**INTRODUCTION**	**9**
Introduction to Optimal control – Comparison between the Conventional control and optimal control procedures - Statement of optimal control problem – Problem formulation and forms of optimal Control - Selection of performance measures. Necessary conditions for optimal control.		
UNIT II	**MATHEMATICAL EVALUATION**	**9**
Introduction and Performance Index - Basic Concept of calculus of variation- The basic variational problem - Fixed end point problem - Free end point problem - Variational Approach to Optimal Control Systems.		
UNIT III	**CONTROL STRATEGY**	**9**
Introduction - Time varying optimal control – LQR steady state optimal control – Frequency Domain Interpretation of LQR (LTI system) - Solution of Ricatti'sequation – Application examples.		
UNIT IV	**PROBLEM FORMATION**	**9**
Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin's Minimum/Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation and its solution.		
UNIT V	**ADVANCED SYSTEMS**	**9**
Discrete-Time Optimal Control Systems - Matrix Discrete Riccati Equation - Analytical Solution of Matrix Difference Riccati Equation - Optimal Control Using Dynamic Programming - The Hamilton-Jacobi-Bellman (HJB) Equation - LQR System HJB Equation-Time Optimal Control System.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Problem formulation, forms of optimal control and its necessary conditions.
CO2	Solving the algebraic equations to design the controller and to study about various problems
CO3	Designing optimal controllers using a class of procedures
CO4	Predict the system dynamic behavior through solution of ODEs and formation of

	optimalcontrol problem
CO5	Solve equations to design the controllers in discrete methods representing spatial and temporal variations in physical systems through numerical methods.

TEXT BOOKS

1.	Kirk, D.E., Optimal Control Theory, Dover Publications, 2004.
2.	D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.
3.	Astrom, K.J. Intro. Stochastic Control Theory, Dover Publications, 2006.

REFERENCES

1.	Gopal M, "Digital Control and State Variable Methods," Tata McGraw-Hill
2.	F.L. Lewis, "Optimal Control," JohnWiley&Sons,Inc.,NewYork,NY,1986
3.	Gopal M, "Modern Control System Theory," NewAgeInternational
4.	Sage. A.P.&White, C.C., "Optimum Systems Control," PrenticeHall, 1977.
5.	http://nptel.ac.in/courses/108105019/

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-
CO4	2	2	3	3	2	-	-	-	-	-	-	-	2	2	-
CO5	2	2	3	2	1	-	-	-	-	-	-	-	2	2	-

EI1732	**LOGIC AND DISTRIBUTED CONTROL SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries.

- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT I	PLC & SCADA	9
PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.		
UNIT II	**BASICS OF PLC PROGRAMMING(LADDER)**	**9**
Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.		
UNIT III	**PLC PROGRAMMING (OTHER LANGUAGES)**	**9**
Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.		
UNIT IV	**DISTRIBUTED CONTROL SYSTEM**	**9**
DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.		
UNIT V	**ADVANCED TOPICS IN AUTOMATION**	**9**
Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

CO1	Ability to understand all the important components such as PLC, SCADA, DCS,
CO2	To understand I/O modules and field devices of an industrial automation system
CO3	Ability to develop PLC program in different languages for industrial sequential applications
CO4	Able to select and use most appropriate automation technologies for a given application.
CO5	Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1.	F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2.	Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3.	D. Popovic and V.P.Bhatkar, “Distributed computer control for industrial Automation”, Marcel

	Dekker, Inc., Newyork , 1990.

REFERENCES:

1.	Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2.	Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3.	McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5thEdition, McGraw- Hill handbook, New York, 1999.
4.	NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg. IIT Kharagpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-
CO4	2	2	3	3	2	-	-	-	-	-	-	-	2	2	-
CO5	2	2	3	2	1	-	-	-	-	-	-	-	2	2	-

EI1733	ADVANCED TOPIC IN PID CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To provide an overview of the features associated with Industrial type PID controller.
•	To make the students understand the various PID Controller Design methods and about PID stabilization for Linear Time-invariant models.
•	To develop the skills needed to design adaptive and non-linear PID control schemes.
•	To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.

UNIT I	INTRODUCTION	9

Evolution of PID controller – PID Controller Structures – PID Implementation Issues – Tuning of PIDController using Classical Approaches.		
UNIT II	**PID CONTROLLER DESIGN**	**9**
PID Controller Design Techniques: Pole placement, Lamda Tuning, Direct Synthesis, Gain Margin & Phase Margin and Optimization methods - Auto-Tuning.		
UNIT III	**PID STABILIZATION**	**9**
Stabilization of Linear Time-invariant Plants using P/PI/ PID controllers – Optimal Design using PIDControllers – Robust and Non-fragile PID Controller Design.		
UNIT IV	**ADAPTIVE/NON-LINEAR PID CONTROL SCHEMES**	**9**
Gain Scheduled PID Controller - Self-tuning PI/PID Controller – PID Types Fuzzy Logic Controller – Predictive PID Control.		
UNIT V	**INTRODUCTION TO FRACTIONAL ORDER SYSTEM AND FRACTIONAL ORDER PID CONTROLLER**	**9**
Fractional-order Calculus and Its Computations — Frequency and Time Domain Analysis of Fractional-Order Systems - Filter Approximations to Fractional-Order Differentiations –Model reduction Techniques for Fractional Order Systems – Fractional Order PI/PID Controller Design.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to determine the advanced Features supported by the Industrial Type PID Controller.
CO2	Ability to Design, tune and implement P/PI/PID Controllers to achieve desired Performance forvarious processes.
CO3	Ability to design and implement adaptive PID controllers and Non-linear PID Control schemes.
CO4	Ability to Analyze Fractional-order systems, Fractional-order- controller
CO5	Design of controller for fractional order systems.

TEXT BOOKS

1.	Karl J. Astrom and Tore Haggland, "Advanced PID Control", ISA Publications, 2005.
2.	Aniruddha Datta, Ming-Tzu Ho, and Shankar P. Bhattacharyya, "Structure and Synthesis of PID Controllers", Advances in Industrial Control, Springer Verlag London, 2000.

REFERENCES

1.	Antonio Visioli, "Practical PID Control" Springer- Verlag London, 2006.

2.	Aidan O' Dwyer, “Handbook of PI and PID Controller Tuning Rules”, Imperial College Press, 2009.
3.	Xue, D., Chen, Y.Q., and Atherton, D.P., "Linear Feedback Control Analysis and Design with MATLAB, Advances in Design and Control", Society for Industrial and Applied Mathematics, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1734	**MODEL PREDICTIVE CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

•	To teach the students the general principles of model predictive control scheme.
•	To provide a comprehensive description of model predictive control schemes namely as dynamic matrix control, generalized predictive control scheme and State space based model predictive control scheme.
•	To highlight the key features of MPC for its Industrial Success.
•	To introduce the skills required to formulate both unconstrained and constrained optimal control schemes.
•	To develop the skills needed to design Model Predictive Control schemes to achieve the desired performance.

UNIT I	**MODEL PREDICTIVE CONTROL SCHEMES**	**9**
Introduction to Model Predictive Control - Model Predictive Control Elements - Model		

Predictive Control Schemes: Dynamic Matrix Control and Model Algorithmic Control – Case Studies.		
UNIT II	**GENERALIZED PREDICTIVE CONTROL SCHEME**	**9**
Generalized Predictive Control Scheme – Simple Implementation of Generalized Predictive Control Scheme for Industrial Processes – Multivariable Generalized Predictive Control Scheme – Case Studies.		
UNIT III	**STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME**	**9**
State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies.		
UNIT IV	**CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME**	**9**
Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.		
UNIT V	**ADVANCED TOPICS IN MPC**	**9**
Robust Model Predictive Control Scheme – Adaptive Model Predictive Control Scheme – Multiple- Model based Model Predictive Control Scheme - Fast Methods for Implementing Nonlinear Model Predictive Control Scheme — Case Studies		
TOTAL : 45 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to explain the advantages and disadvantages of various MPC schemes
CO2	Ability to design both unconstrained and constrained model predictive controllers.
CO3	Ability to explain the advanced Features supported by the MPC Scheme.
CO4	Ability to Identify, formulate and solve problem in the field of Process Control domain using MPC.
C05	Ability to implement MPC algorithms in MATLAB/SCILAB.

TEXT BOOKS

1.	Camacho, E.F., and Bordons, C., “Model Predictive Control”, 2nd Edition, Advanced in Industrial Control Springer Verlag, 2013.
2.	Liuping Wang, “Model Predictive Control System Design and Implementation Using MATLAB”,Advanced in Industrial Control, Springer Verlag, 2009.

REFERENCES

1.	Wayne Bequette, B., “Process Control: Modeling, Design, and Simulation”, Prentice Hall of

	India, 2004.
2.	Seborg, D.E., Duncan, A. Mellichamp , Edgar,T.F., and Doyle,F.J., III, "Process Dynamics and Control", John Wiley and Sons, 3rd Edition, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1735	FAULT DETECTION AND DIAGNOSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an overview of different Fault Detection and Diagnosis methods.
- To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
- To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
- To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
- To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves.

UNIT I	INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS	9
Introduction – Types of faults and different tasks of Fault Diagnosis and Implementation – Different approaches to FDD: Model free and Model based approaches-Introduction-Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of		

Residual generator – Residual specification and Implementation.		
UNIT II	**FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS**	**9**
Limit Checking of absolute values – Trend Checking – Change detection using binary thresholds – adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.		
UNIT III	**FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS**	**9**
Introduction — Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts — Introduction to parity equation implementation and alternative representation - Directional Specifications: Directional specification with and without disturbances — Parity Equation Implementation.		
UNIT IV	**FAULT DIAGNOSIS USING STATE ESTIMATORS**	**9**
Introduction – Review of State Estimators – Fault Detection and Diagnosis using Generalized Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach.		
UNIT V	**CASE STUDIES**	**9**
Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.		
		TOTAL (L: 45): 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to explain different approaches to Fault Detection and Diagnosis.
CO2	Ability to detect faults using Limit Checking, Parameter estimation methods, Principle ComponentAnalysis.
CO3	Ability to design and detect sensor and actuators faults using structured residual approach aswell as directional structured residual approach.
CO4	Ability to design and detect faults in sensor and actuators using GLR and MLR based Approaches.
C05	Ability to detect and quantify and compensate stiction in Control valves.

TEXT BOOKS

1.	Janos J. Gertler, "Fault Detection and Diagnosis in Engineering systems", 2nd Edition, Marcel Dekker, 1998.
2.	Rolf Isermann, "Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance", Springer Verlag, 2006.

REFERENCES

1.	Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools",Springer Publication, 2012.
2.	Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault-Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.
3.	Mogens Blanke, "Diagnosis and Fault-Tolerant Control", Springer, 2006.
4.	Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of ProcessNonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1736	**SAFETY INSTRUMENTAL SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.

- To make the students understand different layers of protection.
- To make student conscious about safety instrumentation applications.
- To make the students aware of potential events and impact of failures.
- To make students aware of design, installation and maintenance procedures.

UNIT I INTRODUCTION 9

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs Safety Control.

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS 9

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.

UNIT III SAFETY INTEGRITY LEVEL (SIL) 9

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.

UNIT IV SYSTEM EVALUATION 9

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modelling Accuracy, Modelling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.

UNIT V CASE STUDY 9

SIS Design check list - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, Verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-startup Tests, Operation and Maintenance procedures.

TOTAL: 45PERIODS

OUTCOMES: At the end of the course students will have the

CO1	Ability to analyse the role of safety instrumented system in the industry.
CO2	Ability to Identify and analyse the hazards.
CO3	Ability to determine the safety integrity level for an application. Ability to characterize the safety environment in industry.
CO4	Ability to analyse the failure modes, failure rates and MTBF using various reliability

	engineering tools.
C05	Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes. Ability to present the results in written and oral forms.

TEXT BOOKS:

1. Paul Gruhn and Harry L. Cheddie," Safety Instrumented systems: Design, Analysis and Justification", ISA, 2nd edition, 2018.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle", exida2nd Edition 2016.

REFERENCES

1. William M. Goble and Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.
2. Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis", ISA, 2002.
3. Standard - ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements", ISA, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	3	0	0	3	0	0	0	0	0	3	0	2	2
CO2	0	0	3	1	0	2	1	1	0	0	1	1	0	2	2
CO3	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2
CO4	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2
CO5	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

EC1008	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives

• To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
• To enunciate the significance of estimation of power spectral density of random processes
• To introduce the principles of optimum filters such as Wiener and Kalman filters

• To introduce the principles of adaptive filters and their applications to communication engineering
• To introduce the concepts of multi-resolution analysis

UNIT I	DISCRETE-TIME RANDOM PROCESSES	9
Random variables - ensemble averages a review, random processes - ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA.		
UNIT II	**SPECTRUM ESTIMATION**	**9**
Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.		
UNIT III OPTIMUM FILTERS		**9**
Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.		
UNIT IV ADAPTIVE FILTERS		**9**
Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.		
UNIT V MULTIRESOLUTION ANALYSIS		**9**
Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.		
		TOTAL:45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

CO1	Articulate and apply the concepts of special random processes in practical applications
CO2	Choose appropriate spectrum estimation techniques for a given random process
CO3	Apply optimum filters appropriately for a given communication application
CO4	Apply appropriate adaptive algorithm for processing non-stationary signals
CO5	Apply and analyse wavelet transforms for signal and image processing based applications

TEXT BOOKS

1.	Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008. (UNIT I-IV).
2.	P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993 (UNIT V)

REFERENCES:

1.	John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2.	Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO2	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO3	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO4	3	2	2	1	1	0	0	0	0	0	0	0	3	3	2
CO5	3	2	2	1	1	0	0	0	0	0	0	0	3	3	2

EC1040	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
•	To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
•	To understand principles of navigation, in addition to approach and landing aids as related to navigation

UNIT I	INTRODUCTION TO RADAR EQUATION	9
Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations.		
UNIT II	MTI AND PULSE DOPPLER RADAR	9
Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).		
UNIT III	DETECTION OF SIGNALS IN NOISE	9
Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays. Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter. - The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.		
UNIT IV	RADIO DIRECTION AND RANGES	9
Introduction - Four methods of Navigation. - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System		
UNIT V	SATELLITE NAVIGATION SYSTEM	9
Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment - Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation Over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning		

System (GPS)	
	TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Explain principles of navigation, in addition to approach and landing aids as related to navigation
CO2	Derive and discuss the Range equation and the nature of detection.
CO3	Describe about the navigation systems using the satellite.
CO4	Describe about radio direction and ranges
CO5	Describe about satellite navigation system

TEXT BOOKS

1.	Merrill I. Skolnik ," Introduction to Radar Systems", 3rd Edition Tata Mc Graw-Hill 2003.
2.	N.S.Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, TMH, 2000.

REFERENCES

1.	Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004
2.	J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	2	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	1	-	-	-	-	-	-	-	2	2	-
CO5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	-

EC1731	CMOS VLSI DESIGN	L	T	P	C
		3	0	0	3

Objectives

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance trade-offs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT - I	INTRODUCTION TO MOS TRANSISTOR	9
MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.		

UNIT - II	COMBINATIONAL MOS LOGIC CIRCUITS	9
Circuit Families: Static CMOS, Ratioed Circuits, Cascade Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.		

UNIT - III	SEQUENTIAL CIRCUIT DESIGN	9
Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Mono stability Sequential Circuits, Astability Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.		

UNIT - IV	DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUB SYSTEM	9
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed trade-offs, Case Study: Design as a trade-off. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.		

UNIT - V	IMPLEMENTATION STRATEGIES AND TESTING	9
FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.		
	Total Periods:	**45**

Text Books:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson , 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits: A Design perspective”, Second Edition , Pearson , 2016.

Reference Books:

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley,1997

2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits: Analysis& Design”,4th edition McGraw HillEducation,2013 3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education,2007 4. R. Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

Course Outcomes (CO)	
CO1	Realize the concepts of digital building blocks using MOS transistor.
CO2	Design combinational MOS circuits and power strategies.
CO3	Design and construct Sequential Circuits and Timing systems.
CO4	Design arithmetic building blocks and memory subsystems.
CO5	Apply and implement FPGA design flow and testing.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

EI1741	**THERMAL POWER PLANT INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES	
•	To make the students familiarize about various power generation methods.
•	To identify various parameters in thermal power plant
•	To impart knowledge about the different types of controls and control loops.
•	To familiarize the student with the methods of monitoring different parameters like speed, vibrationof turbines and their control.

Unit-I	**POWER GENERATION METHODS**	**9**
Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power — importance of instrumentation in power generation. Details ofboiler processes P&I diagram of boiler – cogeneration.		

Unit-II	**MEASUREMENTS IN POWER PLANTS**	**9**
Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.		
Unit-III	**FURNACE CONTROL**	**9**
Coal handling: Pulverizers - Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.		
Unit-IV	**BOILER CONTROL**	**9**
Boiler metal temperature measurement, pressure measuring devices – Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control — distributed control system in power plants — interlocks in boiler operation.		
Unit-V	**TURBINE MONITORING AND CONTROL**	**9**
Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system, Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - lubricant oil temperature - cooling system.		
		TOTAL :45 PERIODS

COURSE OUTCOMES
At the end of the course, the student should have the:

CO1	Understanding various power generation process.
CO2	Identify important parameter to be monitored and controlled in thermal power plant.
CO3	Knowledge about various building blocks and instruments involved in thermal power plant andits controlling process.
CO4	Understanding about boiler control
CO5	Understanding about turbine monitoring and control

TEXT BOOKS

1.	Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2.	Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES

1.	Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013
2.	Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
3.	Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2
CO2	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2
CO3	3	1	2	0	3	0	0	0	0	0	0	0	3	2	2
CO4	3	1	2	0	3	0	0	0	0	0	0	0	3	2	2
CO5	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2

EI1742	MECHATRONICS SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- The students will be exposed to design mechatronics system in Labview & Vim –Sim Environments

UNIT I	INTRODUCTION TO MECHATRONICS SYSTEM	9

Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

UNIT II	SYSTEM MODELLING	9

Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.

UNIT III	REAL TIME INTERFACING	9

Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment & its applications -Man machine interface.

UNIT IV	CASE STUDIES ON MECHATRONIC SYSTEM	9

Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor& Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V	MICRO MECHATRONIC SYSTEM	9

Introduction- System principle - Component design – System design – Scaling laws – Micro actuation – Micro robot – Micro pump – Applications of micro mechatronic components.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	The students will be able to design systems in mechatronics approach using modern software packages.
CO2	The students will be able to do system modelling
CO3	The students will be able to do real time interfacing
CO4	Knowledge about mechatronic system
CO5	Knowledge about micro mechatronic system

TEXT BOOKS

1.	Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition ,Cengage Learning 2011.
2.	Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003.

REFERENCES

1.	Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002
2.	Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010.
3.	De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	2	2	3	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO3	3	2	2	2	3	-	-	-	-	-	-	1	3	2	-
CO4	3	2	2	2	3	-	-	-	-	-	-	1	2	2	-
CO5	3	2	2	2	3	-	-	-	-	-	-	1	2	2	-

EI1743	ADVANCED PROCESS CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To teach students to build and analyze models for time-varying systems and non-linear systems.
•	To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications
•	To make the students learn to formulate optimal control schemes
•	To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems
•	To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

UNIT I	CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS	9
Models for Time-varying and Nonlinear systems – Input signal design for Identification –Realtime parameter estimation – Model Validation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Control of Hammerstein and Wiener Systems.		
UNIT II	**OPTIMAL CONTROL & FILTERING**	**9**
Introduction – Performance Measure for optimal control problem – Dynamic Programming – Computational Procedure for solving Control Problem – LQR – Introduction to Optimal Filtering – Discrete Kalman Filter – Linear Quadratic Gaussian (LQG).		
UNIT III	**FRACTIONAL ORDER SYSTEM & CONTROLLER**	**9**
Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional- Order Linear Systems - Filter Approximations to Fractional-Order Differentiations – Model reduction Techniques for Fractional Order Systems –Controller Design Studies for Fractional Order.		
UNIT IV	**H-INFINITY CONTROLLER**	**9**
Introduction – Norms for Signals – Robust Stability – Robust Performance – Small Gain Theorem – Optimal H2 Controller Design - H-Infinity Controller Design –– Effects of Weighting Functions in H-Infinity Control.		
UNIT V	**FAULT DIAGNOSIS AND FAULT-TOLERANT CONTROL**	**9**
Process Monitoring - Introduction – Statistical Process Control – Fault Detection with Principal Component Analysis – Fault Detection with State Observers – Fault Detection with signal models -		

Fault Detection of Control Loops- Sensor and Actuator Fault-Tolerant Control Design.
TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
CO2	Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
CO3	Ability to Identify, formulate, and solve optimal controller
CO4	Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems. Ability to design and implement H2 and H-infinity Controllers
CO5	Ability to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

REFERENCES

1.	K.J. Astrom and B.J.Wittenmark, “Adaptive Control”, Pearson Education, Second Edition, 2008.
2.	Donald E.Kirk, "Optimal Control Theory – An Introduction", Dover Publications, Inc. Mineola, New York, 2012
3.	D. Xue, Y.Q. Chen, D.P. Atherton, "Linear Feedback Control Analysis and Design with MATLAB, Advances In Design and Control", Society for Industrial and Applied Mathematics, 2008.
4.	R. Isermann, "Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance", Springer, 2006.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-

CO4	2	2	3	3	2	-	-	-	-	-	-	-	2	2	-
CO5	2	2	3	2	1	-	-	-	-	-	-	-	2	2	-

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

EI1851	**INSTRUMENTATION STANDARDS**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES

- To impart basic knowledge on Instrumentation standards

UNIT I	**STANDARDS ORGANIZATION**	**9**
Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems		
UNIT II	**ISA STANDARDS**	**9**
Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37)		
UNIT III	**ISA STANDARDS - CONTROL VALVE AND ACTUATOR**	9
Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24,75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.		
UNIT IV	**ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS**	**9**
Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.		
UNIT V	**BS , ISO, IEC, & ANSI**	**9**
Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)		

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand the role of standards organization
CO2	Ability to interpret and follow different standards while carrying out installation of sensors, transmitters, Industrial automation systems, PLC programming, documentation, equipment selection in hazardous area and instrument specification forms
CO3	Ability to understand and follow different standards while performing control valve sizing, actuator sizing and orifice sizing etc
CO4	Ability to interpret and follow different standards while carrying out monitoring and control of fossil fuel power plants and nuclear power plants.
CO5	Ability to understand BS , ISO, IEC, & ANSI

TEXT BOOKS

1.	API Recommended Practice 551, "Process Measurement Instrumentation", American Petroleum Institute, Washington, D.C., 1st Edition, May 1993
2.	API Recommended Practice 554, "Process Instrumentation and Control – 3 parts", American Petroleum Institute, Washington, D.C., 1st Edition, October 2008.
3.	ISA standard 5, "Documentation of Measurement and Control Instruments and Systems", ISA, North Carolina, USA
4.	ISA standard 12, "Electrical Equipment for Hazardous Locations", ISA, North Carolina, USA.
5.	ISA standard 20, "Instrument Specification Forms", ISA, North Carolina, USA
6.	ISA standard 37, "Measurement Transducers", ISA, North Carolina, USA.
7.	ISA standard 75, "Control Valve Standards", ISA, North Carolina, USA.
8.	ISA standard 96, "Valve Actuator", ISA, North Carolina, USA.
9.	ISA standard 77, "Fossil Power Plant Standards", ISA, North Carolina, USA
10.	ISA standard 67, "Nuclear Power Plant Standards", ISA, North Carolina, USA
11.	BS EN 60584-1, "Thermocouples - EMF specifications and tolerances", British Standard, 2013

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	0	0	2	2	0	0	0	0	0	2	2	0
CO2	1	0	1	0	2	2	2	0	0	0	0	0	2	2	0
CO3	1	1	2	0	2	2	1	0	0	0	0	0	2	2	0
CO4	1	1	1	0	1	2	2	0	0	0	0	0	2	2	0
CO5	1	1	2	0	2	1	2	0	0	0	0	0	2	2	0

GE1003	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

Objectives

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT – I	HUMAN VALUES	9
Morals, values and Ethics; Integrity; Work ethics; Service learning; Civic virtue; Respect for others; Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character; Spirituality; Introduction to Yoga and meditation for professional excellence and stress management.		**CO1**

UNIT – II	ENGINEERING ETHICS	9
Senses of 'Engineering Ethics' – Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory; Gilligan's theory; Consensus and Controversy; Models of professional roles; Theories about right action; Self–interest; Customs and Religion; Uses of Ethical Theories.		**CO2**

UNIT – III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law.	**CO3**

UNIT – IV	**SAFETY, RESPONSIBILITIES AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk; Respect for Authority; Collective Bargaining; Confidentiality; Conflicts of Interest; Occupational Crime; Professional Rights; Employee Rights; Intellectual Property Rights (IPR), Discrimination.		**CO4**

UNIT – V	**GLOBAL ISSUES**	**9**
Multinational Corporations; Environmental Ethics; Computer Ethics; Weapons Development; Engineers as Managers – Consulting Engineers, Engineers as Expert Witnesses and Advisors; Moral Leadership; Code of Conduct; Corporate Social Responsibility.		**CO5**

Total Periods:	**45**

Text Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Books:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2012.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd, New Delhi, 2013.
6. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.

Course Outcomes (CO)

CO1	Define the dimensions or senses of engineering ethics and describe the various theories of moral development.
CO2	Describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.
CO3	Understand significance of safety and risk assessment when developing engineering products.
CO4	Understand the social responsibilities and intellectual property rights of engineers.
CO5	Understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO2	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO3	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO4	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO5	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3

MG1001	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Objectives

- To enable the students to study the evolution of Management.
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

UNIT – I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9
Definition of Management – Science or Art – Manager Vs Entrepreneur – Types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.		**CO1**

UNIT – II	PLANNING	9
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		**CO2**

UNIT – III	ORGANISING	9
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority –		**CO3**

Centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.	

UNIT – IV	DIRECTING	9
Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.		**CO4**

UNIT – V	CONTROLLING	9
System and process of controlling – Budgetary and non–budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.		**CO5**

Total Periods:	**45**

Text Books:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

Reference Books:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 6th Edition 2017.

Course Outcomes (CO)

CO1	Ability to understand the various terms and definitions related to management and organization.
CO2	Ability to acquire the skill of planning and various strategies of management in an organization.
CO3	Ability to understand the various hierarchies of management and also get an insight into an HR values in an organization management.
CO4	Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.
CO5	Ability to analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1
CO2	1	2	2	2	3	3	3	3	3	3	3	3	1	1	1
CO3	2	2	2	2	3	2	2	3	3	3	3	3	1	1	1
CO4	1	1	2	2	3	3	3	3	3	3	3	3	1	1	1
C05	3	3	3	3	3	3	3	3	3	3	3	3	1	2	1

CE1025	DISASTER MANAGEMENT	L	T	P	C
	(Common to EEE,ECE,IT)	3	0	0	3

Objectives

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country.
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT - I	INTRODUCTION TO DISASTERS	9
Definition - Disaster, Hazard, Vulnerability, Resilience, Risks ; Disasters- Types of disasters, Earthquake, Landslide, Flood, Drought, Volcanoes, Forest fire, Manmade disaster; Causes, Impacts including social, economic, political, environmental, health, psychosocial; Differential impacts - in terms of caste, class, gender, age, location, disability; Global trends in disasters - urban disasters, pandemics, complex emergencies, Climate change; Dos and Don’ts during various types of Disasters.		**CO1**

UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness; Structural, non-structural measures; Community based DRR; Roles and responsibilities of community,		**CO2**

Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre & other stake holders; Institutional Processes and Framework at State and Central Level; State Disaster Management Authority(SDMA); Early Warning System, Advisories from appropriate agencies.		
UNIT - III	**INTER– RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting Vulnerabilities; Differential impacts; Impact of Development projects such as dams, embankments, changes in Land-use ; Climate Change Adaptation– IPCC Scenario and Scenarios in the context of India; Relevance of indigenous knowledge, appropriate technology and local resources.		**CO3**
UNIT - IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9**
Hazard and Vulnerability profile of India; Components of Disaster Relief- Water, Food, Sanitation, Shelter, Health, Waste Management; Institutional arrangements Mitigation, Response and Preparedness, Disaster Management Act and Policy , Other related policies, plans, programmes and legislation ; Role of GIS and Information Technology components in preparedness, Risk assessment, Response and recovery phases of disaster ;Disaster damage assessment.		**CO4**
UNIT - V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide hazard zonation - Case Studies; Earthquake vulnerability assessment of buildings and Infrastructure- Case Studies; Drought assessment - Case Studies; Coastal Flooding - Storm surge assessment; Floods - Fluvial and Pluvial Flooding Case Studies; Forest Fire - Case Studies; Man Made disasters - Case Studies; Space based inputs for disaster mitigation and management and field works related to disaster management.		**CO5**
	Total Periods:	**45**

Text Books:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN– 10: 9380386427 ISBN– 13: 978– 9380386423.
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN– 10: 1259007367, ISBN– 13: 978– 1259007361.
3. Gupta Anil K, Sreeja S. Nair,” Environmental Knowledge for Disaster Risk Management” NIDM, New Delhi, 2011.
4. Kapur Anu, ”Vulnerability India: A Geographical Study of Disasters” IIAS and Sage Publishers, New Delhi, 2010.

Reference Books:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

Course Outcomes (CO):

CO1	Differentiate the types of disasters, causes and their impact on environment and society.
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.

CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
CO4	Understand the disaster risk management process in India.
CO5	Acquire knowledge on disaster management applications and case studies.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	2	1	1	2	2	1	1	1	2	2	2	2	2
CO2	1	2	1	1	1	2	2	1	1	1	2	2	2	2	2
CO3	1	1	1	1	2	2	2	1	1	1	2	2	2	2	2
CO4	1	1	1	1	2	1	1	1	1	1	2	2	2	2	2
CO5	2	1	1	1	2	2	2	1	1	1	2	2	2	2	2

MG1002	PRINCIPLES OF OPERATION RESEARCH	L	T	P	C
		3	0	0	3

Objectives

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT - I	LINEAR MODELS	9
The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.		**CO1**
UNIT – II	**TRANSPORTATION MODELS AND NETWORK MODELS**	**9**
Transportation Assignment Models –Traveling Salesman problem– Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.		**CO2**
UNIT – III	**INVENTORY MODELS**	**9**
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.		**CO3**
UNIT – IV	**QUEUEING MODELS**	**9**
Queueing models – Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite		**CO4**

population – Simulation.		
UNIT – V	**DECISION MODELS**	**9**
Decision models – Game theory – Two-person zero sum games – Graphical solution– Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variability search technique – Dynamic Programming – Simple Problem.		**CO5**
	Total Periods:	**45**

Text Books:

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005
2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

Reference Books:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. ShennFoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Course Outcomes (CO)

CO1	Apply formulation and solution of Linear programming problem to practical applications like resource allocations and interpret the result with concept of duality and Sensitivity analysis.
CO2	Get the solution for transportation problems and project management problems
CO3	Handle and study the inventory models, which is inevitable in engineering and business situations.
CO4	Formulate Queuing models, upon study the solution of the same. Also handle the real life applications through simulation.
CO5	Analysis the decision making process through game theory.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	2	1	1	1	-	-	-	-	1	2	1	1	1
CO2	3	3	2	1	1	1	-	-	-	-	1	2	3	3	3
CO3	3	3	2	0	1	1	-	-	-	-	1	2	3	3	3

CO4	3	3	2	0	1	1	-	-	-	-	1	2	3	3	3
C05	3	3	2	1	1	1	-	-	-	-	1	2	3	3	3

GE1002	**HUMAN RIGHTS**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT - I	**INTRODUCTION**	**9**
Human Rights- Meaning, origin and development; Notion and classification of Rights - Natural, Moral and Legal Rights, Civil and Political rights, economic, social and cultural rights, collective/ Solidarity rights.		**CO1**

UNIT - II	**EVOLUTION OF HUMAN RIGHTS MOVEMENT**	**9**
Evolution of the concept of Human rights- Magana Carta, Geneva Convection of 1864, Universal Declaration of Human rights 1948;Theories of Human rights.		**CO2**

UNIT - III	**INTERNATIONAL PRESPECTIVES**	**9**
Theories and perspective of UN Laws; UN Agencies to monitor and compliance.		**CO3**

UNIT - IV	**HUMAN RIGHTS IN INDIA**	**9**
Human Rights in India; Constitutional Provisions/ Guarantees.		**CO4**

UNIT – V	**HUMAN RIGHTS SUPPORT ORGANISATION**	**9**
Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disable persons, including aged and HIV infected people; Implementation of Human Rights - National and State Human Rights Commission; Judiciary; Role of NGO's, Media, Educational Institutions, Social Movements.		**CO5**

Total Periods: 45

Reference Books:

1. Kapoor S.K., “Human Rights under International law and Indian laws", Central law agency, Allahabad, 2014.
2. Chandra U., “Human Rights", Allahabad law agency, Allahabad, 2014.
3. Upendra Baxi, The future of Human Rights, Oxford University Press, New Delhi.

Course Outcomes (CO)

CO1	Able to understand the definition and types of human rights
CO2	Able to understand the evolution and theories of human rights

CO3	Able to understand the theories and perspectives of human rights
CO4	To know about human rights in India
CO5	To know about human rights of people of various classes and implementation of human rights

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

GE1004	**FUNDAMENTALS OF NANOSCIENCE**	**L**	**T**	**P**	**C**
		3	0	0	3
Objectives					
To learn about basis of nanomaterial science, preparation method, types and application.					
UNIT - I	**INTRODUCTION**				**9**
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).					**CO1**
UNIT - II	**GENERAL METHODS OF PREPARATION**				**9**
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.					**CO2**
UNIT - III	**NANOMATERIALS**				**9**
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property					**CO3**

Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.		
UNIT - IV	**CHARACTERIZATION TECHNIQUES**	**9**
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation.		**CO4**
UNIT - V	**APPLICATIONS**	**9**
Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.		**CO5**
	Total Periods:	**45**

Text Books:

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

Reference Books:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

Course Outcomes (CO)

CO1	Ability to understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Ability to acquire knowledge in general methods of preparation of nano materials.
CO3	Ability to understand the Nano forms of Carbon and methods of synthesis
CO4	Ability to acquire knowledge in characteristic nanomaterial on various technique.
CO5	Ability to gain knowledge on various application of nano materials.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3
CO1	3	2	2	3	1	2	1	1	2	1	1	3	2	2	3
CO2	3	2	3	3	1	2	1	1	2	1	1	3	3	2	3

CO3	3	3	3	3	1	2	1	1	2	1	1	3	3	2	3
CO4	3	3	3	3	1	2	1	1	2	1	2	3	3	2	3
CO5	3	2	3	3	1	2	1	1	2	1	2	3	3	2	3

EI1861	**NON-LINEAR CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the nature of non-linear systems and to analyze the stability of such systems
- To develop suitable models of non-linear systems and to develop suitable controllers for such systems
- To understand the chaotic and bifurcation behavior of non-linear systems
- To linearize the non-linear systems

Unit-I	**NON-LINEAR SYSTEMS**	**9**

Types of Non-Linearity – Typical Examples – Properties of nonlinear systems – Nonlinear differential equations – Numerical solutions to nonlinear differential equations – Equilibrium points – free and forced responses – Input and output multiplicities.

Unit-II	**STABILITY OF NON-LINEAR SYSTEMS**	**9**

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) – Lyapunov Stability Criteria – Krasovskil's method – Variable Gradient Method – Stability Analysis by Describing function method.

Unit-III	**MODELLING AND CONTROL OF NON-LINEAR SYSTEMS**	**9**

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification – On-line parameter estimation for nonlinear systems – Nonlinear PID controller – Gain scheduling control – case studies

Unit-IV	**CHAOS AND BIFURCATION BEHAVIOR**	**9**

Introduction to Chaos - The Lorenz Equations – Test for chaos - Bifurcation Behavior of ordinary differential equations - Types of Bifurcations - Limit Cycle Behavior and Hopf Bifurcation.

Unit-V	**LINEARIZATION**	**9**

Methods of linearization – Taylor's series expansion – Jacobean method - state model for systems – Role of Eigen values and Eigenvectors – State transition matrix and its properties – Controllability and observability – Stabilizability and Detectability

TOTAL:45 PERIODS

COURSE OUTCOMES At the end of the course, the student should have the:	
CO1	Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
CO2	Ability to analyze non-linear system based on the first principle model.
CO3	Ability to come out the solution for complex non-linear system.
CO4	Ability to develop various control schemes for non-linear systems.
C05	Ability to linearize non-linear system for developing linear control.
TEXT BOOKS	
1.	Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process systems".
2.	Gopal, M., "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata McGraw-Hill, 2012.
REFERENCES	
1.	Shankar Sastry, "Nonlinear Systems: Analysis, Stability, and Control", Springer New York, 2013.
2.	Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.
3.	Bequette, B.W., "Process Control: Modeling, Design and Simulation", Prentice Hall International series in Physical and Chemical Engineering Sciences, 2003.
4.	Steven E. LeBlanc, and Donald R. Coughanowr, "Process Systems Analysis and Control", 3rd Edition, Chemical Engineering series, McGraw-Hill Higher Education, 2009.
5.	**5.** Thompson, J. M. T., and Stewart, H. B.," Nonlinear Dynamics and Chaos", John Wiley & Sons, 2002.
6.	William S. Levine, "The Control Systems Handbook", Second Edition: Control System Advanced Methods, 2nd Edition, CRC Press, 2010.
7.	NPTEL Lecture on "Non-linear system Analysis" by Prof. Laxmidhar Behera, IIT Kanpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	2	3	1	1	0	0	0	0	1	0	1	2	2	0
CO2	1	2	2	1	1	0	0	0	0	1	0	1	2	2	0
CO3	1	2	2	1	1	0	0	0	0	1	0	1	2	2	0

CO4	1	2	1	1	1	0	0	0	0	1	0	1	2	2	0
CO5	1	2	3	1	1	0	0	0	0	1	0	1	2	2	0

EI1862	**PROCESS DATA ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Experimental Design
- Linear Regression Analysis
- Linear Model Selection and Regularization
- Classification
- Process Identification, Performance Monitoring and Soft Sensor Design

Unit-I	**INTRODUCTION**	**9**

Introduction to Process data analytics and Statistical learning - Review of Linear Algebra Concepts – Review of Probability & Statistics - Design of experiments - Industrial case studies on factorial experiments.

Unit-II	**REGRESSION**	**9**

Linear Regression:- Simple Linear Regression, Multiple Linear Regression -K-nearest neighbours regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:-The validation set approach, Leave-One-Out Cross Validation, k-Fold Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation.-**Python Programming**

Unit-III	**LINEAR MODEL SELECTION & REGULARIZATION**	**9**

Subset Selection: - Best Subset Selection, Step-wise Selection and Choosing the Optimal Model – Shrinkage Methods: - LASSO, Ridge regression, Elastic nets – Dimension reduction Methods:- Principal Components Regression, Partial Least Squares. .-**Python Programming**

Unit-IV	**SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES**	**9**

Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis –Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting -Deep Learning. .-**Python Programming**

Unit-V	**APPLICATIONS**	**9**

Process data analysis for system identification (under open and closed loops) – Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares

(PLS) for soft-sensor design - Data-based causality analysis for identification of process topology. .- **Python Programming**

TOTAL :45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Be able to apply Design of Experiments for Problem solving and Process Troubleshooting
CO2	Be able to select the right choice of regression method for a given application.
CO3	Be able to select the right choice of classification method for a given application.
CO4	Be able to systematically carryout System Identification, Process & Performance Monitoring.
CO5	Be able to cohesively analyze alarm data, process data and process connectivity information

REFERENCES

1.	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics, 2013.
2.	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2013
3.	Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition, 2016.
4.	Arun K. Tangirala, Principles of System Identification – Theory and Practice, CRC Press, 2018.
5.	Huang, B. and Shah, S.L., Performance Assessment of Control Loops: Theory and Applications, Springer-Verlag,2007.
6.	Fan Yang, Ping Duan, Sirish L Shah, Tongwen Chen, Capturing Connectivity and Causality in Complex Industrial Processes, Springer, 2014.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO2	2	2	0	0	0	0	1	1	0	0	1	2	2	0	1
CO3	2	1	0	0	0	0	1	1	0	0	1	2	2	0	1
CO4	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO5	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1

EI1863	CYBER SECURITY FOR INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To understand the Industrial security environment and cyberattacks
•	To analyze and assess risks in the industrial environment
•	To access, design and implement cybersecurity
•	To test and troubleshoot the industrial network security system

UNIT I	**INTRODUCTION**	**9**
Industrial security environment-Industrial automation and control system (IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks.		
UNIT II	**RISK ANALYSIS**	**9**
Risk identification, classification and assessment, Addressing risk:Cybersecurity Management System(CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.		
UNIT III	**ACCESSING THE CYBERSECURITY OF IACS**	**9**
Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results		
UNIT IV	**CYBERSECURITY DESIGN AND IMPLEMENTATION**	**9**
Cybersecurity lifecycle- conceptual design process- detailed design process- firewall designremote access design- intrusion detection design		
UNIT V	**TESTING AND MAINTENANCE**	**9**
Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response		
		TOTAL: 45

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to apply basis of science and engineering to understand Industrial security environment and cyberattacks.
CO2	Ability to analyze and assess risks in the industrial environment
CO3	Ability to access the cybersecurity of IACS
CO4	Ability to design and implement cyber security
CO5	Ability to test and troubleshoot the industrial network security system.

TEXT BOOKS

1.	Ronald L and Krutz, Industrial Automation and Control System Security Principles,ISA, 2013.
2.	David J.Teumim, Network Security, Second edition,ISA,2010

REFERENCES

1.	Edward J.M. Colbert and Alexander Kott, Cyber-security of SCADA and other industrial control systems, Springer, 2016.
2.	Perry S. Marshalland John S. Rinaldi, Industrial Ethernet, Second edition, ISA, 2004

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1														2
CO2	1	1													1
CO3	1	1													2
CO4	1		2		2										1
CO5	1		2									2			2

EI1864	**ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

•	To study the various parts of robots and fields of robotics.

•	To study the various kinematics and inverse kinematics of robots.
•	To study the Euler, Lagrangian formulation of Robot dynamics.
•	To study the trajectory planning for robot.
•	To study the control of robots for some specific applications.
•	To educate on various path planning techniques
•	To introduce the dynamics and control of manipulators

UNIT I	**BASIC CONCEPTS**	**9**
Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots - **Introduction about Robotic languages.**		
UNIT II	**POWER SOURCES, SENSORS AND ACTUATORS**	**9**
Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.		
UNIT III	**MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION**	**9**
Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.		
UNIT IV	**KINEMATICS AND PATH PLANNING**	**9**
Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.		
UNIT V	**DYNAMICS AND CONTROL AND APPLICATIONS**	**9**
Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Ability to understand the evolution of robot technology and its applications.

CO2	Ability to known the mathematical representation of different types of robots
CO3	Get exposed to the case studies and design of robot machine interface.
CO4	Familiarize various control schemes of Robotics control.
CO5	Ability to known various robots applications.

TEXT BOOKS

1.	Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2.	Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications, Prentice Hall, 3 edition 2104.

REFERENCES

1.	Deb. S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2.	Asfahl. C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3.	Klafter. R.D., Chimielewski T.A., Negin M., Robotic Engineering — An integrated approach,Prentice Hall of India, New Delhi, 1994.
4.	R.K. Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
5.	John.J.Craig, Introduction to Robotics Mechanics and Control, Third edition, PearsonEducation,2009.
6.	Issac Asimov, I Robot, Ballantine Books, New York, 1986.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1865	**INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

1.	To introduce the students the method of oil recovery and the steps involved in oil gas production process
2.	To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model
3.	To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
4.	To provide information about the most important derivatives obtained from petroleum products
5.	To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT I	**OIL EXTRACTION AND OIL GAS PRODUCTION**	**9**
Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.		
UNIT II	**IMPORTANT UNIT OPERATIONS IN REFINERY**	**9**
Petroleum-chemical composition, petroleum conversion process- Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization		
UNIT III	**DERIVATIVES FROM PETROLEUM**	**9**
Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene —Derivatives from ethylene – Derivatives from propylene		
UNIT IV	**IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS**	**9**
BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene –		

PVC production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments		
UNIT V	**SAFETY IN INSTRUMENTATION SYSTEMS**	**9**
Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance		
TOTAL :45 PERIODS		

COURSE OUTCOMES

At the end of the course, the student should have the:

CO1	Gain knowledge on oil gas production process and important unit operations in a refinery
CO2	Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes
CO3	. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery
CO4	Gain knowledge on the most important chemical derivatives obtained from petroleum products
CO5	Understand safety instrumentation followed in process industries.

TEXT BOOKS

1.	Waddams, A.L., "Chemicals from Petroleum", Wiley, 1973. (digitized in 2007)
2.	Balchen, J.G., and Mumme K.I., "Process Control Structures and Applications", Von Nostrand Reinhold Company, New York, 1988

REFERENCES

1.	Liptak, B.G., "Instrumentation in Process Industries", Chilton Book Company, 2005. (Digitized in 2008.)
2.	Austin, G.T. and Shreeves, A.G.T., "Chemical Process industries", McGraw-Hill, 2012
3.	.HavardDevold, "Oil and Gas Production Handbook", ABB, 2006.
4.	Paul Gruhn and Harry Cheddie, "Safety Instrumented Systems: Design, Analysis, and Justification", 2nd Edition, ISA Press, 2006.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course	Program Outcomes	Program Specific

Outcomes													Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO5	2	2	1	-	2	-	-	-	-	-	-	-	2	2	-

OPEN ELECTIVE -I (VI SEMESTER)

OCS103	**INTRODUCTION TO CLOUD COMPUTING**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To understand the concept of cloud computing.
- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I	**INTRODUCTION**	**9**
Introduction to Cloud Computing– Definition of Cloud– Evolution of Cloud Computing- Roots of Cloud Computing– Desired Features of Cloud Computing-– Benefits and Disadvantages of Cloud Computing- On-demand provisioning.		**CO1**
UNIT II	**VIRTUALIZATION**	**9**
Introduction to Virtualization Technology– Service Oriented Architecture- Web Services– Load Balancing and Virtualization- Hypervisor– Seven Layers of Virtualization - Types of Virtualization – Server, Desktop, and Application Virtualization.		**CO2**
UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**9**
NIST Cloud Computing Reference Architecture– Public, Private and Hybrid Clouds – laaS – PaaS – SaaS– Architectural Design Challenges– Cloud Storage - Storage-as-a-Service -S3-AdvantageofCloudStorage,MongoDB.		**CO3**
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**9**
Inter Cloud Resource Management-– Resource Provisioning Methods– Security Overview– Cloud Security Challenges–Data Security–Application Security–Virtual Machine Security.		**CO 4**
UNIT V	**CLOUD ADVANCEMENT TECHNOLOGIES**	**9**
Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE- Dockers- AWS-		**CO5**

Kubernetes-Pods-Container-container-Hadoop – Map Reduce – Oracle Virtual box-Cloud Software Environments- – Eucalyptus – Open Nebula.	

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017

REFERENCE BOOKS

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.
3. https://kubernetes.io/docs/home/
4. https://docs.mongodb.com/
5. https://aws.amazon.com/documentdb/

COURSE OUTCOMES(CO)

CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2	Learn the key and enabling technologies that help in the development of cloud.
CO3	Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
CO4	Explain the core issues of cloud computing such as resource management and security.
CO5	Be able to install and use current cloud technologies and Choose the appropriate technologies and approaches for implementation and use of cloud.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**L**	**1**	**2**	**3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OCS109	FUNDAMENTALS OF DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT - I	**DBMS AND CONCEPTUALDATAMODELING**		**9**
Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.		**CO1**	
UNIT - II	**DATABASE QUERYING**		**9**
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries –joins aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.		**CO2**	
UNIT – III	**DATABASE PROGRAMMING**		**9**
Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle		**CO3**	
UNIT – IV	**DATABASE DESIGN**		**9**
Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system / university database system.		**CO4**	
UNIT – V	**ADVANCED TOPICS**		**9**
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.		**CO5**	
		Total Periods:	**45**

Text Books:

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson,2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth

Edition, Tata McGraw Hill,2011

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education,2006.
2. Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill College Publications,2015.

Course Outcomes (CO)

CO1	Ability to understand relational data model, evolve conceptual model of a given problem.
CO2	Understand query the relational database and write programs with database connectivity
CO3	Ability to understand the DBMS programming
CO4	Ability to understand the DBMS Design
CO5	Ability to understand the database security and information retrieval concepts

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	F	G	h	i	J	k	L	1	2	3
CO1	3	3	3	1	1	1	1	1	3	3	1	1	3	2	2
CO2	3	3	3	1	1	1	1	1	3	3	1	1	3	3	2
CO3	3	3	3	1	1	1	1	2	3	3	1	1	3	3	2
CO4	3	3	3	1	1	2	1	2	3	3	1	1	3	3	2
CO5	3	3	3	1	1	1	1	2	3	3	1	1	3	2	2

OME106	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

Objectives

- To study the various material testing methods and standards.
- To study the various mechanical testing and material characterization
- To study the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT - I	INTRODUCTION TO MATERIALS TESTING	9
Overview of materials: Classification of material testing, Purpose of testing, Selection of		CO1

material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.			
UNIT - II	**MECHANICAL TESTING**		**9**
Introduction to mechanical testing: Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations,Applications.			**CO2**
UNIT - III	**NON DESTRUCTIVE TESTING**		**9**
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.			**CO3**
UNIT - IV	**MATERIAL CHARACTERIZATION TESTING**		**9**
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.			**CO4**
UNIT - V	**OTHER TESTING**		**9**
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.			**CO5**
		Total Periods:	**45**

Text Books:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu, "Practical Non-Destructive Testing", 3rd and later Edition, Narosa Publishing House, 2014.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2005.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys", 7th Edition, Cousens Press, 2007.
4. Suryanarayana A. V. K., "Testing of metallic materials", 2nd Edition, BS publications, 2018

Reference Books:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986. Publishing, 1998.

Course Outcomes (CO): At the end of the course students will have the,

CO1	Ability to Identify various materials, different types of material testing, material testing

	standards and organizations, characterization and techniques
CO2	Ability to Identify various mechanical testing and its procedure with application for industrial use.
CO3	Ability to understand the various non-destructive testing techniques with application for industrial use.
CO4	Ability to analyze the surface and elemental behavior of various materials using different material characterization techniques.
CO5	Ability to understand the thermal and chemical behavior of various materials by special testing techniques.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OBT104	**BIOSENSORS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	**PROTEIN BASED BIOSENSORS**	**9**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		**CO1**
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		**CO2**
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**

Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		**CO3**
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		**CO4**
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2

CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OEE107	**SOLAR AND WIND ENERGY SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand types and applications of various form of energy sources and its environmental impacts
- To attain a broad comprehension of solar photovoltaic systems used for various applications.
- To understand and estimate performance of wind turbine

UNIT - I	**INTRODUCTION OF SOLAR ENERGY**	**9**
Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors - solar thermal applications - heating, cooling, desalination, drying, cooking, etc - solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells		CO1

UNIT - II	**SOLAR PHOTOVOLTAIC TECHNOLOGY**	**9**
Photovoltaic basics - structure and working of solar cells - types, electrical properties and behaviour of solar cells - cell properties and design, stand alone PV systems - schematics, components, batteries, charge conditioners, grid connected PV systems - schematics, components , charge conditioners, interface components, hybrid systems - solar, biomass, wind, diesel hybrid systems, design of PV systems - radiation and load data, simple case studies.		CO2

UNIT - III	**PHOTOVOLTAIC APPLICATIONS**	**9**
Battery charger, domestic lighting, street lighting, water pumping etc - Solar PV power plant - Net metering concept. National / International PV Power Programmes - Photovoltaic Power Systems - System Integration - Energy Storage - Power Electronics - Stand-Alone Systems - Grid-Connected Systems - Concentrating Photovoltaics (CPV) - Electrical Performance. Applications of IoT and Machine learning for SPV applications.		CO3

UNIT - IV	**WIND ENERGY**	**9**
Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications - offshore wind energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India - Repowering concept.		CO4

UNIT - V	**AERODYNAMICS AND PERFORMANCE OF WIND TURBINE**	**9**

Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Power Developed, Maximum power coefficient (Betz Limit), Thrust, Efficiency, Rotor selectionRotor design considerations, Diameter of the Rotor. Aerodynamic design principles, Blade Profile, Blade Element Theory, Choice of the number of blades, Choice of the Pitch angle, Tip speed ratio, Power speed characteristics, Torque speed characteristics, Solidity. Applications of IoT and Machine learning for wind turbines performance assessment.	CO5
TOTAL PERIODS:	**45**

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Understand the basics of solar energy and its measurements applications
CO2	Understand the fundamentals of solar photovoltaic technology and design different SPV systems
CO3	Understand the application of solar photovoltaic technologies
CO4	Understand the wind resource assessment and conversion systems
CO5	Analyse wind turbine performance with regard to aerodynamics

TEXT BOOKS:

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984
2. Twidell& Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011 G.D. , "Non-Conventional Energy Sources",

REFERENCE BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2011
3. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2010
4. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2010
5. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

❖ OBJECTIVES:

❖ · To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I	**INTRODUCTION**	**9**
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.		**CO1**
UNIT II	**CHEMICAL HAZARDS**	**9**
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.		**CO2**
UNIT III	**ENVIRONMENTAL CONTROL**	**9**
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.		**CO3**
UNIT IV	**HAZARD ANALYSIS**	**9**
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment		**CO4**
UNIT V	**SAFETY REGULATIONS**	**9**
Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCE BOOKS	
1. Safety Manual, "EDEL Engineering Consultancy", 2000. 2. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	understand the basic safety concepts in Industrial boilers, pressure vessels
CO2	understand the hazardous effects caused and prevention methods of chemicals used in industry
CO3	understand the environmental measures and controls towards safety
CO4	understand the analysis of safety preventions and hazards in industry
CO5	understand the safety regulations and safety management.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
	(COMMON TO BIOTECH, EEE, EIE, MECH)	3	0	0	3

Objectives

- To impart knowledge on the principle and design of particulate/ gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT - I	**AIR QULALITY MONITORING**		**9**
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Composition of Particulate and Gaseous Pollutants.		**CO1**	
UNIT - II	**EFFECT OF ATMOSPHERIC DISPERSION**		**9**
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.		**CO2**	
UNIT - III	**PARTICULATE CONTAMINANTS**		**9**
Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.		**CO3**	
UNIT - IV	**GASEOUS CONTAMINANTS**		**9**
Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing.		**CO4**	
UNIT - V	**INDOOR AIR QUALITY MONITORING**		**9**
Sources, types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution– Standards–Control and Preventive measures.		**CO5**	
		Total Periods:	**45**

Text Books:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies‟, Allied Publishers (P) Ltd., India 2002.

Reference Books:

1. David H.F. Liu, Bela G. Liptak, “Air Pollution”, Lweis Publishers, 2000.
2. Arthur C. Stern, “Air Pollution (Vol.I – Vol.VIII)”, Academic Press, 2006.
3. Wayne T.Davis, “Air Pollution Engineering Manual”, John Wiley & Sons, Inc, 2000.

Course Outcomes (CO) : The students completing the course will have	
CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**I**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO2	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO3	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO4	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO5	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

OPEN ELECTIVE -II (VII SEMESTER)

OCS105	**DATA ANALYTICS WITH R PROGRAMMING**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- ❖ Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- ❖ By completion of this course, students will be able to become data analyst

UNIT I	**INTRODUCTION TO DATA ANALYSIS**	**9**

Overview of Data Analytics, Need of Data Analytics, Nature of Data**,** Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		**CO1**
UNIT II	**R PROGRAMMING BASICS**	**9**
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		**CO2**
UNIT III	**DATA VISUALIZATION USING R**	**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. **Working with R Charts and Graphs:** Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		**CO3**
UNIT IV	**STATISTICS WITH R**	**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		**CO4**
UNIT V	**PRESCRIPTIVE ANALYTICS**	**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.
   URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
7. Joseph F Hair, William C Black etal , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
8. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts

CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2

OME102	**DESIGN OF EXPERIMENTS**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE).
- To demonstrate knowledge and understanding of Taguchi's approach.
- To develop skills to design and conduct experiments using DOE and Taguchi's approach.
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT - I	**FUNDAMENTALS OF EXPERIMENTAL DESIGNS**	**9**
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.		**CO1**
UNIT - II	**SINGLE FACTOR EXPERIMENTS**	**9**
Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design –		**CO2**

Applications.		
UNIT - III	**FACTORIAL DESIGNS**	**9**
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.		**CO3**
UNIT - IV	**SPECIAL EXPERIMENTAL DESIGNS**	**9**
Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design- introduction to response surface methods, central composite design.		**CO4**
UNIT - V	**TAGUCHI METHODS**	**9**
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies.		**CO5**
	Total Periods:	**45**

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

Reference Books:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

Course Outcomes (CO)
Upon completion of course, the students will be able to

CO1	understand the basic principle of DOEs and ANOVA.
CO2	understand the various single factor experiments
CO3	learn full and fraction factorial experiment design.
CO4	Ability to design various resolution using 2^k.
CO5	understand the Taguchi Orthogonal Arrays.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1
CO2	3	2	2	1	2	1	2	1	1	1	2	3	2	1	1

CO3	3	2	1	2	2	1	2	1	1	1	2	3	2	1	1
CO4	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1
CO5	3	2	2	2	2	1	2	1	1	1	1	3	2	1	1

OME105	**PRODUCT DESIGN AND DEVELOPMENT**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- Basic idea about the planning in product design.
- Basic idea about the industrial design tools.
- Basic idea about patents.

UNIT I	**INTRODUCTION**	**9**
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.		**CO1**
UNIT II	**CONCEPT GENERATION AND SELECTION**	**9**
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.		**CO2**
UNIT III	**PRODUCT ARCHITECTURE**	**9**
Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.		**CO3**
UNIT IV	**INDUSTRIAL DESIGN**	**9**
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM		**CO4**

tools –Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.	

UNIT V	DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT	9
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCE BOOKS

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New York, NY.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design some products for the given set of applications and also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.
CO2	Understand the concepts in generation and selection criteria.
CO3	Carry out pipeline execution and in establishing the architecture for developing products.
CO4	Acquire knowledge on investigation for customer needs related to industrialisation.
CO5	Develop and execute the developed prototypes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	L	1	2	3
CO1	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

CO2	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO3	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO4	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
C05	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

OME107	**VIBRATION AND NOISE CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Objectives

- ❖ To study the basics, sources and its control techniques of vibration
- ❖ To study the basics, sources and its control techniques of noise
- ❖ To study the sources of vibration and noise in automobiles
- ❖ To reduce vibration and noise in automotive components

UNIT - I	**BASICS OF VIBRATION**	**9**
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.		**CO1**
UNIT - II	**BASICS OF NOISE**	**9**
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.		**CO2**
UNIT - III	**AUTOMOTIVE NOISE SOURCES**	**9**
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.		**CO3**
UNIT – IV	**CONTROL TECHNIQUES**	**9**
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.		**CO4**
UNIT – V	**SOURCE OF NOISE AND CONTROL**	**9**
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers		**CO5**
	Total Periods:	**45**

Text Books:
1. Singiresu S.Rao, “Mechanical Vibrations”, 5th Edition, Pearson Education, 2010. 2. David Bies and Colin Hansen, “Engineering Noise Control – Theory and Practice”,4th Edition, E and FN Spon, Taylore & Francise, e-Library,2009.
Reference Books:
1. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University,2007. 2. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, “Theory of Vibration with Application”, 5th Edition Pearson Education,2011. 3. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 1996. 4. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book”, Second Edition, SAE International,1999. 5. Julian Happian-Smith , “An Introduction to Modern Vehicle Design”- Butterworth-Heinemann, 2004. 6. Rao, J.S and Gupta, K., “Introductory course on Theory and Practice of Mechanical Vibration”, 2nd Edition, New Age International Publications, 2010. 7. Shabana. A.A., “Theory of vibrations – An introduction”, 2nd Edition, Springer,2010. 8. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009. 9. John Fenton, “Handbook of Automotive body Construction and Design Analysis", Professional Engineering Publishing,1998.

Course Outcomes (CO) **Upon completion of the course, students will have the ability**	
CO1	To understand the basics, different types and source of vibration
CO2	To understand the basics, different types and source of noise
CO3	To understand and analyze the various sources of automotive noise
CO4	To understand the various control techniques of vibration
CO5	To understand the sources and control techniques of automotive noise

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2
CO4	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO5	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3

OEC101	INTRODUCTION TO SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3
Objectives					
• To understand the basic properties of signal and systems • To know the methods of characterization of LTI systems in the time domain • To analyze continuous-time signals and system in the Fourier and Laplace domain • To analyze discrete-time signals and system in the Fourier and Z transform domain					
UNIT - I	**CLASSIFICATION OF SIGNALS AND SYSTEM**				**12**
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals – Continuous-time (CT) and Discrete-time (DT) signals, Periodic and Aperiodic signals, Deterministic and Random signals, Energy and Power signals - Classification of systems- CT systems and DT systems- – Linear and Nonlinear, Time-variant and Time-invariant, Causal and Non- causal, Stable and Unstable.					**CO1**
UNIT - II	**ANALYSIS OF CONTINUOUS TIME SIGNALS**				**12**
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.					**CO2**
UNIT - III	**LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS**				**12**
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series and parallel.					**CO3**

UNIT-IV	ANALYSIS OF DISCRETE TIME SIGNALS	12
Baseband signal Sampling – Fourier Transform of discrete-time signals (DTFT) – Properties of DTFT - Z Transform and Properties.		CO4

UNIT - V	LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS	12
Impulse response – Difference equations-Convolution sum- Discrete-time Fourier Transform and Z Transform analysis of Recursive and Non-Recursive systems-DT systems connected in series and parallel.		CO5
	Total Periods:	**60**

Text Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.

Reference Books:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford,2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson,2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson,2007.

Course Outcomes (CO)

CO1	To be able to determine if a given system is linear/causal/stable
CO2	Capable of determining the frequency components present in a deterministic signal
CO3	Capable of characterizing LTI systems in the time domain and frequency domain
CO4	Understand the process of sampling and able to analyze the discrete-time signals in the frequency domain.
CO5	To be able to compute the output of an LTI system in the time and frequency domains.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1

CO2	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1
CO3	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1
CO4	3	2	3	3	2	2	0	0	0	0	1	2	2	2	1
CO5	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1

OCH102	PROCESS MODELLING AND SIMULATION	L	T	P	C
(COMMON TO EEE & EIE)		3	0	0	3

Objectives

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the steady state lumped systems.
- To analyze the unsteady state lumped systems
- To analyze the steady state distributed systems
- To analyze the unsteady state distributed systems and various modeling approaches.

UNIT – I	INTRODUCTION	7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.		CO1
UNIT – II	**STEADY STATE LUMPED SYSTEMS**	**9**
Degree of freedom analysis, single and network of process units, systems yielding linear and non- linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.		CO2
UNIT – III	**UNSTEADY STATE LUMPED SYSTEMS**	**9**
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.		CO3
UNIT – IV	**STEADY STATE DISTRIBUTED SYSTEM**	**7**
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.		CO4
UNIT – V	**UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES**	**13**
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat		CO5

exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.	

Total Periods: 45

Text Books:

1. Ramirez, W.; "Computational Methods in Process Simulation ", 2nd Education., Butterworths Publishers, New York,2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Education, McGraw-Hill Book Co., 1996

Reference Books:

1. Felder,R.M.andRousseau,R.W.,"Elementary Principles of Chemical Processes",John Wiley, Fourth edition 2018.
2. Franks, R. G. E., "Mathematical Modelling in Chemical Engineering ", John Wiley,2014.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Education,PHI Learning Ltd (2012).
4. Amiya K. Jana, "ChemicalProcess Modelling and Computer Simulation" 2nd Education,PHI Learning Ltd,(2012).

Course Outcomes (CO)

CO1	Student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.
CO2	Ability to analyze steady state lumped system
CO3	Ability to analyze unsteady state lumped system
CO4	Ability to analyze steady state distributed system
CO5	Ability to understand unsteady state distributed system and various modelling approaches

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**E**	**f**	**g**	**h**	**I**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	2	1	1	2	2	1	1	1	1	1	2	2	2
CO2	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2
CO3	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2
CO4	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2
CO5	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2

OMB104	QUALITY FOR MANAGEMENT SCIENCE	L	T	P	C
(Common to Electrical and Electronics Engineering, Electronics and Communication Engineering and Electronics & Instrumentation Engineering)		3	0	0	3

Objectives

- To facilitate the understanding of Quality Management principles and process.

UNIT - I	INTRODUCTION	9
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, customer retention.		**CO1**

UNIT - II	TQM PRINCIPLES	9
Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.		**CO2**

UNIT - III	TQM TOOLS AND TECHNIQUES I	9
The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to benchmark, Bench marking process - FMEA - Stages, Types.		**CO3**

UNIT - IV	TQM TOOLS AND TECHNIQUES II	9
Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.		**CO4**

UNIT - V	QUALITY MANAGEMENT SYSTEM	9
Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements — Implementation— Documentation—Internal Audits—Registration-- ENVIRONMENTAL MANAGEMENTSYSTEM: Introduction— ISO 14000 Series Standards — Concepts of ISO 14001— Requirements of ISO 14001— Benefits of EMS.		**CO5**

Total Periods:	**45**

Text Books:

1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011

Reference Books:

2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.Ltd., 2006.
5. ISO 9001-2015 standards

Course Outcomes (CO)

CO1	The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO3	Students can understand the organisational, communication and teamwork requirements for effective quality management
CO4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans
CO5	The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
C05	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

AUDIT COURSE

AD1001	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**C**
		2	0	0	0

Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.

UNIT – I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION**	**5**
History, Drafting Committee, (Composition & Working)		**CO1**
UNIT – II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**5**
Preamble, Salient Features		**CO2**
UNIT – III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**5**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		**CO3**
UNIT – IV	**ORGANS OF GOVERNANCE**	**5**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		**CO4**
UNIT – V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		**CO5**
UNIT – VI	**ELECTION COMMISSION**	**5**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		**CO5**
	Total Periods:	**30**

Reference Books:

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar 'Framing of Indian Constitution',1stEdition, 2015.
3. M.P. Jain, Indian Constitution Law, 7thEdition, Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes (CO)	
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4	Discuss the passage of the Hindu Code Bill of 1956.
CO5	Discuss about the role and functioning of election commission.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1

AD1002	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
		2	0	0	0
Objectives					
· Understand value of education and self-development · Imbibe good values in students · Let the students know about the importance of character					
UNIT – I					**6**
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements					**CO1**
UNIT – II					**6**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.	**CO2**

UNIT – III		**6**
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.		**CO3**

UNIT – IV		**6**
Character and Competence–Holy books vs Blind faith. Self-management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.		**CO4**

Total Periods:	**30**

Reference Books:

1. Chakroborty, S.K.'Values and Ethics for organizations Theory and practice', Oxford University Press, New Delhi

Course Outcomes (CO)

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality.
CO4	Developing the competence and self-control

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1

AD1003	**PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
		2	0	0	0

Objectives		
· Review existing evidence on their view topic to inform programme design and policy · Making under taken by the DFID, other agencies and researchers. · Identify critical evidence gaps to guide the development		
UNIT – I	**INTRODUCTION AND METHODOLOGY**	**6**
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.		**CO1**
UNIT – II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries – Curriculum, Teacher education.		**CO2**
UNIT – III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		**CO3**
UNIT – IV	**PROFESSIONAL DEVELOPMENT**	**6**
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.		**CO4**
UNIT – V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy – Teacher education – Curriculum and assessment – Dissemination and research impact.		**CO5**
	Total Periods:	**30**
Reference Books:		
1. J. Ackers, F. Hardman,'Classroom interaction in Kenyan primary schools', Compare, Vol. 31, No. 2, Page: 245-261, 2001. 2. M. Agrawal,'Curricular reform in schools: The importance of evaluation', Journal of Curriculum Studies, Vol. 36, No. 3, Page:361-379,2004. 3. K. Akyeampong,'Teacher training in Ghana-does it count? Multi-site teacher education research project' (MUSTER) Country report 1, London, 2003. 4. K. Akyeampong,K. Lussier, J. Pryor and J. Westbrook,'Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?' International Journal Educational Development, Vol. 33, No. 3, Page: 272–282, 2013. 5. R. J. Alexander 'Culture and pedagogy: International comparisons in primary education', Oxford		

and Boston: Blackwell, 2001.
6. M. Chavan,‘Read India: Amass scale, rapid, ‘learning to read’ campaign’, 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes (CO)

CO1	Students will be able to understand what pedagogical practices are being used by teachers in informal and informal classrooms in developing countries.
CO2	Students will be able to understand the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
CO3	Students will be able to understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Students will be able to understand professional development, curriculum and assessment
CO5	Students will be able to understand the research design and its impact.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO2	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO3	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO4	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO5	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

Objectives

- To achieve overall health of body and mind
- To overcome stress

UNIT – I	10
Definitions of Eight parts of yoga.(Ashtanga)	CO1

UNIT – II	10
Yam and Niyam – Do`s and Don’t’s in life – i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.	CO2

UNIT – III		10
Asan and Pranayam – Various yoga poses and their benefits for mind & body – Regularization of breathing techniques and its effects – Types of pranayam		**CO3**
Total Periods:		**30**

Reference Books:

1. ‘Yogic Asanas for Group Tarining-Part-I’, Janardan Swami Yoga bhyasi Mandal, Nagpur.
2. ‘Rajayoga or conquering the Internal Nature, by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Course Outcomes (CO)

CO1	Students will be able to develop healthy mind in a healthy body thus improving social health also
CO2	Improve efficiency
CO3	Students will be able to understand effects of regularization of breathing techniques

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

Objectives

· To learn to achieve the highest goal happily
· To become a person with stable mind, pleasing personality and determination
· To awaken wisdom in students

UNIT – I		10
Neetisatakam– holistic development of personality – Verses-19,20,21,22 (wisdom) – Verses-29,31,32 (pride & heroism) – Verses-26,28,63,65 (virtue) – Verses-52,53,59 (dont’s) – Verses-71,73,75,78 (do’s)		**CO1**

UNIT – II		10
Approach to day-to-day work and duties – Shrimad Bhagwad Geeta: Chapter 2– Verses 41, 47,48 – Chapter 3– Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,1		CO2

UNIT – III		10
Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2– Verses 56, 62, 68 Chapter 12 – Verses 13, 14, 15, 16,17, 18 – Personality of role model – Shrimad Bhagwad Geeta – Chapter2– Verses 17, Chapter 3– Verses 36,37,42 – Chapter 4– Verses 18, 38,39 Chapter18 – Verses 37,38,63		CO3
	Total Periods:	**30**

Reference Books:

1. Gopinath, P. Rashtriya Sanskrit Sansthanam, 'Bhartrihari's Three Satakam', Niti-sringar- vairagya, New Delhi,2010.
2. Swami Swarupananda, 'Srimad Bhagavad Gita', Advaita Ashram, Publication Department, Kolkata, 2016.

Course Outcomes (CO)

CO1	Students will be able to study the Shrimad-Bhagwad-Geeta that will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I	**QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN**	**9**
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.		**CO1**
UNIT -II	**RURAL ECONOMY AND LIVELIHOOD**	**9**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **Assignment:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		**CO 2**
UNIT -III	**RURAL INSTITUTIONS**	**9**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		**CO3**
UNIT -IV	**RURAL DEVELOPMENT PROGRAMMES**	**9**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		**CO4**
UNIT - V	**FIELD WORK**	**9**

Each student selects one programme for field visit Field based practical activities: • Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities • Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site • Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures • Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) • Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization • Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps • Participate in Gram Sabha meetings, and study community participation • Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries • Attend Parent Teacher Association meetings, and interview school drop outs • Visit local Anganwadi Centre and observe the services being provided • Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. • Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys • Raise understanding of people's impacts of climate change, building up community's disaster preparedness • Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants • Formation of committees for common property resource management, village pond maintenance and fishing.	CO5
Total Periods:	**45**

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

Course Outcomes (CO)

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

Objectives

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT - I	INTRODUCTION TO CULTURE	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.		**CO1**
UNIT - II	**INDIAN LANGUAGES AND LITERATURE**	**9**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		**CO2**
UNIT - III	**RELIGION AND PHILOSOPHY**	**9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)	**CO3**

UNIT - IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.		**CO4**

UNIT - V	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**

Total Periods:	**45**

Reference Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

Course Outcomes (CO)

CO1	Understand philosophy of Indian culture
CO2	Distinguish the Indian languages and literature
CO3	Learn the philosophy of ancient, medieval and modern India
CO4	Acquire the information about the fine arts in India. Know the contribution of scientists of different eras
CO5	Understand education systems in India

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

Objectives

- Introduction to Sanga Tamil Literature.
- ‘Agathinai’ and‘Purathinai’ in SangaTamil Literature.
- ‘Attruppadai’ in SangaTamil Literature.
- ‘Puranaanuru’ in SangaTamil Literature.
- ‘Pathitrupaththu’ in SangaTamil Literature.

UNIT - I	**SANGA TAMIL LITERATURE AN INTRODUCTION**	**9**
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature’s Grammar Tamil Sangam Literature’s parables.		**CO1**
UNIT - II	**AGATHINAI AND PURATHINAI**	**9**
Tholkappiyar’s Meaningful Verses –Three literature materials – Agathinai’s message - History of Culture from Agathinai – Purathinai – Classification – Mesage to Society from Purathinai.		**CO2**
UNIT - III	**ATTRUPPADAI**	**9**
Attruppadai Literature – Attruppadai in‘Puranaanuru’ – Attruppadai in‘Pathitrupaththu’- Attruppadai in ‘Paththupaattu’.		**CO3**
UNIT - IV	**PURANAANURU**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**
UNIT - V	**PATHITRUPATHTHU**	**9**
Pathitrupaththuin‘Ettuthogai’–Pathitrupaththu’sParables–Tamildynasty:Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		**CO5**
	Total Periods:	**45**

Text Books:

1. Sivaraja Pillai, The Chronology of the Early Tamils, SagwanPress,2018.

2. Hank Heifetz and GeorgeL. Hart, The Purananuru, Penguin Books,2002.

Reference Books:

1. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub,1997.
2. GeorgeL. Hart, Poetsof the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.
3. Xavier S. Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub. House, 1967.

Course Outcomes (CO)

CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate 'Agathinai' and 'Purathinai' in their personal and societalife.
CO3	Appreciate and apply the messages in 'Attruppadai' in their personal and societalife.
CO4	Appreciate and apply the messages in 'Puranaanuru' in their personal and societallife.
CO5	Appreciate and apply the messages in 'Pathitrupaththu' in their personal and societallife.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Faculty of Information and Communication Engineering

REGULATIONS – 2021

CURRICULUM & SYLLABI

B.E – ELECTRONICS AND COMMUNICATION ENGINEERING

Choice based Credit System (CBCS)

I-VIII Semesters

 # Students admitted in the year 2021

Vision and Mission of the Department:

Vision:

To become a world class renowned department where dissemination and application of knowledge in design and analysis of electronic circuits in the field of communication is delivered and to synergistically balance through relentless pursuit of student success towards the economic prosperity of the society and the world at large.

Mission:

- **Professionalism:** Achieve excellence in teaching, learning, and educational activities which ensure that each student has the opportunity to attain his or her fullest potential.
- **Core Competence:** Inculcate innovative skills, research aptitude, team-work, ethical practices in students so as to meet expectations of the industry as well as society.
- **Research:** Provide research and intellectual resources that address problems facing the industry and the world, while advancing the boundaries of disciplinary and multidisciplinary research and its applications.
- **Industrial Interaction:** Provide professional development opportunities for all by creating an open and accessible learning environment and incorporating appropriate technology through collaboration with industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.

PEO 2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.

PEO 3: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide validconclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and 1. under standing of the engineering and management principles and applythesetoone’sownwork,asamemberand leader in a team, to manage projects and in multidisciplinaryenvironments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technologicalchange.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO 1: To analyse, design and develop solutions by applying foundational concepts of electronics and communication engineering.

PSO 2: To apply design principles and best practices for developing quality products for scientific and business applications.

PSO 3: To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

Mapping of Programme Educational Objectives (PEOs) and the Program Outcomes (Pos):

PEOs	PROGRAM OUTCOMES (POS)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	2	3	3	3	-	-	3	3	3
PEO2	3	3	3	3	3	3	3	2	2	3	3	3
PEO3	2	2	-	-	3	3	3	3	3	3	3	3

You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

OMR, Chennai - 119

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**30**	**18**	**1**	**12**	**24**

SEMESTER II

Sl. No	COUSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics - II	BSC	4	3	1	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	EC1205	Circuit Analysis	PCC	3	3	0	0	3
6.	EC1206	Electronic Devices	PCC	3	3	0	0	3
PRACTICALS								
7.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8.	EC1208	Circuits and Devices Laboratory	PCC	4	0	0	4	2
TOTAL				**27**		**1**	**8**	**23**

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1352	Linear Algebra and Partial Differential Equations	BSC	4	3	1	0	4
2.	EC1302	Electronic Circuits - I	PCC	3	3	0	0	3
3.	EC1303	Signals and Systems	PCC	3	3	0	0	3
4.	EC1304	Digital Electronics	PCC	3	3	0	0	3
5.	EC1305	Electromagnetic Fields	PCC	3	3	0	0	3
6.	EE1351	Basic Electrical and Instrumentation Engineering	ESC	3	3	0	0	3
7.		Audit Course	AC	2	2	0	0	0
PRACTICALS								
8.	EC1307	Analog and Digital Circuits Laboratory	PCC	4	0	0	4	2
9.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
TOTAL				**27**	**21**	**1**	**6**	**22**

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1451	Probability and Random Processes	BSC	4	3	1	0	4
2.	EC1402	Electronic Circuits- II	PCC	3	3	0	0	3
3.	EC1403	Communication Theory	PCC	3	3	0	0	3
4.	EC1404	Linear Integrated Circuits	PCC	3	3	0	0	3
5.	CS1302	Data Structures	ESC	3	3	0	0	3
6.	EC1406	Control Systems Engineering	ESC	3	3	0	0	3
PRACTICALS								
7.	EC1407	Circuits Design Simulation and Linear Integrated Circuits Laboratory	PCC	4	0	0	4	2
8.	CS1307	Data Structures Laboratory using C	ESC	4	0	0	4	2
TOTAL				**27**	**19**	**1**	**8**	**23**

SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EC1501	Digital Communication	PCC	3	3	0	0	3
2.	EC1502	Discrete-Time Signal Processing	PCC	4	3	1	0	4
3.	EC1503	Communication Networks	PCC	3	3	0	0	3
4.	EC1504	Transmission lines and RF Systems	PCC	3	3	0	0	3
5.		Professional Elective -I	PEC	3	3	0	0	3
6.		Open Elective -I	OEC	3	3	0	0	3
PRACTICALS								
7.	EC1507	Digital Signal Processing Laboratory	PCC	4	0	0	4	2
8.	EC1508	Communication Systems Laboratory	PCC	4	0	0	4	2
9.	EC1509	Communication Networks Laboratory	PCC	4	0	0	4	2
10.	EC1510	Internship*	EEC	Two weeks				1
Total				**31**	**19**	1	**12**	**26**

*** Students should undergo two weeks internship during IV semester vacation which will be evaluated during V semester**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EC1602	VLSI Design	PCC	3	3	0	0	3
2.	EC1603	Wireless Communication	PCC	3	3	0	0	3
3.	EC1604	Antennas and Microwave Engineering	PCC	3	3	0	0	3
4.	EC1605	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
5.		Professional Elective –II	PEC	3	3	0	0	3
LAB INTEGRATED								
6.	EC1606	Digital Image Processing	PCC	5	3	0	2	4
PRACTICALS								
7.	EC1607	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
8.	EC1608	VLSI Design Laboratory	PCC	4	0	0	4	2
9.	EC1609	Mini Project	EEC	2	0	0	2	1
TOTAL				**30**	**18**	**0**	**10**	**24**
10.		Value Added Course**	One Week					1

**** The credits earned through VAC shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree**

SEMESTER VII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EC1701	Adaptive Learning Techniques	PCC	3	3	0	0	3
2.	EC1702	Optical Communication	PCC	3	3	0	0	3
3.	EC1703	Embedded Systems and IoT	ESC	3	3	0	0	3
4.	EC1704	Adhoc and Wireless Sensor Networks	PCC	3	3	0	0	3
5.		Open Elective – II	OEC	3	3	0	0	3
6.		Professional Elective - III	PEC	3	3	0	0	3
PRACTICALS								
7.	EC1707	Advanced Communication Laboratory	PCC	4	0	0	4	2
8.	EC1708	Embedded Laboratory	PCC	4	0	0	4	2
Total				**26**	**18**	**0**	**08**	**22**
9.	EC1709	Internship***	EEC	Two Weeks				1

*****Students should undergo two weeks internship during VI semester vacation which will be evaluated during VII semester and the credits through this internship shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree**

SEMESTER VIII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective – IV	PEC	3	3	0	0	3
2.		Professional Elective - V	PEC	3	3	0	0	3
PRACTICALS								
3.	EC1803	Project work	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 180

CATEGORIZATION OF COURSES

HUMANITIES AND SOCIALSCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics-II	BSC	4	3	1	0	4
6.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
7.	MA1352	Linear Algebra and Partial Differential Equations	BSC	4	3	1	0	4
8.	MA1451	Probability and Random Processes	BSC	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
2.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
5.	CS1302	Data Structures	ESC	3	3	0	0	3
6.	EE1351	Basic Electrical and Instrumentation Engineering	ESC	3	3	0	0	3
7.	CS1307	Data Structures Laboratory using C	ESC	4	0	0	4	2

8.	EC1406	Control Systems Engineering	ESC	3	3	0	0	3
9.	EC1703	Embedded Systems and IoT	ESC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1205	Circuit Analysis	PCC	3	3	0	0	3
2.	EC1206	Electronic Devices	PCC	3	3	0	0	3
3.	EC1208	Circuits & Devices Laboratory	PCC	4	0	0	4	2
4.	EC1302	Electronic Circuits- I	PCC	3	3	0	0	3
5.	EC1303	Signals and Systems	PCC	3	3	0	0	3
6.	EC1304	Digital Electronics	PCC	3	3	0	0	3
7.	EC1305	Electromagnetic Fields	PCC	3	3	0	0	3
8.	EC1307	Analog and Digital Circuits Laboratory	PCC	4	0	0	4	2
9.	EC1402	Electronic Circuits- II	PCC	3	3	0	0	3
10.	EC1403	Communication Theory	PCC	3	3	0	0	3
11.	EC1404	Linear Integrated Circuits	PCC	3	3	0	0	3
12.	EC1407	Circuits Design Simulation and Linear Integrated Circuits Laboratory	PCC	4	0	0	4	2
13.	EC1501	Digital Communication	PCC	3	3	0	0	3
14.	EC1502	Discrete-Time Signal Processing	PCC	4	3	1	0	4
15.	EC1503	Communication Networks	PCC	3	3	0	0	3
16.	EC1504	Transmission lines and RF Systems	PCC	3	3	0	0	3
17.	EC1507	Digital Signal Processing Laboratory	PCC	4	0	0	4	2
18.	EC1508	Communication Systems Laboratory	PCC	4	0	0	4	2

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
19.	EC1509	Communication Networks Laboratory	PCC	4	0	0	4	2
20.	EC1602	VLSI Design	PCC	3	3	0	0	3
21.	EC1603	Wireless Communication	PCC	3	3	0	0	3
22.	EC1604	Antennas and Microwave Engineering	PCC	3	3	0	0	3
23.	EC1605	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
24.	EC1606	Digital Image Processing (Lab Integrated)	PCC	5	3	0	2	4
25.	EC1607	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
26.	EC1608	VLSI Design Laboratory	PCC	4	0	0	4	2
27.	EC1701	Adaptive Learning Techniques	PCC	3	3	0	0	3
28.	EC1702	Optical Communication	PCC	3	3	0	0	3
29.	EC1704	Adhoc and Wireless Sensor Networks	PCC	3	3	0	0	3
30.	EC1707	Advanced Communication Laboratory	PCC	4	0	0	4	2
31.	EC1708	Embedded Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

ELECTIVE I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1001	Medical Electronics	PEC	3	3	0	0	3
2.	EC1002	Data Converters	PEC	3	3	0	0	3
3.	EI1864	Robotics and Automation	PEC	3	3	0	0	3
4.	EC1003	Compressive Sensing	PEC	3	3	0	0	3
5.	CS1303	Object Oriented Programming	PEC	3	3	0	0	3
6.	IT1811	Information Theory and Coding	PEC	3	3	0	0	3
7.	GE1002	Human Rights	PEC	3	3	0	0	3
8.	CE1025	Disaster Management	PEC	3	3	0	0	3
9.	MG1001	Principles of Management	PEC	3	3	0	0	3
10.	EC1004	Human Assist Devices	PEC	3	3	0	0	3

SEMESTER VI

ELECTIVE II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CS1616	Cryptography and Information Security	PEC	3	3	0	0	3
2.	EC1005	Multimedia Compression and Communication	PEC	3	3	0	0	3
3.	EC1006	Wireless Networks	PEC	3	3	0	0	3
4.	EC1007	Array Signal Processing	PEC	3	3	0	0	3
5.	EC1008	Advanced Digital Signal Processing	PEC	3	3	0	0	3
6.	EC1009	MEMS and NEMS	PEC	3	3	0	0	3
7.	EC1010	Optoelectronics	PEC	3	3	0	0	3
8.	EC1011	CMOS Analog IC Design	PEC	3	3	0	0	3
9.	EC1012	Mixed Signal IC Design	PEC	3	3	0	0	3
10.	EC1013	Low Power VLSI Design	PEC	3	3	0	0	3

SEMESTER VII

ELECTIVE III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1014	Space Time MIMO Wireless Communication	PEC	3	3	0	0	3
2.	EC1015	Electromagnetic Interference and Compatibility	PEC	3	3	0	0	3
3.	CS1729	Introduction to Operating Systems	PEC	3	3	0	0	3
4.	EC1016	Underwater Acoustics Signal Processing	PEC	3	3	0	0	3
5.	EC1017	Advanced Wireless Communication	PEC	3	3	0	0	3
6.	EC1018	Underwater Imaging Systems and Image Processing	PEC	3	3	0	0	3
7.	EC1019	Wearable Devices	PEC	3	3	0	0	3
8.	EC1020	5G Communication Technology	PEC	3	3	0	0	3
9.	EC1021	Medical Imaging Systems	PEC	3	3	0	0	3
10.	EC1022	Wireless Broadband Networks	PEC	3	3	0	0	3
11.	EC1039	Industrial Automation	PEC	3	3	0	0	3

SEMESTER VIII

ELECTIVE IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1023	Photonic Networks	PEC	3	3	0	0	3
2.	EC1024	Satellite Communication	PEC	3	3	0	0	3
3.	EC1025	IoT Enabled Systems Design	PEC	3	3	0	0	3
4.	EC1026	Satellite Remote Sensing and Image Analysis	PEC	3	3	0	0	3
5.	EC1027	Cognitive Radio	PEC	3	3	0	0	3
6.	EC1028	Industrial IoT and Industry 4.0	PEC	3	3	0	0	3
7.	EC1029	Therapeutic Equipments	PEC	3	3	0	0	3
8.	EC1030	ASIC and FPGA based system Design	PEC	3	3	0	0	3
9.	EC1031	Body Area Networks	PEC	3	3	0	0	3
10.	EC1032	Drone Technologies	PEC	3	3	0	0	3

SEMESTER VIII
ELECTIVE V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1851	Fundamentals of Soft Computing	PEC	3	3	0	0	3
2.	EC1033	Speech and Audio Signal Processing	PEC	3	3	0	0	3
3.	CS1827	Cloud Essentials	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
5.	GE1004	Fundamentals of Nanoscience	PEC	3	3	0	0	3
6.	EC1034	Video Analytics	PEC	3	3	0	0	3
7.	EC1035	Computer Vision	PEC	3	3	0	0	3
8.	EC1036	Brain Computer Interface & Applications	PEC	3	3	0	0	3
9.	EC1037	Sensors, Actuators & Interface Electronics	PEC	3	3	0	0	3
10.	EC1038	Radar Technologies	PEC	3	3	0	0	3

OPEN ELECTIVE COURSES (OEC)

SEMESTER V

OPEN ELECTIVE I

	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OMB104	Quality for Management Science	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OEI103	Basics of Biomedical Instrumentation	OEC	3	3	0	0	3
4.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3
5.	OCE102	Introduction to Geographic Information System	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OME104	Industrial Safety Engineering	OEC	3	3	0	0	3
2.	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
3.	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
4.	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
5.	OEI105	SCADA system and application Management	OEC	3	3	0	0	3
6.	OBT107	Introduction of Cell Biology	OEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2.	EC1510	Internship	EEC	2 Weeks				1
3.	EC1609	Mini Project	EEC	2	0	0	2	1
4.	EC1803	Project Work	EEC	20	0	0	20	10

AUDIT COURSES (AC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	2	2	0	0	0
2.	AD1002	Value Education	AC	2	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8.	AD1008	Sanga Tamil literature appreciation	AC	2	2	0	0	0

Value Added Course (VAC)

S.No	Course Code	Course Name
1	ECV101	Artificial Intelligence and Deep Learning
2	ECV102	Image Processing and Machine Learning using Computer vision
3	ECV103	Embedded systems and IoT using Node MCU
4	ECV104	PCB design & Enclosure design for High frequency Electronic Product
5	ECV105	Full stack Web Development
6	ECV106	Unmanned Aerial Vehicle and its Applications
7	ECV107	Cloud Computing
8	ECV108	Embedded C with RTOS and IoT
9	ECV109	LabView based Real Time Applications development using industrial Controller
10	ECV110	Robotics and its Applications

SUMMARY OF CURRICULUM

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL	Percentage (%)
		I	II	III	IV	V	VI	VII	VIII		
1.	HSMC	3	6	-	-	-	-	-	-	09	5
2.	BSC	12	7	4	4	-	-	-	-	27	15
3.	ESC	9	2	3	8	-	-	3	-	25	13
4.	PCC	-	8	14	11	19	20	13	-	85	47
5.	PEC	-	-	-	-	3	3	3	6	15	10
6.	OEC	-	-	-	-	3	-	3	-	06	3
7.	EEC	-	-	1	-	1	1	-	10	13	7
8.	AC	-	-	0	-	-	-	-	-	0	-
Total		24	23	22	23	26	24	22	16	180	

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students
- To help learners develop their listening skills, which will enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/ FAMILY & FRIENDS 9

Reading– critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.

UNIT II GENERAL READING AND FREE WRITING 9

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening **-** long texts - TED talks - extensive speech on current affairs and discussions Speaking– describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing– types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speakingabout friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations

UNIT V EXTENDED WRITING 9

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2021.

2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.

3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007.
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student‘s Book & Workbook) Cambridge University Press, New Delhi: 2005.
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011.
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013.
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford
7. University Press: 2020.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2 Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5 Identify topics and formulate questions for productive inquiry

MA1102 ENGINEERING MATHEMATICS –I L T P C

(Common for all branches of B.E. / B. Tech Programmes) 3 1 0 4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of single variable and multivariable calculus which plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I MATRICES 12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms

UNIT II CALCULUS OF ONE VARIABLE 12

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.

UNIT III CALCULUS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

UNIT V MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units II & IV - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., — Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., — Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Have a clear idea of matrix algebra pertaining to Eigenvalues and Eigenvectors in addition to dealing with quadratic forms.

CO2 Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.

CO3 Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.

CO4 Understand the concept of integration through the fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.

CO5 Do double and triple integration so that they can handle integrals of higher order which are applied in the engineering field.

PH1103	ENGINEERING PHYSICS	L P T C
		3 0 0 3

OBJECTIVES

To make the students conversant with

- Elastic properties of materials and various moduli of elasticity.
- Principles of laser and fiber optics and its various technological applications.
- Thermal conduction in solids, heat exchangers and its applications in various devices.
- Quantum concepts to explain black body radiation, Compton effect and matter waves.
- Various crystal structures, Miller indices and crystal growth techniques.

UNIT I PROPERTIESOF MATTER 9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity- I shaped girders - stress due to bending in beams.

UNIT II LASER ANDFIBER OPTICS 9

Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.

UNIT III THERMAL PHYSICS 9

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat-conduction through compound media (series and parallel)- Lee's disc method: theory and experiment - Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.

UNIT IV QUANTUMPHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope- tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press,2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers,2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India,2013.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley,2015.

2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.

3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman,2014.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young’s modulus by various methods.

CO2 Principle of laser, Einstein’s coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.

CO3 The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee’s disc method and radial flow of heat.

CO4 The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, tunnelling electron microscopy and its applications.

CO5 The importance of various crystal structures, Miller indices and various growth techniques.

CY1104 ENGINEERING CHEMISTRY L P T C

3 0 0 3

OBJECTIVES

To make the student conversant with the

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys
- Various types of fuels, applications and combustion
- Conventional and non–conventional energy sources and energy storage device

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Surface chemistry : Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC.

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT III PHASE RULE AND ALLOYS 9

Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process.

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate) – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel.

Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.

UNIT V NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell .

Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.

TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, “Engineering Chemistry” 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).

2. S.S. Dara, S.S. Umare, “A text book of Engineering Chemistry” S.Chand& Co.Ltd., New Delhi(2020).

3. S. Vairam, P. Kalyani and Suba Ramesh, “Engineering Chemistry”, Wiley India (P) Ltd. NewDelhi, (2018).

4. P. Kannan, A. Ravikrishnan, “Engineering Chemistry”, Sri Krishna Hi-tech Publishing Company(P) Ltd., Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, “Engineering Chemistry”, Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, “Engineering Chemistry–Fundamentals and Applications”, Cambridge University, Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, “Engineering Chemistry”, Firewall Media, New Delhi., (2010)
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

COURSE OUTCOMES

Upon completion of the course, the students should be

CO1 Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.

CO2 Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.

CO3 Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.

CO4 Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.

CO5 Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II INTRODUCTION TO PYTHON 9

Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.

UNIT III CONTROL FLOW, FUNCTIONS AND STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016

(http://greenteapress.com/wp/thinkpython/)

2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013

2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop algorithmic solutions to simple computational problems

CO2 Develop simple console application in python

CO3 Develop python program by applying control structure and decompose program into functions.

CO4 Represent compound data using python lists, tuples, and dictionaries.

CO5 Read and write data from/to files in Python.

GE1106 **ENGINEERING GRAPHICS** **L T P C**

OBJECTIVES **2 0 4 4**

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To inculcate drawing practice in standardized form whenever technical drawing is needed.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and 1dimensioning.

UNIT - I PLANE CURVES AND FREEHAND SKETCHING7 + 12

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloidal curves - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles - Representation of Three-Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)

UNIT - II PROJECTION OF POINTS, LINES AND PLANE SURFACE6 + 12

Orthographic projection - principles-Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principalplanes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT - III PROJECTION OF SOLIDS5 + 12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes when the solid is simply suspended by rotating object method.

UNIT - IVPROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES5 + 12

Sectioning of simple solids like prisms, pyramids, cylinder, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other - obtaining true shape of section.

Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points.

UNIT - V ISOMETRIC AND PERSPECTIVE PROJECTIONS6 + 12

Principles of isometric projection - isometric scale -Isometric projections and isometric viewsof simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions.Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method.

TOTAL: 90 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Understand the fundamentals and standards of Engineering graphics.

CO2 Perform freehand sketching of basic geometrical constructions and multiple views of Objects.

CO3 Understand the concept of orthographic projections of lines and plane surfaces.

CO4 Draw projections of the section of solids and development of surfaces.

CO5 Visualizeand to project isometric and perspective sections of simple solids.

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty ninth edition 2017

2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.

3. S. Ramachandran and K. Pandian, “Engineering Graphics” Airwalk Publications; 8th edition 2014

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.

2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2018.

3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.

4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.

5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.

6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

GE1107 PYTHON PROGRAMMING LABORATORY **L T P C**

(Common for all branches of B.E. / B. Tech Programmes) 0 0 4 2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3. Scientific problem-solving using decision making and looping.

- Armstrong number, palindrome of a number, Perfect number.

4. Simple programming for one dimensional and two-dimensional arrays.

- Transpose, addition, multiplication, scalar, determinant of a matrix

5. Program to explore string functions and recursive functions.
6. Utilizing 'Functions' in Python

- Find mean, median, mode for the given set of numbers in a list.
- Write a function dups to find all duplicates in the list.
- Write a function unique to find all the unique elements of a list.
- Write function to compute gcd, lcm of two numbers.

7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.

- To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.

9. Find the most frequent words in a text of file using command line arguments.

10. Demonstrate Exceptions in Python.

Applications**:** Implementing GUI using turtle, pygame.

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019

2. Allen B. Downey , “ Think Python: How to Think Like a Computer Scientist”, Second Edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016.

3. Shroff “Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.

4. David M.Baezly “Python Essential Reference”. Addison-Wesley Professional; Fourth edition, 2009.

5. David M. Baezly “Python Cookbook” O’Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Develop simple console applications through python with control structure and functions

CO2 Use python built in data structures like lists, tuples, and dictionaries for representing compound data.

CO3 Read and write data from/to files in Python and applications of python.

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS– PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of wavelength of mercury spectra using Spectrometer and grating.
4. Determination of dispersive power of prism using Spectrometer.
5. (a) Determination of wavelength and particle size using a laser.

   (b) Determination of numerical aperture and acceptance angle of an optical fibre.

   (c) Determination of width of the groove of compact disc using laser

6. Determination of Young's modulus of the material of the given beam by uniform bending method.
7. Determination of energy band gap of the semiconductor.
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Estimation of HCl using Na2CO3 as primary standard and determination of alkalinity
2. in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Determination of strength of given hydrochloric acid using pH meter.
8. Determination of strength of acids in a mixture of acids using conductivity meter.
9. Estimation of iron content of the given solution using potentiometer.
10. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
11. Conductometric titration of strong acid vs strong base.

TOTAL: 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students should be

CO1 Able to understand the concept about the basic properties of matter like stress, strain and types of moduli.

Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.

CO2 Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation.

Able to understand the working principle of laser components and working of different laser system.

Able to understand the phenomenon of light, applications of fibre optics.

CO3 Able to understand the concept of determining the pH value by using pH meter.

Able to understand the concept about the amount of chloride present in the given sample of water.

CO4 Able to understand the concept of determining the emf values by using potentiometer.

Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.

CO5 Able to understand the amount of dissolved oxygen present in the water.

Able to understand the concept of estimation of hardness of water by EDTA method.

Able to understand the concept of estimation of alkalinity in water sample.

HS1201 **PROFESSIONAL ENGLISH** **L P T C**

(Common to all Branches) 3 0 0 3

OBJECTIVES

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend Engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I **INTRODUCTION TO PROFESSIONAL ENGLISH** **9**

Listening: Listening to technical talks with comprehension tasks - Speaking– conversationmethodsinreallifeoccurrencesusingexpressions ofdifferentemotionsandimperativeusages- Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations- Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.

UNIT II **READING AND STUDY SKILLS** **9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms,homophones,homographs-easilyconfusedwordsLanguage Development- impersonal passive voice, numerical adjectives.

UNIT III **TECHNICAL WRITING AND GRAMMAR** **9**

Listening–listening to conversation– effectiveuseofwordsandtheirsound aspects,stress,intonation&pronunciation- Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.

UNIT IV REPORT WRITING 9

Listening – Model debates & documentaries and making notes. Speaking– expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter – Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 9

Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.

4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.

CO2 Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.

CO3 Read different genres of texts adopting various reading strategies.

CO4 Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5 Identify topics and formulate questions for productive inquiry.

MA1202	ENGINEERING MATHEMATICS – II	L	T	P	C
(Common to branches of B.E / B.Tech Programmes except AI&DS and AI&ML)		3	1	0	4

OBJECTIVES

- This course is designed to cover topics such as Differential Equations, Vector Calculus, Complex Analysis and Laplace Transform.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler's and Legendre's type – System of simultaneous first order linear differential equations with constant coefficients.

UNIT II VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and simple application in evaluating line, surface and volume integrals.

UNIT III COMPLEX VARIABLES 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties – Harmonic conjugates – Construction of analytic function (Milne-Thomson method) – Conformal mapping – Standard transformations W = Z + C, CZ, 1/Z - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Cauchy's integral theorem –Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Cauchy's Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line).

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function - Basic properties - Shifting theorems – transforms of derivatives and integrals –Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44th Edition, 2018.
2. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCE BOOKS

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2017.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics , Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O‘Neil, P.V. Advanced Engineering Mathematics , Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, Engineering Mathematics, Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics – II, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems

CO2 The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrotational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.

CO3 The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

CO4 The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.

CO5 Students will understand the purpose of using transforms to create new domain which can give easier ways to handle the problem that is being investigated.

PH1253	PHYSICS FOR ELECTRONICS ENGINEERING	L	P	T	C
	(Common to EEE, ECE and	3	0	0	3

EIE branches)

OBJECTIVES

Enable the students to

- Understand the transport properties of conducting materials and their modeling using classical and quantum theories,
- Acquire knowledge in semiconductors and their applications in various devices
- Grasp the principles of magnetic and dielectric materials and their applications
- Understand the functioning of optical materials for
- Understand the basics of quantum structures, properties of nano materials and their applications.

UNIT I CONDUCTINGMATERIALS 9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi-Dirac statistics - Density of energy states - Electron in periodic potential: Bloch theorem - metals and insulators - Energy bands in solids - tight binding approximation - Electron effective mass - concept of hole.

UNIT II PHYSICS OF SEMICONDUCTOR DEVICES 9

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n- type & p-type semiconductors - carrier transport: velocity-electric field relations - drift and diffusion transport - Einstein's relation - Hall effect and devices - Zener and avalanche breakdown in p-n junction diode - Zener diode as voltage regulator - Ohmic contacts - tunnel diode - Schottky diode - MOS Capacitor.

UNIT III MAGNETIC ANDDIELECTRIC MATERIALS 9

Origin of magnetic moment - Bohr magneton - Microscopic and macroscopic classification of magnetic materials : diamagnetic, paramagnetic and ferromagnetic materials - Domain theory - Hysteresis (based on domain theory) - soft and hard magnetic materials - Ferrites - applications. Dielectric materials: Polarization processes - internal field - Clausius-Mosotti relation - dielectric loss - dielectric breakdown.

UNIT IV OPTICAL MATERIALS 9

Classification of optical materials - carrier generation and recombination processes - Absorption, emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in p-n junction diode - solar cell - photo detectors - LED - Organic LED - excitons - quantum confined Stark effect - quantum dot laser, quantum well laser.

UNIT V NANO ELECTRONIC DEVICES 9

Introduction - electron density in bulk material - size dependence of Fermi energy - quantum confinement - quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - resonant tunneling - quantum interference effects - mesoscopic structures - Coulomb blockade effects - Single electron phenomena and Single electron Transistor - magnetic semiconductors - spintronics, Spintronic Devices: Spin Valve, Spin FET- Carbon nanotubes: Types ,Preparation-CVD, Properties and applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ben Streetman and Sanjay Banerjee Solid State Electronic Devices ,Prentice Hall , 6th Edition, 2005.

2. Donald Neaman , Dhrubes Biswas , Semiconductor Physics and Devices (SIE) 4th Edition ,2017

3. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”,Springer, 2008

4. Adaptation by Balasubramanian, R, Callister “Material Science and Engineering”, Wiley India Pvt.Ltd., 2nd Edition, 2014.

5. Mani.P , “Physics for Electronics Engineering”, Dhanam Publishers

, 2017.

6. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., “Physics for Electronics Engineering and Information Science”, McGraw Hill Education (India) Private Limited, 2018.

REFERENCE BOOKS

1. Traugott Fischer , “Materials Science for Engineering Students” ,Ist Edition,Elsevier , 2009

2. Budinski, K.G. & Budinski, M.K. “Engineering Materials Properties and Selection”, Prentice Hall, 2009.

3. Rogers, B., Adams, J.& Pennathur, S.“Nanotechnology: Understanding Small Systems”. CRC Press,2014

4. Hanson, G.W. “Fundamentals of Nanoelectronics”. Pearson Education,2009

5. Kwok Ng, Simon Sze, and Yiming Li ,” Physics of Semiconductor Devices”, 2006.

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1 Gain knowledge on classical and quantum free electron theories and formation of energy band structures.

CO2 Gain knowledge on semiconducting devices and its applications.

CO3 Acquire knowledge on magnetic and dielectric materials and their applications.

CO4 Understand the relationship of optoelectronic materials and their applications.

CO5 Acquire knowledge about the nano structures and its applications.

EC1205	CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology.

UNIT I BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY 12

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C.circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees –Cut sets - Fundamental cut sets - Cut set matrix – Tie sets - Link currents and Tie set schedules - Twig voltages and Cut set schedules, Duality and dual networks

UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS 12

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem ,application of Network theorems- Network reduction: voltage and current division, source transformation – star delta conversion.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency –Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor -Selectivity. Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multilinking coupled circuits - Series, Parallel connection of coupled inductors - Single tuned coupled circuits.

UNITIV TRANSIENT ANALYSIS 12

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

UNIT V TWO PORT NETWORKS **12**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks.

TOTAL:60 PERIODS

TEXT BOOKS:

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis" , McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.

2. Joseph Edminister and Mahmood Nahvi, "Electric Circuitsǁ, Schaum's Outline Series", TataMcGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition,McGraw Hill, 9th Reprint 2015.

2. A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2nd Indian Reprint 2009.

3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning,Fifth Edition, 1st Indian Reprint 2013.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1 To Develop the capacity and analyze electrical circuits, apply the circuit theorems in real time.

CO2 To impart knowledge on solving circuits using network theorems.

CO3 To introduce the phenomenon of resonance in coupled circuits.

CO4 To educate on obtaining the transient response of circuits.

CO5 To model any device using two port networks.

EC1206	ELECTRONIC DEVICES	L	P	T	C
		3	0	0	3

OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field-effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.

UNIT I SEMICONDUCTOR DIODE 9

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi-Emitter Transistor.

UNIT III FIELD EFFECT TRANSISTORS 9

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage - Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES 9

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

UNIT V POWER DEVICES AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Phototransistor, Opto Coupler, Solar cell, CCD.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHillInc. 2012.

2. Salivahanan. S, Suresh Kumar. N, Vallavaraj. A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.

REFERENCE BOOKS

1. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition, July 2008.

2. R.S.Sedha, " A Text Book of Applied Electronics" S.Chand Publications, 2006.

3. Yang, "Fundamentals of Semiconductor Devices", McGraw Hill International Edition, 1978.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 To analyze the operation and characteristics of the PN junction diode.

CO2 To analyze the operation and characteristics of Bipolar junction transistor (BJT).

CO3 To understand and analyze the Field-effect transistor – JFET, MOSFET.

CO4 To study and analyze the special semiconductor devices like MESFET, FINFET, PINFET, CNTFET, Varactor diode, Tunnel Diode, GaAs Devices, LASER, and LDR Diode.

CO5 To understand the basic concepts of Power and Display devices

GE1204 ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All branches)

	L	P	T	C
	3	0	0	3

OBJECTIVES

- To study the inter relationship between living organisms and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 11

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem.

Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 9

Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 8

Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies

TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hyderabad, (2015).
3. G. Tyler Miller, Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies - From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course, the students should be able

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to the environmental problems.
CO5	To understand the impact of environment on human population and human health.

GE1207 ENGINEERING PRACTICES LABORATORY L T P C

(Common to ALL Branches) 0 0 4 2

OBJECTIVES:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I **CIVIL ENGINEERING PRACTICE 13**

Buildings:

a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Prepration of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III **ELECTRICAL ENGINEERING PRACTICE** 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV **ELECTRONICS ENGINEERING PRACTICE** 16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Uponcompletion ofthecourse,studentswillbeableto

CO1 Fabricate carpentry components and pipe connections including plumbing works.

CO2 Use welding equipments to join the structures, carry out the basic machining operations, and make the models using sheet metal works

CO3 Illustrate on centrifugal pump, air conditioner, operations of smithy, foundary and fittings

CO4 Carry out basic home electrical works and appliances, measure the electrical quantities

CO5 Elaborate on the electronic components and gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. **CIVIL**

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs andother fittings.15 Sets.

2. Carpentry vice (fitted to work bench)15 Nos.

3. Standard woodworking tools15 Sets.

4. Models of industrial trusses, door joints, furniture joints5 each

5. Power Tools: (a) Rotary Hammer2 Nos

(b) Demolition Hammer2 Nos

(c) Circular Saw2 Nos

(d) Planer2 Nos

(e) Hand Drilling Machine2 Nos

(f) Jigsaw2 Nos

2. **MECHANICAL**

1. Arc welding transformer with cables and holders5 Nos.

2. Welding booth with exhaust facility5 Nos.

3. Welding accessories like welding shield, chipping hammer,wire brush, etc.5 Sets.

4. Oxygen and acetylene gas cylinders, blow pipe and otherwelding outfit.2 Nos.

5. Centre lathe2 Nos.

6. Hearth furnace, anvil and smithy tools2 Sets.

7. Moulding table, foundry tools2 Sets.

8. Power Tool: Angle Grinder2 Nos

9. Study-purpose items: centrifugal pump, air-conditionerOne each.

3. **ELECTRICAL**

1. Assorted electrical components for house wiring15 Sets

2. Electrical measuring instruments10 Sets

3. Study purpose items: Iron box, fan and regulator, emergency lamp1 each

4. Megger (250V/500V)1 No.

5. Power Tools: (a) Range Finder2 Nos

(b) Digital Live-wire detector2 Nos

4. **ELECTRONICS**

1. Soldering guns10 Nos.

2. Assorted electronic components for making circuits50 Nos.

3. Small PCBs10 Nos.

4. Multimeters10 Nos.

5. Study purpose items: Telephone, FM radio, low-voltage power supply

EC1208	CIRCUITS AND DEVICES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn the characteristics of basic electronic devices such as Diode, BJT, FET, SCR
- To understand the working of RL, RC and RLC circuits
- To gain hand on experience in Thevenin & Norton theorems, KVL & KCL, and Superposition Theorems.

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics and Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & FWR
8. Verifications of Thevenin & Norton theorem
9. Verifications of KVL & KCL
10. Verifications of Super Position Theorem
11. Verifications of maximum power transfer & reciprocity theorem
12. Determination of Resonance Frequency of Series & Parallel RLC Circuits
13. Transient analysis of RL and RC circuits

LABORATORY REQUIREMENTS

BC 107, BC 148,2N2646, BFW10	-	25 each
1N4007, Zener diodes	-	25 each
Resistors, Capacitors, Inductors	-	sufficient quantities
Bread Boards	-	15 Nos.
CRO (30MHz)	-	15 Nos.
Function Generators (3MHz)	-	10 Nos.
Dual Regulated Power Supplies (0 – 30V)	-	10 Nos.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

- Analyze the characteristics of basic electronic devices
- Design RL and RC circuits
- Verify Thevenin's& Norton's theorem KVL & KCL, and Super Position Theorems

MA1352	LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To understand the basis and dimension of vector space.
- To understand the concept of linear transformation, inner product spaces and process of orthogonalization.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series which plays a vital role in many engineering problems.
- To acquaint the student with Fourier series techniques in solving boundary value problems

UNIT I VECTOR SPACES 12

Vector spaces, Subspaces, Linear combinations, Linear independence and linear dependence, Bases and dimensions.

UNIT II LINEAR TRANSFORMATION AND DIAGONALIZATION 12

Linear transformation, Null spaces and ranges, Dimension theorem, Matrix representation of a linear transformations. Inner product, norms - Gram Schmidt orthogonalization process.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of PDE - Classification of partial differential equations, Solutions of first order equations: Standard types, Lagrange's linear equation, solution of linear equations of second order with constant coefficients, linear non-homogeneous partial differential equations.

UNIT IV FOURIER SERIES 12

Dirichlet's conditions, General Fourier series, odd and even function, Half range cosine series and half range sine series, Parseval's identity, Harmonic analysis.

UNIT V APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Solutions of one-dimensional wave equation, Solutions of one-dimensional heat equation, Steady state solution of two-dimensional heat equation.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Friedberg S.H, Insel A.J. and Spence L, Linear Algebra, Fifth edition, Pearson, 2018.
2. B.S. Grewal, Higher engineering mathematics, Khanna publishers, New Delhi 44th edition, 2017.
3. Strang G, Linear algebra for everyone, Wellesley Cambridge press, first edition, 2020.

REFERENCES:

1. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. James, G. "Advanced Modern Engineering Mathematics‖, Pearson Education, 2007.
3. Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan, S. "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
5. Lay, D.C. "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
6. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning, 2007.
7. Strang, G. "Linear Algebra and its applications", Thomson (Brooks),New Delhi, 2005.

CO1 Find the basis and dimension of vector space

CO2 Find the matrix of linear transformation and orthonormal basis of inner product space.

CO3 Understand how to solve various types of partial differential equations.

CO4 Find the Fourier series of periodic functions.

CO5 Solve one and two dimensional heat flow and one dimensional wave equations by Fourier series techniques.

EC1302 ELECTRONIC CIRCUITS – I

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To understand the DC biasing methods of transistors and verify its performance.
- To design and analyze single stage and multistage BJT amplifier circuits.
- To design & analyze the small signal JFET & MOSFET amplifiers.
- To analyze the frequency response of small signal JFET & MOSFET amplifiers.
- To design, analyze and troubleshoot the fault analysis of the regulated DC power supplies.

UNIT I BIASING OF DISCRETE BJT, JFET AND MOSFET 9

BJT– Need for biasing - DC Load Line and Bias Point – DC analysis of Transistor circuits - Various biasing methods of BJT – Bias Circuit Design - Thermal stability - Stability factors - Bias compensation techniques using Diode, thermistor and sensistor - JFET - DC Load Line and Bias Point - Various biasing methods of JFET - JFET Bias Circuit Design - MOSFET Biasing.

UNIT II BJT AMPLIFIERS 9

Small Signal analysis of CE, CC and CB amplifiers using Hybrid-π equivalent circuits - AC Load Line Analysis- Darlington Amplifier –Miller's Theorem-Bootstrap technique - Cascade, Cascode configurations - Differential amplifier, Basic BJT differential pair – Small signal analysis and CMRR

UNIT III SINGLE STAGE FET, MOSFET AMPLIFIERS 9

Small Signal equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π equivalent circuits - Basic FET differential pair-BiCMOS circuits.

UNIT IV FREQUENCY RESPONSE OF AMPLIFIERS 9

Amplifier frequency response – Frequency response of transistor amplifiers with circuit Capacitors – BJT frequency response – short circuit current gain - cut off frequency – f_α, f_β and unity gain bandwidth – Miller effect on capacitors - frequency response of FET – High frequency analysis of CE and MOSFET CS amplifier.

UNIT V POWER SUPPLIES AND ELECTRONIC DEVICE TESTING 9

Linear mode power supply - Rectifiers - Filters - Half-Wave Rectifier Power Supply - Full-Wave Rectifier Power Supply - Voltage regulators: Voltage regulation - Linear series, shunt and switching Voltage Regulators - Over voltage protection - BJT and MOSFET – Switched mode power supply (SMPS) - Power Supply Performance and Testing - Troubleshooting and Fault Analysis.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, Mc-Graw Hill Education (India) Private Ltd., 2010. (Unit I-IV)

2. Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 11th Edition, Pearson Education, 2013. (Unit V)

REFERENCES:

1. Millman J, Halkias.C.and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.

2. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4th Edition,Mc Graw Hill Education (India) Private Ltd., 2017.

3. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.

4. David A. Bell, Electronic Devices & Circuits, 5th Edition, Oxford University Press,2008

5. Anwar A. Khan and Kanchan K. Dey, A First Course on Electronics, PHI, 2006.

6. Rashid M, Microelectronics Circuits, Thomson Learning, 2007.

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1 acquire knowledge about different BJT and FET biasing circuits.

CO2 analyze the performance of small signal BJT, multistage and Differential amplifiers.

CO3 analyze the performance of single stage FET, MOSFET amplifiers.

CO4 analyze the performance of Frequency response characteristics of BJT and FET and MOSFET amplifiers.

CO5 design and troubleshoot the regulated DC power supplies

EC1303	SIGNALS AND SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform &Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To characterize LTI systems in the Time domain and various Transform domains.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Introduction, Continuous-Time signals, Discrete-Time signals, Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic and Aperiodic signals, Deterministic and Random signals, Symmetric and asymmetric signals, Energy and Power signals, Continuous-Time systems, Discrete-Time systems-Basic system properties – Static and Dynamic systems , Linear and Nonlinear systems, Time-variant and Time invariant systems, Causal and Non-causal systems, Stable and Unstable systems.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series representation of continuous-Time periodic signals, Convergence of Fourier Series, Gibb's phenomenon. Fourier series representation of Discrete-Time periodic signals, Continuous-Time Fourier Transform, Representation of Aperiodic signals using Continuous-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous-Time Fourier Transform, Inverse Fourier Transform, The Laplace Transform, The Region of Convergence for Laplace Transforms, Properties of the Laplace Transform, Inverse Laplace Transform

UNIT III ANALYSIS OF LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9

LTI systems characterized by Linear Constant Coefficient Differential Equations using the Laplace Transform, System Function, Impulse Response, Step response and response with initial conditions, System Function Algebra and Block Diagram Representation, Interconnection of systems, Convolution integral Representation of LTI systems, LTI systems characterized by Linear Constant Coefficient Differential Equations using

Continuous-Time Fourier Transform, Frequency Response, Impulse Response, Step response and response.

UNIT IV ANALYSIS OF DISCRETE-TIME SIGNALS 9

Sampling theorem, Sampling theorem for Band limited signals, The Effect of under sampling: Aliasing, The Discrete-Time Fourier Transform - Representation of Aperiodic signals using Discrete-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Discrete-Time Fourier Transform, Inverse Fourier Transform, The z-Transform, The Region of Convergence for the z- Transform, Properties of the z- Transform, Inverse z-Transform

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

LTI systems characterized by Linear Constant Coefficient Difference Equations using the z-Transform, System Function, Impulse Response, Step response and response with initial conditions, System Function Algebra and Block Diagram Representation, Interconnection of systems, Convolution sum Representation of LTI systems, LTI systems characterized by Linear Constant Coefficient Difference Equations using Discrete-Time Fourier Transform, Frequency Response, Impulse Response, Step response and response.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2007.

REFERENCES:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.

2. R.E.Zeimer, W.H.Tranter and D.Ronald Fannin, “Signals and Systems : Continuous and Discrete”,Fourth Edition Pearson, 2007.

3. Simon Haykin and Barry Van Veen “Signals & Systems”, Second Edition Wiley 2007.

COURSE OUTCOMES:

CO1 To be able to determine the classification of systems based on their properties

CO2 Apply the Laplace transform and continuous-time Fourier transform of continuous-time signals.

CO3 Apply the Laplace transform and continuous-time Fourier transform of continuous-time systems.

CO4 Apply the z-Transform and discrete-time Fourier transform of discrete-time signals.

CO5 Apply the z-Transform and discrete-time Fourier transform of discrete-time systems.

EC1304 DIGITAL ELECTRONICS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

UNIT I DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1' s and 2' s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity generator and checker, Code converter.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design of sequence detector –Design- Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS 9

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan- in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, ―Digital Design‖, 5th Edition, Pearson, 2014.

REFERENCES:

1. Charles H.Roth. ―Fundamentals of Logic Design‖, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, ―Digital Fundamentals‖, 10th Edition, Pearson Education Inc, 2011
3. S.Salivahanan and S.Arivazhagan―Digital Electronics‖, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini ―Digital Electronics‖, Wiley, 2014.
5. A.Anand Kumar ―Fundamentals of Digital Circuits‖, 4th Edition, PHI Learning Private Limited 2016
6. Soumitra Kumar Mandal ― Digital Electronics‖, McGraw Hill Education Private Limited, 2016.

COURSE OUTCOMES:

CO1 Use digital electronics in the present contemporary world

CO2 Design various combinational digital circuits using logic gates

CO3 Do the analysis and design procedures for synchronous and asynchronous sequential circuits

CO4 Use the semiconductor memories and related technology

CO5 Use electronic circuits involved in the design of logic gates

EC1305 ELECTROMAGNETIC FIELDS L T P C

3 0 0 3

OBJECTIVES:

- To gain basic mathematical understanding of vector algebra
- To gain conceptual and basic mathematical understanding of Electric and Magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

UNIT I INTRODUCTION TO VECTOR ANALYSIS 9

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem

UNIT II ELECTROSTATICS 9

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Electric flux density and dielectric constant, Conductors in static electric field, Dielectrics in static electric field, Current density, Ohm's law, Continuity equation, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations

UNIT III MAGNETOSTATICS 9

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS 9

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields

UNIT V PLANE ELECTROMAGNETIC WAVES 9

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

TOTAL : 45 PERIODS

TEXT BOOKS:

1. William H Hayt and Jr John A Buck, “Engineering Electromagnetics” , Tata Mc Graw-Hill Publishing Company Ltd, New Delhi, 2008.
2. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989
3. Sadiku MH, “Principles of Electromagnetics”, Oxford University Press Inc, New Delhi, 2009.

REFERENCES:

1. John D Kraus and Daniel A Fleisch, “Electromagnetics with Applications”, Mc Graw Hill Book Co, 2005
2. Karl E Longman and Sava V Savov, “Fundamentals of Electromagnetics”, Prentice Hall of India, New Delhi, 2006
3. Ashutosh Pramanic, “Electromagnetism”, Prentice Hall of India , New Delhi, 2006.

COURSE OUTCOMES:

CO1 To Understand the basics of vector algebra and its significance in coordinate systems

CO2 To analyse electric field, electric potential and behaviour of conductors, dielectrics in static electric fields

CO3 To analyse magnetic field, magnetic potential and behaviour of magnetic materials in static magnetic fields

CO4 To analyse the relation between the electric fields and magnetic fields under time varying fields using Maxwell's and Wave Equations

CO5 To understand the wave propagation in conductors and dielectrics

EE1351	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Operation of Three phase electrical circuits and power measurement
- To understand concepts of AC machines.
- To learn basic measurement concepts.
- To learn the concepts of electronic measurements.
- To learn about importance of digital instruments in measurements

UNIT I AC CIRCUITS AND POWER SYSTEMS 9

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement – Transmission & Distribution of electrical energy – Over head Vs Underground system – Protection of power system – types of tariff – power factor improvement

UNIT II TRANSFORMER 9

Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no–load phasor diagram –– Transformer on–load phasor diagram –– Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency-All day efficiency –auto transformers.

UNIT III INDUCTION MACHINES AND SYNCHRONOUS MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Types of single phase induction motors – Double revolving field theory – starting methods – Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

UNIT IV BASICS OF MEASUREMENT AND INSTRUMENTATION 9

Static and Dynamic Characteristics of Measurement – Errors in Measurement – Classification of Transducers – Variable resistive – Strain gauge, thermistor RTD – transducer – Variable Capacitive Transducer – Capacitor Microphone – Piezo Electric Transducer – Variable Inductive transducer – LVDT, RVDT

UNIT V ANALOG AND DIGITAL INSTRUMENTS 9

DVM, DMM – Storage Oscilloscope. Comparison of Analog and Digital Modes of operation, Application of measurement system, Errors. Measurement of R, L and C, Wheatstone, Kelvin, Maxwell, Anderson, Schering and Wien bridges Measurement of Inductance, Capacitance, Effective resistance at high frequency, Q-Meter.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016.
2. Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGraw Hill Education(India) Private Limited, 2010.
3. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011.

REFERENCES:

1. Del Toro ,"Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2015.
2. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013.
3. Rajendra Prasad ,"Fundamentals of Electrical engineering", Prentice Hall of India, 2006.
4. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, 24th reprint 2016.
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009.

COURSE OUTCOMES:

CO1 Understand the concept of three phase electrical circuits and power measurement.

CO2 Understand the concepts in transformers.

CO3 Understand the concepts of AC machines.

CO4 Understand the basic measurement and instrumentation based devices.

CO5 Understand the relevance of digital instruments in measurements.

EC1307 **ANALOG AND DIGITAL CIRCUITS LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

The student should be made to:

- Study the Frequency response of CE, CB and CC Amplifier
- Learn the frequency response of CS Amplifiers
- Study the Transfer characteristics of differential amplifier
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
- Perform SPICE simulation of Electronic Circuits
- Design and implement the Combinational and sequential logic circuits

LIST OF ANALOG EXPERIMENTS:

1. Design of Regulated Power supplies
2. Frequency Response of CE, CB, CC and CS amplifiers
3. Darlington Amplifier
4. Cascode and Cascade amplifiers
5. Determination of bandwidth of single stage and multistage amplifiers
6. Analysis of BJT with Fixed bias and Voltage divider bias using Spice / Multisim
7. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice/ Multisim
8. Analysis of Cascode and Cascade amplifiers using Spice/ Multisim
9. Analysis of Frequency Response of BJT and FET using Spice/ Multisim

LIST OF DIGITAL EXPERIMENTS:

1. Design and Implementation of Half adder, Full adder, Half subtractor and Full subtractor
2. Design and implementation of BCD to Excess-3, Excess-3 to BCD, Binary to Gray and Gray to Binary code converters
3. Design and implementation of 4 bit binary Adder/ Subtractor using IC 7483
4. Design and implementation of encoder and decoder using logic gates
5. Design and implementation of Multiplexer and De-multiplexer using logic gates
6. Construction and verification of 4 bit ripple counter and Mod-10 Ripple counters
7. Design and implementation of 3-bit synchronous up/down counter
8. Implementation of Shift Registers (i) SISO,(ii)SIPO,(iii) PIPO

EQUIPMENTS FOR ANALOG LAB

CRO/DSO (30MHz)	-	15 Nos.
Signal Generator /Function Generators (3 MHz)	-	15 Nos.
Dual Regulated Power Supplies (0 – 30V)	-	15 Nos.
Standalone desktop PCs with SPICE software	-	15 Nos.
Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	-	50 Nos.

Components and Accessories: Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers

SPICE Circuit Simulation Software: (any public domain or commercial software)

EQUIPMENTS FOR DIGITAL LAB

Dual power supply/ single mode power supply	-	15 Nos.
IC Trainer Kit	-	15 Nos.
Bread Boards	-	15 Nos.
Seven segment display	-	15 Nos.
Multimeter	-	15 Nos.
ICs	-	each 50 Nos.
7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 /74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474		

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1 Design and Test BJT/JFET amplifiers, cascade and cascode amplifiers

CO2 Measure CMRR in differential Amplifiers

CO3 Design and Test rectifiers, filters and regulated power supplies

CO4 Simulate and analyze amplifiers circuits using Pspice/Multisim

CO5 Design and Test the digital logic Circuits

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I 6

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.

UNIT II 6

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language

UNIT III 6

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others’ views / ideas; Arguing against others’ views or ideas, etc

UNIT IV **6**

Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.

UNIT V **6**

Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes

TOTAL : 30 PERIODS

REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success.
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, Orient BalckSwan: Hyderabad, 2016.

COURSE OUTCOMES:

CO1 Make effective presentations

CO2 Participate confidently in Group Discussions

CO3 Attend job interviews and be successful in them.

CO4 Develop adequate Soft Skills required for the workplace

CO5 Develop their speaking skills to enable them 1speak fluently in real contexts

MA1451 **PROBABILITY AND RANDOM PROCESSES**

L	T	P	C
3	1	0	4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I RANDOM VARIABLES 12

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO – DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression

UNIT III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNITIV CORRELATION AND SPECTRAL DENSITIES 12

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 12

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output.

TOTAL : 60 PERIODS

TEXT BOOKS:

1. Ibe,O.C.," Fundamentals of Applied Probability and Random Processes ", 2nd Edition, Academic press, 2014.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", 4th Edition, New Delhi, McGraw Hill Education, 2017.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum‘s Outline of Theory and Problems of Probability, Random
3. Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
4. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
5. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
6. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

COURSE OUTCOMES:

CO1 Able to get the exposure to random variable and well founded the knowledge of

standard distributions which can be described real life phenomena.

CO2 Able to handle situations involving more than one random variable and functions.

CO3 Able to acquire skills and knowledge of applications of random phenomena with respect to time in probabilistic manner.

CO4	Able to find the relation between two or more random variables, the nature of relationship and degree of relationship.
CO5	Able to find the functional relationship between the input, output signals and able to analyze the response of random inputs to linear time invariant systems.

		L	T	P	C
EC1402	**ELECTRONIC CIRCUITS- II**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To Study and analyse the negative feedback amplifiers
- To Study and analyse the positive feedback amplifiers
- To design and analyse the performance of Turned amplifiers
- To design and construct wave shaping circuits
- To Study and analyse the performance of power amplifiers and DC converters

UNIT I FEEDBACK AMPLIFIERS AND STABILITY 9

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, series-shunt, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

UNIT II OSCILLATORS 9

Barkhausen criterion for oscillation –Analysis of RC oscillators: Phase shift, Wien bridge - Analysis of LC- oscillators: Hartley, Colpitt's & Clapp oscillators-Armstrong Oscillator and crystal oscillators – Oscillator amplitude stabilization

UNIT III TUNED AMPLIFIERS 9

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers –Analysis of capacitor coupled single tuned amplifier – Effect of cascading single tuned amplifiers on bandwidth – Double Tuned Amplifier (Characteristics Study) - Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization – Broad band neutralization : Hazeltine & Neutrodyne neutralization methods- Narrow band neutralization

UNIT IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

RC integrator and differentiator circuits – Diode clampers and clippers – Multivibrators: Collector coupled Astable, Monostable & Bistable multivibrators -Triggering methods of Bistable and Monotable multivibrators - Schmitt Trigger- UJT relaxation oscillator.

UNIT V POWER AMPLIFIERS AND DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C- Temperature Effect - Distortions in Power Amplifier – DC-DC Converters : Buck, Boost and Buck-Boost- Quantitative analysis only

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sedra and Smith, "Micro Electronic Circuits", Sixth Edition, Oxford University Press, 2011. (UNIT I, III,IV,V)

2. Jacob Millman, "Microelectronics", McGraw Hill, 2nd Edition, Reprinted, 2009. (UNIT I,II,IV,V)

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008

2. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2008.

3. Millman J. and Taub H., "Pulse Digital and Switching Waveforms", TMH, 2000.

4. Rao B. Visvesvara “Electronic Circuits-II” Pearson Education India 2018

5. S Salivahanan, N Suresh Kumar “Electronic Circuits – II” McGraw Hill India 2018

COURSE OUTCOMES:

CO1	Analyze different types of negative feedback amplifiers design and Stability
CO2	Analyze different types of sinusoidal oscillators design
CO3	Analyze the characteristics of different types of tuned amplifiers and its Stability
CO4	Understand the design and characteristics of different types of wave shaping circuits
CO5	Analyze the performance of power amplifiers and also investigate the performance of DC convertors

		L	T	P	C
EC1403	**COMMUNICATION THEORY**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the concepts of various amplitude modulations and their spectral characteristics.
- To analyze the concepts of angle modulation.
- To understand random processes and their characteristics.
- To know the effect of noise on communication systems.
- To study the limits set by Information Theory.

UNIT I AMPLITUDE MODULATION 9

Amplitude Modulation- DSBSC, SSB, VSB – Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope –comparison of different AM techniques, Superheterodyne Receiver-FDM

UNIT II ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth – FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator – PLL as FM Demodulator.

UNIT III RANDOM PROCESS 9

Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process through a LTI filter.

UNIT IV NOISE CHARACTERIZATION 9

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and quadrature, Envelope and Phase – Noise performance analysis in AM & FM systems – Threshold effect, Pre-emphasis and de-emphasis for FM.

UNIT V INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Mutual Information – Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2006.
2. S. Haykin, “Digital Communications”, John Wiley, 2005.

REFERENCES:

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.
2. B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007
3. H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
4. Couch.L., “Modern Communication Systems”, Pearson, 2001.
5. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006

COURSE OUTCOMES:

CO1	Design AM communication systems
CO2	Design Angle modulated communication systems
CO3	Apply the concepts of Random Process to the design of Communication systems
CO4	Analyze the noise performance of AM and FM systems
CO5	Configure Source coding schemes

EC1404	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of waveform generators, and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III WAVEFORM GENERATORS AND PLL 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT V SPECIAL FUNCTION ICS 9

Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier, Optocoupler and fibre optic IC.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)

REFERENCES:

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. B.S.Sonde, "System design using Integrated Circuits" , 2nd Edition, New Age Pub, 2001.
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International,5th Edition, 2009.
5. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education,4th Edition,2001.
6. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

COURSE OUTCOMES:

CO1 Analyse the internal structure of operational amplifiers

CO2 Design linear and non-linear applications of operational amplifiers.

CO3 Able to generate waveforms using operational amplifiers and design applications of PLL

CO4 Able to design ADC and DAC using operational amplifiers

CO5 Able to explain the concepts of special function ICs

CS1302	DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.

UNIT III NON-LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.

UNIT IV NON-LINEAR DATA STRUCTURES – GRAPHS 9

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
2. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
3. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

REFERENCES:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1996
2. Reema Thareja, —Data Structures Using C, Second Edition , Oxford University Press, 2011.

COURSE OUTCOMES:

CO1 Implement abstract data types for linear data structures.

CO2 Apply the different linear data structures to problem solutions.

CO3 Implement abstract data types for non-linear data structures.

CO4 Apply Graph data structure for the real world problems.

CO5 Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

EC1406	**CONTROL SYSTEMS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation.

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5 th Edition, 2007.
2. K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
3. S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.

COURSE OUTCOMES:

CO1 Identify the various control system components and their representations.

CO2 Analyze the various time domain parameters.

CO3 Analysis the various frequency response plots and its system.

CO4 Apply the concepts of various system stability criterions.

CO5 Design various transfer functions of digital control system using state variable models

		L	T	P	C
EC1407	**CIRCUITS DESIGN SIMULATION AND LINEAR INTEGRATED CIRCUITS LABORATORY**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance calculation
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. Single Tuned Amplifier
5. RC Integratorand Differentiatorcircuits
6. Astable and Monostable Multivibrators
7. Clippers and Clampers
8. Integrator and Differentiator.
9. Instrumentation amplifier.
10. Active low-pass, High-pass and band-pass filters.
11. Astable & Monostable multivibrators using Op-amp
12. Schmitt Trigger using op-amp.
13. Phase shift and Wien bridge oscillators using Op-amp.
14. Astable and Monostable multivibrators using NE555 Timer.
15. Study of SMPS

SIMULATION USING SPICE (Using Transistor)

1. Tuned Collector Oscillator
2. Twin-T Oscillator /Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Monostable multivibrator with emitter timing and base timing
7. Analysis of Power Amplifier
8. Active low-pass, High-pass and band-pass filters using Op-amp
9. Astable and Monostable multivibrators using NE555 Timer

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

S.NO	EQUIPMENTS	
1	CRO (Min 30MHz)	- 15 Nos.
2	Signal Generator /Function Generators (2 MHz)	- 15 Nos.
3	Dual Regulated Power Supplies (0 – 30V)	- 15 Nos.
4	Digital Multimeter	- 15 Nos.
5	Digital LCR Meter	- 2 Nos.
6	Standalone desktops PC	- 15 Nos
7	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	- 50 Nos

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1 Analyzevarioustypesoffeedbackamplifiers

CO2 Design various types of oscillators.

CO3 Design tunedamplifiers,

CO4 Design wave-shapingcircuitsandmultivibrators

CO5 Design and simulate feedback amplifiers, oscillators, tuned amplifiers,

CS1307	DATA STRUCTURES LABORATORY USING C	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

1. IMPLIMENTATION OF LIST

Write C programs to

a. Array implementation of Stack ADTs

b. Array implementation of Queue ADTs.

2. LIST ADT

Array implementation of List ADT.

3. IMPLEMENTATION OF STACK AND QUEUE

Write C programs to

a. Design and implement Single Linked List.

b. Design and implement Stack and its operations using List.

c. Design and implement Queue and its operations using List.

4. APPLICATIONS OF LINEAR DATA STRUCTURE

Write C programs to

a. Design and implement polynomial ADT using list

b. Uses Stack operations to convert infix expression into postfix expression.

c. Uses Stack operations for evaluating the postfix expression.

5. IMPLEMENTATION OF TREE

a. Write a C program to Design and implement binary search tree.

6. IMPLEMENTATION OF ADVANCED TREE

a. Design and Implement AVL tree using Templates.

b. Design and Implement heap tree using Templates.

7. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS

Write C programs for the following:

a. Design and Implement Dijkstra's algorithm

b. Design and Implement Floyd Warshall algorithm.

8. IMPLEMENTATION OF MINIMUM SPANNING TREE

Write C programs for the following:

a. Design and Implement Kruskal's algorithm.

b. Design and Implement Prim's algorithm.

9. GRAPH TRAVERSAL & SORTING

Write C programs to implement the following algorithms:

a. Depth first search.

b. Breadth first search.

c. Topological Sorting

10. **SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION**

a. Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order.

i.Insertion sort

i.Selection sort

v.Quick sort

v.Merge sort

b. Write C programs for implement linear search and binary search.

c. Write C programs for implement Hashing – any two collision techniques

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1 Write functions to implement linear and non-linear data structure operations

CO2 Suggest appropriate linear / non-linear data structure operations for solving a given problem

CO3 Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

EC1501 DIGITAL COMMUNICATION

	L	T	P	C
EC1501 DIGITAL COMMUNICATION	**3**	**0**	**0**	**3**

OBJECTIVES:

- To know the principles of Information coding Techniques
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various band pass signaling schemes
- To know the fundamentals of channel coding

UNIT I INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memorylesschannels – Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law – Sourcecoding theorem - Shannon - Fano & Huffman codes.

UNIT II WAVEFORM CODING & REPRESENTATION 9

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ &NRZ – Bipolar NRZ – Manchester

UNIT III BASEBAND TRANSMISSION & RECEPTION 9

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding -Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK,BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers -Principle of DPSK.

UNIT V ERROR CONTROL CODING 9

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. S. Haykin, “Digital Communications”, John Wiley, 2005

REFERENCES:

1. B. Sklar, “Digital Communication Fundamentals and Applications”, 2nd Edition, Pearson Education, 2009
2. B.P.Lathi, “Modern Digital and Analog Communication Systems” 3rd Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series “Analog and Digital Communications”, TMH 2006
4. J.G Proakis, “Digital Communication”, 4th Edition, Tata Mc Graw Hill Company, 2001.

COURSE OUTCOMES:

CO1 Design and implement different source coding techniques and the limits of channel

CO2 Design and analysis of adaptive quantized schemes and different line code schemes

CO3 Design and implement base band transmission schemes.

CO4 Analyze the spectral characteristics of band pass signalling schemes and their noise performance

CO5 Design error control coding schemes

		L	T	P	C
EC1502	**DISCRETE-TIME SIGNAL PROCESSING**	**3**	**1**	**0**	**4**

OBJECTIVES:

- To learn discrete Fourier transform, properties and its application to linear filtering
- To know the characteristics of IIR filters and learn the design of infinite impulse response filters for filtering undesired signals
- To know the characteristics of FIR filters and learn the design of finite impulse response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multirate signal processing and applications

UNIT I DISCRETE FOURIER TRANSFORM 9

Review of signals and systems- Discrete Fourier Transform (DFT) - Deriving DFT from DTFT, properties of DFT — Circular convolution - Filtering long data sequences - Overlap save and Overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time Fast Fourier transform (DIT-FFT), Decimation-in-frequency Fast Fourier transform (DIF-FFT), Linear filtering using FFT.

UNIT II INFINITE IMPULSE RESPONSE FILTER DESIGN 9

Structures of IIR Filter — Analog filter design - Butterworth filter, Chebyshev filter — Design of Discrete time IIR filter from analog filter-Impulse Invariance method, Bilinear transformation, Approximation of derivatives – Frequency transformation in the analog domain.

UNIT III FIR FILTER DESIGN 9

Structures of FIR Filter- Design of Linear phase FIR filter — Fourier Series method - Windowing techniques (Rectangular, Hamming, Hanning) and Frequency sampling method.

UNIT IV FINITE WORDLENGTH EFFECTS 9

Fixed point and Floating point number representations –Quantization- Truncation and Rounding errors - Finite word length effects in digital Filters- Quantization noise — Coefficient quantization error — Product quantization error — Overflow error — round off noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

UNIT V MULTIRATE DSP AND ITS APPLICATIONS **9**

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor — Adaptive Filters: Introduction, Applications of adaptive filters -Adaptive noise cancellation, Adaptive equalizer, Adaptive echo canceller, Sub band coding.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.

2. S. Haykin, "Digital Communications", John Wiley, 2005

REFERENCES:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill,2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

COURSE OUTCOMES:

CO1 Able to analyze the signal performance in frequency domain using DFT
CO2 Able to design IIR filters using different transformation techniques.
CO3 Able to design FIR filters using different methods and also investigate its structure realization.
CO4 Able to analyze finite word length effects for real time implementation
CO5 Able to analyze the Multirate Signal Processing and applications of Adaptive filters

EC1503	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand various network architectures, physical media, channel access techniques and the related link level protocols.
- To understand the evolving nature of access techniques in wired and wireless media and IP addressing.
- To explain the routing protocols, switch basics and Global Internet and analyze the Multicast Addressing and Multicast Routing.
- To get the knowledge about the transport layer protocols, Congestion control and avoidance in networks and QoS issues.
- To understand the various types of Application layer protocols such as SMTP, POP3, IMAP, MIME, HTTP, Web services, DNS, SNMP.

UNIT I FUNDAMENTALS & LINK LAYER 9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Model – Physical Layer –Introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction

UNIT II MEDIA ACCESS & INTERNETWORKING 9

Overview of Data link Control - Media access - Random, Controlled and channelization, IEEE Standards IEEE 802.3, IEEE 802.4, IEEE 802.5 - Wireless LANs – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN– Zigbee. Network layer services – Packet Switching – IPV4 Address – Network layer protocols (ICMP, IGMP)

UNIT III ROUTING 9

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6

UNIT IV TRANSPORT LAYER 9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection - TCP Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements.

UNIT V APPLICATION LAYER 9

Application Layer Paradigms – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Network Security – Firewalls- Network management protocol

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw – Hill, 2013 (UNIT I –V)

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2nd Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
4. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

COURSE OUTCOMES:

CO1 Identify the components required to build different types of networks and the functionality of each layer

CO2 Understand the functionality of Layer2 for given application

CO3 Understand IPV4 and IPV6 network configuration

CO4 Trace the flow of information from one end to another end in the network

CO5 Understand the use of various Application layer Protocols

EC1504	TRANSMISSION LINES AND RF SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics.
- To give thorough understanding about high frequency line, power and impedance measurements.
- To impart technical knowledge in impedance matching using smith chart.
- To introduce wave behaviour along uniform guiding structures.
- To get acquaintance with RF filter and amplifier design.

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines- Characteristic impedance, propagation constant, attenuation and phase constants, wavelength, velocity of propagation; General Solution of transmission line- Calculation of current, voltage, power delivered and efficiency of transmission; Calculation of Input and Transfer impedance- Open and short circuited lines; The Infinite line; Waveform distortion-Conditions for Distortion less line; Loading and different methods of loading; Line not terminated with Z_0- reflection coefficient, reflection factor and reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies; Parameters of the open -wire line and Coaxial cable at high frequencies, Constants for the line of zero dissipation; Voltage and current on the dissipation-less line; Standing Waves, Nodes, Standing Wave Ratio; Input impedance- dissipation-less line, open circuited lines, short circuited lines, eighth-wave line, half wave line, quarter-wave line; Power and impedance measurement on lines, Smith chart-Measurement of impedance, admittance, reflection coefficient, VSWR, insertion loss, return loss and attenuation using Smith chart.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching- Quarter wave transformer, Matching with Lumped Elements, Single stub matching, Double stub matching; Design of Impedance matching networks using smith chart: Lumped element (L – section) matching, Single stub matching and Double stub matching.

UNIT IV WAVEGUIDES 9

Overview of Maxwell's Equation and Wave Equations, General Wave behavior along uniform guiding structures: Transverse Electric (TE) Waves, Transverse Magnetic (TM) Waves, Transverse Electromagnetic (TEM) Waves. General solutions for TE, TM and TEM waves- parallel plate waveguide, rectangular waveguide, and circular waveguide. Characteristics of wave guide: guide wavelength, cut off wave length, cut off frequency, wave impedance, phase constant, phase velocity, group velocity, power and attenuation.

UNIT V RF SYSTEM DESIGN CONCEPTS 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015.
2. Mathew M. Radmanesh,"Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002.
3. David M. Pozar, "Microwave Engineering", 2012, 4th edition, Wiley, India.
4. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems Prentice Hall of India", 2006.

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko,"RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition,2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2004.
3. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005.
4. David K. Cheng, "Field and Wave Electromagnetics"", 2nd edition, Pearson, Noida, India, 2014.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the characteristics of transmission lines and its losses.

CO2 Analyze the characteristics of a dissipation less transmission line.

CO3 Design impedance matching networks for unmatched lines and learn the importance of Smith chart in the above application.

CO4 Able to analyze transmission of electromagnetic waves in unguided and guided media.

CO5 Able to design RF system transceiver employing active RF components.

EC1507	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- To perform basic signal processing operations such as Linear convolution, Circular convolution, Auto-correlation, Cross-correlation and Frequency analysis in MATLAB.
- To implement FIR and IIR filters in MATLAB and DSP processor
- To implement up-sampling and down-sampling in DSP processor

LIST OF EXPERIMENTS: MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto-correlation and Cross-correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations

DSP PROCESSOR BASED IMPLEMENTATION

1. Linear convolution
2. Circular convolution
3. Design and demonstration of FIR Filter for Low-pass, High-pass, Band-pass and Band-stop filtering
4. Design and demonstration of Butterworth and Chebyshev IIR Filters for Low-pass, High -pass, Band-pass and Band-stop filtering
5. Implement an Up-sampling and Down-sampling operation in DSP Processor

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1	Perform basic signal processing operations such as Linear convolution, Circular convolution, Autocorrelation, Cross-correlation and Frequency analysis using MATLAB
CO2	Design FIR and IIR filters using MATLAB
CO3	Implement linear and circular convolution in DSP processor
CO4	Design and implement FIR and IIR filters in DSP processor for performing filtering operation over real-time signals
CO5	Implement Up-sampling and Down-sampling in DSP processor

EC1508	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- To visualize the effect of sampling and TDM in a transceiver
- To implement AM & FM modulation and demodulation
- To implement Line Coding, PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. Simulation of ASK, FSK, and BPSK generation schemes
9. Simulation of DPSK, QPSK and QAM generation schemes
10. Simulation of signal constellations of BPSK, QPSK and QAM
11. Simulation of ASK, FSK and BPSK detection schemes
12. Simulation of Linear Block and Cyclic error control coding schemes
13. Simulation of Convolutional coding scheme
14. Simulation of error performance of ASK, FSK, BPSK, QPSK, DPSK and QAM
15. Communication link simulation

TOTAL : 60 PERIODS

LAB Requirements for a Batch of 30 students (3 students per experiment):

i) Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes

ii) CROs/DSOs – 15 Nos, Function Generators – 15 Nos.

iii) MATLAB or Octave or LabVIEW or any equivalent software package for simulation experiments

iv) PCs - 15 Nos

COURSE OUTCOMES:

CO1 Simulate & validate the various functional modules of a communication system

CO2 Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes

CO3 Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system

CO4 Compare and contrast the error performance of various digital modulation schemes

CO5 Simulate end-to-end communication Link

EC1509	COMMUNICATION NETWORKS LABORATORY	L T P C 0 0 4 2

OBJECTIVES:

The student should be made to:

- Learn to communicate between two desktop computers
- Learn to implement the different protocols
- Be familiar with IP Configuration
- Be familiar with the various routing algorithms
- Be familiar with simulation tools

LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Implementation of IP Commands such as ping, Traceroute, nslookup.
6. Implementation of IP address configuration.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Implementation of distance vector routing algorithm
9. Implementation of Link state routing algorithm
10. Implementation of Encryption and Decryption Algorithms using any programming language

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SOFTWARE

- C / Python / Java / Equivalent Compiler
- MATLAB SOFTWARE (Few experiments can be practiced with MATLAB)
- Network simulator like NS2/ NS3 / Glomosim/OPNET/
  30 Equivalent HARDWARE
- Standalone Desktops **30 Nos**

COURSE OUTCOMES:

CO1	Communicate between two desktop computers
CO2	Implement the different protocols
CO3	Implementation of IP Configuration
CO4	Implement and compare the various routing algorithms
CO5	Implement algorithms simulation tool.

EC1605	**MICROPROCESSORS AND MICROCONTROLLERS**	**L T P C** **3 0 0 3**

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller MSP430 based system

UNIT I 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set- Assembler directives – 8086 Signals – Basic configurations of 8086 - Minimum and Maximum mode – Assembly language programming – Interrupts and interrupt service routines.

UNIT II 8086 INTERFACING 9

Parallel communication interface (8255) – Serial communication interface (8251) – D/A Interface and Waveform generation – A/D Interface – Timer (8253) – Keyboard /display controller (8279) –Assembly language programming

UNIT III 8051 MICROCONTROLLER 9

Microprocessor Vs Micro Controller – Von Neumann Vs Harvard Architecture – Architecture of 8051 – Memory Organization – Special Function Registers (SFRs) – Instruction set – Addressing modes – Interrupts – Timers – Serial Port – External Memory Interface – Stepper Motor Interface- Assembly language programming .

UNIT IV MSP430 - 16 BIT MICROCONTROLLER 9

MSP430 RISC CPU architecture – Clock system – Memory subsystem – Addressing Modes – Instruction set – On chip peripherals.

UNIT V ADVANCED FEATURES OF MSP430 9

Low power features of MSP430 – Power Management Module – Functions, Interrupts, and Low-Power Modes - Clock request feature – Mixing scheme of the MSP430 pins – Programming using C and assembly language - Debugging through Emulation Vs Simulation.

TOTAL : 45 PERIODS

OUTCOMES:

By the end of this course, the student should be able

CO1:To understand the Architecture of 8086 microprocessor

CO2: To learn the design aspects of I/O and Memory Interfacing

CO3: To understand the Architecture of 8051 Microcontroller

CO4: To understand the architecture of MSP430 microcontroller and its onboard Peripherals

CO5: To design and implement MSP430 microcontroller based systems

TEXT BOOKS:

1. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals " 3rd edition, Tata McGrawHill,2012
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C" , Second Edition, Pearson education, 2011. (UNIT IV-V)
3. Kenneth J.Ayala, "The 8051 Microcontroller-Architecture, Programming and Applications" West Publishing company, 3rd edition.
4. John Davies, “MSP430 Microcontroller Basics”, Elsevier, 2008.

EC1602 VLSI DESIGN

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits & its characteristics and CMOS Fabrication Technologies.
- Learn the design and realization of combinational digital circuits.
- Learn the design and realization of sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

Introduction to VLSI Design, MOS Transistor, CMOS logic, Inverter, CMOS Fabrication Technologies, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Introduction, Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL. Power: Dynamic Power, Static Power, Low power design principles, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs. Designing Memory and Array structures: Memory

Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V FPGA ARCHITECTURES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Testing: Introduction, Manufacturing Test Principles, Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017 (UNIT I,II,V)
2. Jan M. Rabaey ,AnanthaChandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design perspective", Second Edition , Pearson , 2016.(UNIT III,IV)

REFERENCES:

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim CMOS Digital Integrated Circuits: Analysis Design",4th edition McGraw Hill Education,2013
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI, David E.Boyee, "CMOS Circuit Design, Layout & Simulation", Prentice Hall of India 2005.

COURSE OUTCOMES:

CO1 Realize the concepts of digital building blocks using MOStransistor.

CO2 Design combinational MOS circuits and powerstrategies.

CO3 Design and construct Sequential Circuits and Timingsystems.

CO4 Design arithmetic building blocks and memorysubsystems.

CO5 Apply and implement FPGA design flow andtesting.

EC1603	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the characteristic of wireless channel
- To understand the design of a cellular system
- To study the various digital signalling techniques
- To understand multipath mitigation techniques
- To understand the concepts of MIMO system

UNIT I WIRELESS CHANNELS 9

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

UNIT II CELLULAR ARCHITECTURE 9

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations– Cellular concept- Frequency reuse - channel assignment- hand off-interference & system capacity-trunking & grade of service – Coverage and capacity improvement.

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Offset-QPSK, pi/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT V MULTIPLE INPUT MULTIPLE OUTPUT SYSTEMS 9

MIMO systems – spatial multiplexing -System model - Channel state information-capacity in flat-fading and non-fading channels-Impact of the channel diversity- Linear precoding.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Rappaport,T.S., —Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)

2. Andreas.F. Molisch, —Wireless Communications‖, John Wiley – India, 2006. (UNIT III,V)

REFERENCES:

1. Andrea Goldsmith,-Wireless Communication , Cambridge University Press, 2011

2. Aditya K Jagannatham, - Principles of Modern Wireless Communication Systems, Theory and Practice, McGraw Hill Education,2016

3. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000

4. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.

5. Upena Dalal, —Wireless Communication, Oxford University Press, 2009.

COURSE OUTCOMES:

CO1	Characterize a wireless channel and evolve the system design specifications
CO2	Design a cellular system based on resource availability and traffic demands
CO3	Identify suitable signalling scheme for the wireless channel and system under consideration
CO4	Identify suitable multipath mitigation techniques to improve performance
CO5	Analyse and design MIMO systems

EC1604	ANTENNAS AND MICROWAVE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable the student to understand the basic principles in antenna and microwave system design.
- To enhance the student knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications

UNIT I INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS 9

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver.

UNIT II ANTENNA RADIATION MECHANISMS AND DESIGN ASPECTS 9

Retarded potentials, Radiation Mechanisms of Linear Wire antennas: Half-wave dipole, Quarter-wave monopole; Loop antennas; Aperture antennas: Horn Antennas,Slot Antennas, Reflector antennas; Microstrip antennas; Frequency independent antennas:Spiral antennas,Log-Periodic Dipole Array – Design considerations and applications.

UNIT III ANTENNA ARRAYS AND APPLICATIONS 9

Two-element array, Array factor, Pattern multiplication, uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas.

UNIT IV PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator; Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes; Microwave tubes: Klystron, TWT, Magnetron.

UNIT V MICROWAVE DESIGN PRINCIPLES 9

Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design.

TOTAL : 45 PERIODS

TEXT BOOKS

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antenna and Wave Propagation: Fourth Edition, Tata McGraw –Hill, 2006. (UNIT I, II, III)
2. David M.Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012. (UNIT I, IV, V).

REFERENCE BOOKS

1. Constantine A.Balanis,"Antenna Theory Analysis and Design", Third edition, John Wiley India Pvt Ltd., 2005.
2. R.E.Collin, "Fundamentals for Microwave Engineering", Second edition, IEEE Press, 2001.
3. Samuel Y. Liao, "Microwave Devices and Circuits", Third edition, Pearson Education India, 2003.

COURSE OUTCOMES:

CO1 Understand the theoretical principles and basic of Microwave evaluate the Antenna parameters.

CO2 Design and assess the performance of different types of Antennas.

CO3 Understand and acquire knowledge about Antenna and Array and its application.

CO4 Ability to analyze the microwave active and passive components such as Power dividers, hybrid junctions and understand the operational concepts of microwave vacuum tubes-based oscillators and amplifiers.

CO5 Ability to Design a Microwave amplifier and oscillator system for practical application specifications.

EC1606	DIGITAL IMAGE PROCESSING	L	T	P	C
	(LAB INTEGRATED)	3	0	2	4

OBJECTIVES

- To become familiar with digital image fundamentals and basics of MATLAB
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain and understand their operations through MATLAB
- To learn concepts of degradation function and restoration techniques.
- To study image segmentation and corresponding programs using MATLAB
- To become familiar with image representation, description and object recognition methods and the corresponding programs using MATLAB

UNIT I DIGITAL IMAGE FUNDAMENTALS 9+2

Steps in Digital Image Processing – Elements of Visual Perception-Image Sampling and Quantization – Relationships between pixels -Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Lab Component

Fundamentals of MATLAB programming

- Reading, writing and displaying an image.
- Different types of images.

UNIT II IMAGE ENHANCEMENT 9+8

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Lab Component

Implement the following in Matlab

- Gray Level Transformation and Histogram calculation of an image.
- Linear and Non-linear Spatial Filtering of an image.
- DFT filtering of an image.

UNIT III IMAGE RESTORATION 9+2

Image Restoration - Degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Lab Component

Implement the following in MATLAB

- Inverse and Wiener Filtering of images.

UNIT IV IMAGE SEGMENTATION 9+8

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation –Region growing – Region splitting and merging – Morphological processing- Erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

Lab Component

Implement the following in MATLAB

- Edge detection.
- Otsu and Canny edge detection.
- Morphological operators
- Watershed Segmentation Algorithm.

UNIT V IMAGE REPRESENTATION, DESCRIPTION AND OBJECT DETECTION 9+10

Representation – Descriptors – Principal Components – Topological feature, Texture - Patterns and Pattern Classes – Recognition based on Decision theoretic approach – Structural Methods

Lab Component

Implement the following in MATLAB

- Boundary and Regional descriptors
- Principal Component extraction of an image
- Minimum Distance Classifier
- Design and implement a simple image-based application.
- MATLAB program for representation, description and object recognition

TOTAL: 75 PERIODS

TEXT BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, ‗Digital Image Processing', Pearson, Third Edition,2010.
2. Anil K. Jain, ‗Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCE BOOKS

1. Kenneth R. Castleman, ‗Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‗Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, ‗Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, ‗Digital Image Processing', John Wiley, New York, 2002

5. Milan Sonka et al ‗Image processing, analysis and machine vision‘, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

COURSE OUTCOMES:

CO1 To become familiar with digital image fundamentals and basics ofMATLAB

CO2 To get exposed to simple image enhancement techniques in Spatial and Frequency domain and understand their operations throughMATLAB

CO3 To learn concepts of degradation function and restorationtechniques.

CO4 To study the image segmentation and the corresponding programs usingMATLAB

CO5 To become familiar with image representation, description and object recognition methods

EC1607	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		4	0	0	2

OBJECTIVES:

The student should be made to:

- To Introduce concepts of 8086 and 8051 Assembly Language Programming
- To write and execute ALP for arithmetic and logical operations in 8086 and 8051
- To acquire knowledge of interfacing 8086 and 8051 with I/O devices
- To program Timers/Counters and Serial ports of 8051
- To introduce C programming for MSP430 in Code Composer Studio

LIST OF EXPERIMENTS:

8086 Programs using kits

1. Basic arithmetic and Logical operations
2. Code conversion and Decimal arithmetic operations
3. Matrix operations
4. String manipulations
5. Sorting and Searching

Peripherals and Interfacing

1. Traffic light controller Interface
2. Stepper motor control Interface
3. Key board and Display Interface
4. Parallel interface
5. A/D and D/A interface
6. Timer Interface

8051 Programs and Interfacing

1. Basic arithmetic and Logical operations
2. Square and Cube program, 2‘s complement of a number, Unpacked BCD to ASCII
3. 8051 Timer/Counter Programming
4. 8051 Parallel and Serial Port Programming
5. Stepper motor control Interface

MSP430 Programs and Interfacing using CCS

1. Arithmetic Instructions – Addition, subtraction, multiplication and division
2. Square, Cube
3. ADC & DAC Interface
4. Stepper motor control interface to MSP

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30

HARDWARE

- 8086 development kits - 30 nos
- Interfacing Units - Each 5 nos
- 8051 Microcontroller kit - 30 nos
- MSP430 Microcontroller kit – 10 Nos
- PC (INTEL 7) – 10 Nos.

SOFTWARE:

- Code Composer Studio (IDE for MSP430 Experiments)

COURSE OUTCOMES:

CO1 Write and execute 8086 Assembly Language Programs for Arithmetic and Logical operations

CO2 Interface different I/Os with 8086 Microprocessor and 8051 Microcontroller

CO3 Write and execute 8051 Assembly Language Programs for Arithmetic and Logical operations

CO4 To perform Serial port and Timer/Counter Programming in 8051

CO5 Write and execute C programs for Arithmetic, Logical operations and Interfacing using MSP430 Microcontroller

EC1608 VLSI DESIGN LABORATORY

	L	T	P	C
	0	**0**	**4**	**2**

OBJECTIVES:

The student should be made to:

- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms
- To provide hands on design experience to implement IOT based applications using FPGA

LIST OF EXPERIMENTS:

Part I: Digital System Design using HDL & FPGA (24 Periods)

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Compare pre synthesis and post synthesis simulation for experiments 1 to 6.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Part II: Digital Circuit Design (24 Periods)

1. Design and simulate a CMOS inverter using digital flow
2. Design and simulate a CMOS Basic Gates & Flip-Flops
3. Design and simulate a 4-bit synchronous counter using a Flip-Flops Manual/ Automatic Layout Generation and Post Layout Extraction for experiments 7 to 9
4. Analyze the power, area and timing for experiments 7 to 9 by performing Pre Layout and Post Layout Simulations.by Xilinx/Altera FPGA
5. Compare pre synthesis and post synthesis simulation for experiments 1 to 6.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Part-III Analog Circuit Design (12 Periods)

1. Design and Simulate a CMOS Inverting Amplifier.
2. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
3. Analyze the input impedance, output impedance, gain and bandwidth for experiments 10 and 11 by performing Schematic Simulations.
4. Design and simulate simple 5 transistor differential amplifier. Analyze Gain,
5. Bandwidth and CMRR by performing Schematic Simulations.

Requirements: Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools

Part-IV Implementation of IOT applications using FPGA (12 Periods)

1. Measurement and Analysis: Develop the acceleration and vibration measurement of an object and generate the analysis report.
2. Real-Time Tank Level Control: Prototype the RT tank level observation and automatic pump control using sensors and actuators.
3. Remote Monitoring using IoT: Monitor the ambient light intensity and transfer the data to the cloud using IOT protocol.

Requirements: NI myRIO FPGA board and Lab View software tool

LIST OF EQUIPMENT FOR A BATCH OF 30

S.NO	EQUIPMENT	REQUIRED
1.	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 User License
2.	Xilinx/Altera/equivalent FPGA Boards	10 nos.
3.	Cadence/Synopsis/Mentor Graphics/Tanner/equivalent EDA Tools	10 User License
4.	Personal Computer	30 Nos.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

CO1 Write HDL code for basic as well as advanced digital integratedcircuit

CO2 Import the logic modules into FPGABoards

CO3 Synthesize Place and Route the digitalIP's

CO4 Design, Simulate and Extract the layouts of Digital & Analog IC Blocks usingEDA

CO5 Design and develop IOT based real time applications using FPGA & Lab View software tool

EC1701	ADAPTIVE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of Machine Learning.
- To learn Regression algorithms and their applications.
- To learn Supervised Classification algorithms, Ensemble techniques and their applications.
- To understand unsupervised learning and EM algorithms.
- To acquire knowledge about ANN and Deep Learning.

UNIT I LEARNING FROM DATA 9

Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Reinforcement Learning- Basic Concepts in Machine Learning – Machine Learning Process – CRISP DM, Testing Machine Learning Algorithms– Errors, Performance metrics- overfitting, under fitting and generalization - Bias -Variance Trade off, no free lunch theorem-Turning Data into Probabilities: Centrality theorem, distributions – Bayes Theorem.

UNIT II REGRESSION FOR PREDICTIVE MODELING 9

Linear Models for Regression – Linear Basis Function Models –Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms: Simple Linear Regression – Multiple Linear Regression- Applications of Regression Models

UNIT III CLASSIFICATION AND ENSEMBLE TECHNIQUES 9

Classification – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models.

Common Classification Algorithms: Logistic Regression, k-Nearest Neighbours – Naive Bayes Classifiers – Decision Trees – Random Forest model – Support Vector Machines- Ensemble Learning: Voting - Bagging– Boosting. Applications of Classification Models

UNIT IV SELF-ORGANIZING DATA ANALYSIS 9

Mixture Models and Expectation Maximization (EM) — Dirichlet Process Mixture Models- K-Means Clustering– Spectral Clustering – Hierarchical Clustering.

Curse of Dimensionality – Dimensionality Reduction – Linear Discriminate Analysis (LDA)- Principal Component Analysis (PCA)

UNIT V BUILDING ADAPTIVE SYSTEMS WITH DEEP LEARNING 9

Neuron - Perceptron learning - Activation functions- Models of a neuron: shallow networks to deep networks, feed-forward neural networks – Multi-layer feedforward neural network, back propagation algorithm - convergence of back-propagation - Gradient descent algorithm, Convolutional Neural Network.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, —Introduction to Machine Learning, Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, —Pattern Recognition and Machine Learning, Springer, 2006.
2. Kevin P. Murphy, —Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
3. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, CRC Press, 2014.
4. Tom Mitchell, —Machine Learning, McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, —The Elements of Statistical Learning, Second Edition, Springer, 2008.
6. Fabio Nelli, —Python Data Analytics with Pandas, Numpy, and Matplotlib, Second Edition, Apress, 2018.

COURSE OUTCOMES:

CO1 **Gain knowledge about basic concepts of Machine Learning Techniques**

CO2 **Understand and Apply Regression Algorithms for various applications**

CO3 **Understand Supervised Learning Classification models and Analyze Ensemble Techniques**

CO4 **Understand various Unsupervised Learning Algorithms**

CO5 **Design deep neural network models**

EC1702	OPTICAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the various optical fiber modes, configuration and classification of optical fibers
- To understand the transmission characteristics of optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

UNIT I INTRODUCTION TO OPTICAL FIBERS 9

Introduction-general optical fiber communication system-basic optical laws and definitions-Total Internal Reflection-Acceptance Angle- Numerical Aperture-Skew Ray optical modes and configurations-mode analysis for optical propagation through fibers-modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes-fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber-single mode fiber-graded index fiber.

UNIT II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

Attenuation-absorption—scattering losses-bending losses-core and cladding losses-signal dispersion–inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion-dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile- cutoff wave length-dispersion calculation-mode field diameter.

UNIT III OPTICAL SOURCES AND DETECTORS 9

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort effect. Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.

UNIT IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit. Optical power measurement-attenuation measurement-dispersion measurement-Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing-Optical Fiber connectors.

UNIT V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

System design consideration Point–to–Point link design–Link power budget–rise time budget, WDM–Passive DWDM Components-Erbium Doped Fiber Amplifier(EDFA)-Elements of optical networks-SONET/SDH-Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton

TOTAL : 45 PERIODS

TEXT BOOKS:

1. P Chakrabarti, 'Optical Fiber Communication', McGraw Hill Education (India)Private Limited, 2016 (UNIT I, II, III)
2. Gred Keiser, 'Optical Fiber Communication', McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, IV, V)

REFERENCES:

1. John M.Senior, ‘Optical fiber communication’, Pearson Education, second edition.2007.

2. Rajiv Ramaswami, ‘Optical Networks’, Second Edition, Elsevier , 2004.

3. J.Gower, ‘Optical Communication System’, Prentice Hall of India, 2001.

4. Govind P.Agrawal, ‘Fiber-optic communication systems’, Third edition, John Wiley & sons, 2004.

COURSE OUTCOMES:

CO1 Realize basic elements in optical fibers, different modes and configurations.

CO2 Analyze the transmission characteristics associated with dispersion and polarization techniques.

CO3 Design optical sources and detectors with their use in optical communication system.

CO4 Construct fiber optic receiver systems, measurements and coupling techniques.

CO5 Design optical communication systems and its networks.

EC1703 EMBEDDED SYSTEMS AND IOT

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IOT

UNIT I INTRODUCTION TO EMBEDDEDSYSTEM DESIGN 9

Complex systems and microprocessors– Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors –Design example: Model train controller.

UNIT II ARM ARCHITECTURE AND PERIPHERAL INTERFACING 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU

UNIT III EMBEDDED PROGRAMMING AND OPERATING SYSTEM 9

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing-Introduction – Multiple tasks and Multiple processes – Multirate systems- Pre-emptive real-time operating systems- Priority based scheduling-Evaluating operating system performance – Example Real time operating systems-POSIX-Windows CE.

UNIT IV INTRODUCTION TO IOT 9

Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT, Embedded Systems and M2M - Industry 4.0 concepts- Passive and active sensors - Different applications of sensors - Multi-sensors - Pre-processing - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.

UNIT V COMMUNICATION PROTOCOLS FOR EMBEDDED AND IOT 9

Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C), IoT Infrastructure - 6LowPAN - IPv6 - URIs, Communication/ Transport - Wi-Fi, Bluetooth, ZigBee, LPWAN.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Marilyn Wolf, —Computers as Components - Principles of Embedded Computing System Design‖, Third Edition —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-on-Approach", 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons", Inc, USA, 2013

REFERENCES:

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley & Sons Ltd, UK, 2014
2. Peter Waher, "Learning Internet of Things", 1st Edition, Packt Publishing Ltd, UK, 2015.
3. Charles Bell, "Beginning Sensor Networks with Arduino and Raspberry Pi" , 1st Edition, Apress Publishers, USA, 2013.
4. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017

COURSE OUTCOMES:

By the end of this course, the student should be able to:

CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming and operating system
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

EC1704	AD HOC AND WIRELESS SENSOR NETWORKS	L	P	T	C
		3	0	0	3

OBJECTIVES

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

UNIT I AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS 9

Introduction to Wireless Networks- Infrastructure and Infrastructure less networks, Key definitions of adhoc networks, , advantages of ad-hoc network, Elements of Ad hoc Wireless Networks, unique constraints and challenges, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

UNIT II SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES 9

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT III WSN NETWORKING CONCEPTS AND PROTOCOLS 9

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT IV SENSOR NETWORK SECURITY 9

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management. Reliability requirements in sensor networks.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – nS2 and its extension to sensor networks, COOJA, TOSSIM, Case Study: Intelligent Traffic monitoring - Target detection and tracking - Contour/edge detection - Field sampling.

TOTAL : 45 PERIODS

TEXT BOOKS

1. C. Siva Ram Murthy and B. S. Manoj, ―Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004. (UNIT I)
2. Holger Karl , Andreas willig, ―Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Jan 2006.(UNIT II-V)

REFERENCE BOOKS

1. Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004.
2. Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.

COURSE OUTCOMES:

CO1 Know the basics of Ad hoc networks and Wireless Sensor Networks

CO2 Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement

CO3 Apply the knowledge to identify appropriate physical and MAC layer protocols

CO4 Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CO5 Be familiar with the OS used in Wireless Sensor Networks and build basic modules

EC1707	ADVANCED COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- Understand the working principle of optical sources, detector, fibers
- Develop understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand and capture an experimental approach to digital wireless communication
- Understand actual communication waveforms that will be sent and received across wireless Channel

LIST OF OPTICAL EXPERIMENTS

1. Measurement of bending and fiber attenuation losses.
2. Numerical Aperture calculation of Fiber.
3. DC Characteristics of LED and PIN Photo diode.

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios
4. OFDM Signal Transmission and Reception using Software Defined Radios

LIST OF MICROWAVE EXPERIMENTS

1. Reflex Klystron Characteristics
2. S matrix characterization of E, H and hybrid TEEs
3. Radiation Pattern Measurement of Horn Antenna
4. VSWR and Impedance Measurement
5. Characterization of Directional Couplers, Isolators, Circulators

6. Gunn Diode Characteristics

7. Microwave IC – Filter Characteristics

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1	Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter	2 Nos
2	Trainer kit for determining the mode characteristics, losses in optical fiber	2 Nos
3	Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope	2 Nos
4	Kit for measuring Numerical aperture and Attenuation of fiber	2 Nos
5	Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement, Pulse broadening.	2 Nos
5	MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors	2 sets
6	LEDs with ST / SC / E2000 receptacles – 650 / 850 nm	2 sets
7	PIN PDs with ST / SC / E2000 receptacles – 650 /850 nm	2 sets
8	Digital Communications Teaching Bundle (LabVIEW/MATLAB/Equivalent software tools)	10 Users
9	Transmit/receive pair of NI USRP-2920 transceivers (50 MHz to 2.2 GHz)	2 Nos

COURSE OUTCOMES:

CO1 Analyze the performance of simple optical link by measurement of losses

CO2 Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER

CO3 Estimate the Wireless Channel Characteristics and Analyze the performance of Wireless Communication System

CO4 Test microwave and optical components. Understand the intricacies in Microwave System design.

CO5 Analyse the radiation of pattern of antenna.

EC1708	**EMBEDDED LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES:

The students should be made to:

- To learn the working of ARM processor
- To understand the Building Blocks of Embedded Systems
- To learn the concept of interfacing
- To write programs to interface I/O s with processor
- To Study the interrupt performance

LIST OF EXPERIMENTS

1. Study of ARM Evaluation system
2. Flashing of LEDS.
3. Interfacing LED and SWITCHES.
4. Interfacing ADC and DAC.
5. Interfacing stepper motor and temperature sensor.
6. Interfacing real time clock and serial port.
7. Interfacing PWM.
8. Interfacing keyboard and LCD.
9. Interfacing EPROM and interrupt
10. Interrupt performance characteristics of ARM and FPGA
11. Implementing zigbee protocol with ARM

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS (3 students per batch)

1. Embedded trainer kits with ARM board 10Nos
2. Embedded trainer kits suitable for wireless communication 10Nos
3. Adequate quantities of Hardware, software andconsumables

COURSE OUTCOMES:

CO1 Write programs in ARM for a specific application

CO2 Write programs for interfacing keyboard, display, motor and sensor.

CO3 Interface A/D and D/A convertors with ARM system.

CO4 To analyze the performance of interrupt characteristics of ARM and FPGA and

CO5 To formulate a mini project using embedded system.

EC1001	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

PH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES 9

Cardiac Pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies- Shortwave, Ultrasonic and Microwave type and their applications, Surgical Diathermy, Biotelemetry.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Medical Information systems, Telemedicine, Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, IoT healthcare, Lab on a chip.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Leslie Cromwell, —Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)

REFERENCES:

1. Khandpur, R.S., —Handbook of Biomedical Instrumentation‖, TATA Mc Graw-Hill, New Delhi, 2003.
2. John G.Webster, —Medical Instrumentation Application and Design‖, 3rd Edition, Wiley IndiaEdition,2007
3. Joseph J.Carr and John M.Brown, —Introduction to Biomedical Equipment Technology‖, John Wiley and Sons, New York,2004.

COURSE OUTCOMES:

CO1 Know the human body electro-physiological parameters and recording of bio-potentials

CO2 Comprehend the non-electrical physiological parameters and their measurement body temperature, blood pressure, pulse, blood cell count, blood flow meter etc

CO3 Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators,dialyzers and ventilators

CO4 Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave

surgical diathermies , and bio-telemetry principles and methods

CO5 Know about recent trends in medical instrumentation

EC1002 DATA CONVERTERS

L	T	P	C
3	0	0	3

OBJECTIVES

- To design MOS circuits applied for various building blocks of data conversion stages namely Anti aliasing filters, Quantization Noise
- To design D/A converters, sample and hold circuits
- To design CMOS realization of various comparator architecture and switched capacitor amplifiers
- To, study the various CMOS design considerations of ADC architectures used in practice including SAR, Pipeline, Flash ADCs
- To study the general design principles design sigma delta converters

UNIT I INTRODUCTION 9

Quantization noise, anti aliasing filters, gain and offset errors, definitions of INL and DNL, SNR, SFDR, ENOB of ADC/DACs, finite duration pulse aperture effects, transistor matching, Bandgap reference design.

UNIT II D/A CONVERTER DESIGN, SAMPLE AND HOLD CIRCUITS 9

Current Steering DACs, current cell design issues. Properties of MOS Switches, charge injection, bootstrapping, sampling jitter, thermal noise, Quantization noise and nonlinearity effects.

UNIT III COMPARATOR DESIGN 9

Comparator architectures, metastability and yield, Clock feed through effects, switched capacitor amplifiers and offset cancellation.

UNIT IV ADC/DAC ARCHITECTURES 9

SAR, Flash, Pipeline and time interleaved ADC topologies and their CMOS realizations issues. Error correction procedures for ADCs.

UNIT V OVER SAMPLING CONVERTERS 9

Delta sigma modulators, alternative modulator architectures, quantization and noise shaping, decimation filtering, implementation of Delta sigma modulators, delta sigma DACs

TOTAL : 45 PERIODS

TEXT BOOKS

1. Marcel Pelgrom, "Analog to Digital Conversion", Springer Verlag, 2nd Edition, 2013.
2. Shanthi Pavan, Richard Schreier, Gabor C. Temes , “Understanding Delta-Sigma Data Converters”, Willey –IEEE Press, 2 nd Edition, 2017

REFERENCE BOOKS

1. Franco Malobreti "Data Converters", Springer Verlag, 2007
2. VLSI Data Conversion Circuits EE658 recorded lectures available at http://www.ee.iitm.ac.in/~nagendra/videolecture

COURSEOUTCOMES:

CO1 To carry out the design of the various building blocks used in mixed signal (A/D and D/A converters) CMOS IC Design

CO2 To carry out the design of the D/A converter and sample and hold circuits

CO3 To carry out the design of the comparator circuits

CO4 To carry out the CMOS design of D/A and A/D converter architectures

CO5 To carry out the design of oversampling converters- Delta sigma modulators

EI1864 ROBOTICS AND AUTOMATION

	L	T	P	C
	3	**0**	**0**	**3**

OBJECTIVES:

The student should be made:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots - Introduction about Robotic languages.

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002

REFERENCES:

1. Deb. S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl. C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter. R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. R.K. Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
5. John.J.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
6. Issac Asimov, I Robot, Ballantine Books, New York, 1986.

EC1003 COMPRESSIVE SENSING

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To present the basic theory and ideas showing when it is possible to reconstruct sparse or nearly sparse signals from under sampled data
- To expose students to recent ideas in modern convex optimization allowing rapid signal recovery
- To give students a sense of real time applications that might benefit from compressive sensing ideas

UNIT I INTRODUCTION TO COMPRESSED SENSING 9

Introduction; Motivation; Mathematical Background; Traditional Sampling; Traditional Compression; Conventional Data Acquisition System; Drawbacks of Transform coding; Compressed Sensing (CS).

UNIT II SPARSITY AND SIGNAL RECOVERY 9

Signal Representation; Basis vectors; Sensing matrices; Restricted Isometric Property; Coherence; Stable recovery; Number of measurements.

UNIT III RECOVERY ALGORITHMS 9

Basis Pursuit algorithm: L1 minimization; Matching pursuit: Orthogonal Matching Pursuit(OMP), Stagewise OMP, Regularized OMP, Compressive Sampling Matching Pursuit (CoSaMP); Iterative Thresholding algorithm: Hard thresholding, Soft thresholding; Model based : Model based CoSaMP, Model based HIT.

UNIT IV COMPRESSIVE SENSING FOR WSN 9

Basics of WSN; Wireless Sensor without Compressive Sensing; Wireless Sensor with Compressive Sensing; Compressive Wireless Sensing: Spatial compression in WSNs, Projections in WSNs, Compressed Sensing in WSNs.

UNIT V APPLICATIONS OF COMPRESSIVE SENSING 9

Compressed Sensing for Real-Time Energy-Efficient Compression on Wireless Body Sensor Nodes; Compressive sensing in video surveillance; An Application of Compressive Sensing for Image Fusion; Single-Pixel Imaging via Compressive Sampling.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Radha S, Hemalatha R, Aasha Nandhini S, —Compressive Sensing for Wireless Communication: Challenges and Opportunities‖, River publication, 2016. (UNIT I-V)
2. Mark A. Davenport, Marco F. Duarte, Yonina C. Eldar and Gitta Kutyniok, —Introduction to Compressed Sensing,‖ in Compressed Sensing: Theory and Applications,
3. Y. Eldar and G.Kutyniok, eds., Cambridge University Press, 2011 (UNIT I)

REFERENCES:

1. Duarte, M.F.; Davenport, M.A.; Takhar, D.; Laska, J.N.; Ting Sun; Kelly, K.F.; Baraniuk, R.G.; , "Single-Pixel Imaging via Compressive Sampling," Signal Processing Magazine, IEEE, vol.25, no.2, pp.83-91, March 2008.
2. Tao Wan.; Zengchang Qin.; , —An application of compressive sensing for image fusion‖, CIVR '10 Proceedings of the ACM International Conference on Image and Video Retrieval, Pages 3-9.
3. H. Mamaghanian , N. Khaled , D. Atienza and P. Vandergheynst "Compressed sensing for real-time energy-efficient ecg compression on wireless body sensor nodes", IEEE Trans. Biomed. Eng., vol. 58, no. 9, pp.2456 -2466 2011.

COURSE OUTCOMES:

CO1 Appreciate the motivation and the necessity for compressed sensing technology.

CO2 Familiar about the recent ideas in modern convex optimization allowing rapid signal recovery

CO3 Able to reconstruct sparse or nearly sparse signals from under sampled data

CO4 Able to extend wireless sensor network with and without compressive sensing

CO5 Design a new algorithm or modify an existing algorithm for different application areas in wireless sensor network.

CS1303	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- Design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I JAVA FUNDAMENTALS 9

Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and StringBuffer

UNIT II OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE 9

Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes.

UNIT III EXCEPTIONS, COLLECTIONS AND STREAMS 9

Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT IV CONCURRENT PROGRAMMING AND GUI PROGRAMMING 9

Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag.

UNIT V JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING 9

Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
3. Paul Deitel, Harvey M. Deitel, “Java How to Program”, 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , “Introduction to Java programming”, 7th Edition, Pearson education, 2010.
3. C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 understand the fundamental ideas behind the object-oriented approach to programming

CO2 To inculcate concepts of inheritance to create new classes from existing one & design the classes needed given a problem specification

CO3 Able to create the good application with proper Exception Handling Mechanisms.

CO4 A modern coverage of concurrent programming that focuses on high-level synchronization constructs and the concept of event handling used in GUI.

CO5 An in-depth exposure to the object-oriented programming paradigm, which builds upon programming experience gained in computer science classes.

IT1811 INFORMATION THEORY AND CODING **L T P C**

3 0 0 3

OBJECTIVES

- Understand error–control coding.
- Understand encoding and decoding of digital data streams.
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- Be aware of compression and decompression techniques.
- Learn the concepts of multimedia communication.

UNIT I INFORMATION THEORY 9

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.

UNIT II SOURCE CODING: TEXT, AUDIO AND SPEECH 9

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO 9

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

UNIT IV ERROR CONTROL CODING: BLOCK CODES 9

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES 9

Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

TOTAL : 45 PERIODS

TEXT BOOKS

1. R Bose, “Information Theory, Coding and Crptography”, TMH 2007
2. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002

REFERENCE BOOKS

1. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
2. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007
3. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Design an application with error–control

CO2 Use compression and decompression techniques

CO3 Apply the concepts of multimedia communication

CO4 Apply the concepts of error control coding: block codes

CO5 Apply the concepts of error control coding: convolutional codes

GE1002 **HUMAN RIGHTS** **L T P C**

3 0 0 3

OBJECTIVES

- To sensitize the Engineering students to various aspects of Human Rights.
- To educate on the evolution of human rights movement.
- To create awareness and understanding on the international deliberations towards human rights.
- To educate on constitutional rights and provisions related to human rights in India.
- Create awareness on support organisations in Human Rights in India.

UNIT - I INTRODUCTION **9**

Human Rights- Meaning, origin and development; Notion and classification of Rights - Natural, Moral and Legal Rights, Civil and Political rights, economic, social and cultural rights, collective/ Solidarity rights.

UNIT- II EVOLUTION OF HUMAN RIGHTS MOVEMENT **9**

Evolution of the concept of Human rights- Magana Carta, Geneva Convection of 1864, Universal Declaration of Human rights 1948;Theories of Human rights.

UNIT-III INTERNATIONAL PRESPECTIVES **9**

Theories and perspective of UN Laws; UN Agencies to monitor and compliance.

UNIT IV HUMAN RIGHTS IN INDIA **9**

Human Rights in India; Constitutional Provisions/ Guarantees.

UNIT V HUMAN RIGHTS SUPPORT ORGANISATION **9**

Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disable persons, including aged and HIV infected people; Implementation of Human Rights - National and State Human Rights Commission; Judiciary; Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. Kapoor S.K., “Human Rights under International law and Indian laws", Central law agency, Allahabad, 2014.

2. Chandra U., “Human Rights", Allahabad law agency, Allahabad, 2014.

3. Upendra Baxi, The future of Human Rights, Oxford University Press, New Delhi.

COURSE OUTCOMES (CO):

Upon completion of the course, students will be able to

CO1 Understand the definition and types of human rights

CO2 Understand the evolution and theories of human rights

CO3 Understand the theories and perspectives of human rights

CO4 Know about human rights in India

CO5 Know about human rights of people of various classes and implementation of human rights

CE1025 DISASTER MANAGEMENT

	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‘ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Singhal J.P. ―Disaster Management‖, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423

2. Tushar Bhattacharya, ―Disaster Science and Management‖, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]

3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011

4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005

2. Government of India, National Disaster Management Policy,2009.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Differentiate the types of disasters, causes and their impact on environment and society

CO2 Assess vulnerability and various methods of risk reduction measures as well as mitigation

CO3 Enhance awareness of institutional processes in the country

CO4 Develop rudimentary ability to respond to their surroundings with potential
disaster response in areas where they live, with due sensitivity

CO5 Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

MG1001 PRINCIPLES OF MANAGEMENT

	L	T	P	C
	3	**0**	**0**	**3**

OBJECTIVES:

- To enable the students to study the evolution of Management.
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur – Types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANIZING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non–budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.

2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India), Pvt. Ltd., 15^{th} Edition, 2020.

REFERENCES:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10^{th} Edition, 2015.

2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.

3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 11^{th} Edition, Pearson Education, 2017.

4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 6^{th} Edition 2017.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- **CO1** Ability to understand the various terms and definitions related to management and organization.
- **CO2** Ability to acquire the skill of planning and various strategies of management in an organization.
- **CO3** Ability to understand the various hierarchies of management and also get an insight into an HR values in an organization management.
- **CO4** Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.
- **CO5** Ability to analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization.

EC1004 HUMAN ASSIST DEVICES L T P C

3 0 0 3

OBJECTIVES:

- To study the role and importance of an Artificial Heart Lung system
- To study various mechanical techniques that help a non-functioning heart
- To learn the functioning of the unit that clears urea from the blood
- To study about Ventilators and Hearing Aids
- To study about recent techniques used in modern clinical applications

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart. Case study.

UNIT II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques. Case study.

UNIT III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of haemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, Classification of Visual Impairments, Prevention and cure of visual impairments, Haptic Devices

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCES:

1. Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering" Marcel Dekker Inc New York 2004.
3. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Explain the principles and construction of an artificial heart.

CO2 Understand various mechanical techniques that improve therapeutic technology.

CO3 Explain the functioning of a Dialyzer.

CO4 Describe tests to assess hearing loss and develop wearable devices for the same.

CO5 Analyze and research on electrical stimulation and Haptic Devices.

CS1616 CRYPTOGRAPHY AND INFORMATION SECURITY L T P C

3 0 0 3

OBJECTIVES

- To define security attacks, services and mechanisms.
- To understand block ciphering techniques and number theory.
- To understand public-key cryptography and hash functions.
- To define cryptographic data integrity algorithms and mutual trust.
- To discuss various security practices and system security measures.

UNIT I INTRODUCTION 9

Computer Security Concepts – The OSI Security Architecture - Security Attacks, Services and Mechanisms - Model for network security – Classical Encryption Techniques: Substitution Techniques, Transposition Techniques, Steganography – Legal and Ethical Aspects.

UNIT II BLOCK CIPHERS & NUMBER THEORY 9

Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm.

Number theory: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem.

UNIT III PUBLIC KEY CRYPTOGRAPHY & HASH FUNCTONS 9

Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange- Elliptic curve arithmetic-Elliptic curve cryptography.

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC

UNIT IV DIGITAL SIGNATURES & SECURITY PRACTICE 9

Digital signature and authentication protocols – DSS – Entity Authentication: Biometrics, Passwords, Challenge Response protocols- EI Gamal – Schnorr – X.509 Certificates - User Authentication- Kerberos.

UNIT V E-MAIL, IP, WEB & SYSTEM SECURITY 9

Electronic Mail security: PGP, S/MIME – IP security – Web Security: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS) – System Security: Intruders – Malicious software – viruses – Firewalls.

TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 5th Edition, 2011.

2. Behrouz A.Forouzan, Introduction to Cryptography and Network Security, McGraw-Hill Ferouzan Networking Series, 2008.

REFERENCES:

1. Shyamala C K, N Harini and Dr T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt. Ltd.

2. Charlie Kaufman, Radia Periman and Mike Speciner, Network Security: private Communication in a public World, Prentice Hall, ISBN 0-13-046019-2

3. William Stallings, "Network Security Essentials Applications and Standards", 2nd edition, Pearson Education, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Describe the key security requirements of confidentiality, Integrity and availability.

CO2 Apply the different cryptographic operations of block ciphering techniques.

CO3 Examines of public key cryptosystem and hash functions.

CO4 Describe the various cryptographic data integrity algorithms and various aspects of key management and distribution.

CO5 Understand various network Security practices and System level security issues.

EC1005	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the compression schemes for audio and voice
- To understand the compression schemes image and video
- To understand the compression schemes for text
- To understand the QoS issues in multimedia network
- To know the communication protocols for multimedia networking

UNIT I AUDIO COMPRESSION 9

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)

UNIT II IMAGE AND VIDEO COMPRESSION 9

Graphics Interchange format- Tagged image file format-Digitized documents-Digitized pictures-JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2.

UNIT III TEXT COMPRESSION 9

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding

UNIT IV GUARANTEED SERVICE MODEL 9

Best Effort service model – Network Performance Parameters – Quality of Service and metrics -Scheduling and Dropping policies – FQ and its variants – Random Early Detection – Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms – An Overview of QoS Architectures-Intserv, Diffserv architectures

UNIT V MULTIMEDIA COMMUNICATION 9

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter removal – Fixed playout and Adaptive playout – Recovery from packet loss – RTSP– Multimedia Communication Standards – RTP/RTCP – SIP and H.323

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Fred Halsall, ―Multimedia communication- Applications, Networks, Protocols and Standards‖, Pearson education, 2007.

REFERENCES:

1. Tay Vaughan, ―Multimedia Making it work , McGraw-Hill Osborne Media, 2006.

2. Kurose and W. Ross, ―Computer Networking ―A Top Down Approach, Pearson education 3rd ed, 2005.

3. KR. Rao,Z S Bojkovic, D A Milovanovic, ―Multimedia Communication Systems: Techniques, Standards, and Networks, Pearson Education 2007

4. R. Steimnetz, K. Nahrstedt, ―Multimedia Computing, Communications and Applications,Pearson Education, First ed, 1995.

5. Nalin K Sharda, Multimedia Information Networking', Prentice Hall of India, 1999

6. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS', Prentice Hall, 2003.

COURSE OUTCOMES:

CO1	Design audio compression techniques
CO2	Configure image and video compression techniques
CO3	Design text compression techniques
CO4	Select suitable service model for specific application
CO5	Configure multimedia communication network

EC1006	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made:

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I WIRELESS LAN 9

Introduction-WLAN technologies - IEEE802.11- System architecture- protocol architecture- 802.11b, 802.11a – Hiper LAN: WATM, BRAN- HiperLAN2 – Bluetooth: Architecture - WPAN – IEEE 802.15.4 - Wireless USB, Zigbee, 6LoWPAN - Wireless HART

UNIT II MOBILE NETWORK LAYER 9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III 3G OVERVIEW 9

Overview of Terrestrial Radio access network-UMTS Core network Architecture: UMTS, 3GPP, Architecture, User equipment, CDMA2000 - Overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV 4G NETWORKS 9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

UNIT V **5G NETWORKS** **9**

Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, Ultra-Dense Network Architecture and Technologies for 5G-Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM)- Principles, Transceiver Block diagram-MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation.

TOTAL:45 PERIODS

TEXT BOOKS:

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, ―Wireless Communications and networking‖, First Edition, Elsevier 2007.(Unit-IV)
3. Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.(Unit V)

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, ―Wireless Networking, First Edition, Elsevier 2011.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications”, Springer, 2016
4. Saad Z Asif, “5G Mobile Communication,Concepts and Challenges", CRC Press
5. Thomas L. Marzetta , Erik G. Larsson , Hong Yang , Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018.

EC1007	ARRAY SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the basics of antenna array fundamentals and principles of the random process.
- To understand the spatial sampling and different types of sensor arrays.
- To understand the spatial domain frequency representation, analysis and processing.
- To understand the various statistical techniques for signal parameter estimation.
- To study different applications of the Array signal processing.

UNIT I ARRAY PROCESSING FUNDAMENTALS 9

Antenna parameters, Basic Antenna elements, Array Fundamentals - Element pattern, Directivity, Power Gain, Polarization, Array pattern, Array gain, Effective array aperture, Random process - Autocorrelation and power spectral density - properties, Noise in communication.

UNIT II SPATIAL SIGNALS AND SENSOR ARRAYS 9

Signals in space and time, Spatial frequency, Direction vs. frequency, Wave fields, Far-field and Near-field signals, Spatial sampling, Nyquist criterion, Sensor arrays - Uniform linear arrays, planar and random arrays, Array transfer (steering) vector, Array steering vector for ULA, Broadband arrays.

UNIT III SPATIAL FREQUENCY 9

Aliasing in the spatial frequency domain, Spatial Frequency Transform, Spatial spectrum, Spatial Domain Filtering, Beamforming, Spatially white signal.

UNIT IV DIRECTION OF ARRIVAL ESTIMATION 9

Array correlation matrix, Non-parametric methods - Beamforming and Capon methods, Resolution of Beamforming method, Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques, Spatial Smoothing.

UNIT V APPLICATIONS OF ARRAY SIGNAL PROCESSING 9

RADAR, Sonar, Seismic, Acoustics, Wireless Communications and networks and Radio Astronomy signal processing applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dan E. Dudgeon and Don H. Johnson, “Array Signal Processing: Concepts and Techniques”, Prentice-Hall, 1993 (UNIT II, III and V)
2. Frank Gross, “Smart Antennas for Wireless Communication with MATLAB”, New York: McGraw Hill, 2005 (UNIT I and IV)

REFERENCES:

1. Simon Haykin and K. J. Ray Liu, “Handbook of Array Signal Processing and Sensor Networks”, Wiley, 2009.
2. Harry L. Van Trees, “Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory”, Wiley, 2002.
3. Prabhakar S. Naidu, “Sensor Array Signal Processing”, CRC Press, 2nd edition, 2009.

COURSE OUTCOMES:

CO1 Able to understand the principle of spatial sampling and spatial aliasing in array signal processing.

CO2 Able to design sensor array-based signal acquisition systems.

CO3 Able to analyze the sensor array signals in the spatial domain.

CO4 Able to develop signal parameter estimation and beamforming methods.

CO5 Able to know about the widespread applications of array signal processing.

EC1008 **ADVANCED DIGITAL SIGNAL PROCESSING** **L T P C**

3 0 0 3

OBJECTIVES

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-resolution analysis

UNIT I DISCRETE- RANDOM PROCESSES 9

Random variables - ensemble averages a review, random processes – ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA.

UNIT II SPECTRUM ESTIMATION 9

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

UNIT III OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

UNIT V MULTI RESOLUTION ANALYSIS 9

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008. (UNIT I-IV)

2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993 (UNIT V)

REFERENCES:

1. John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007.

2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Articulate and apply the concepts of special random processes in practical applications

CO2 Choose appropriate spectrum estimation techniques for a given random process

CO3 Apply optimum filters appropriately for a given communication application

CO4 Apply appropriate adaptive algorithm for processing non-stationary signals

CO5 Apply and analyse wavelet transforms for signal and image processing based applications

EC1009 **MEMS AND NEMS** **L T P C**

3 0 0 3

OBJECTIVES

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To introduce the concepts of quantum mechanics and nano systems.

UNIT I INTRODUCTION TO MEMS AND NEMS 9

New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressuresensors, Case study: Piezoelectric energy harvester

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study:RF Switch.

UNIT V NANO DEVICES 9

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Marc Madou, —Fundamentals of Microfabrication, CRC press 1997.
2. Stephen D. Senturia, Micro system Design , Kluwer Academic Publishers,2001.

REFERENCE BOOKS

1. Tai Ran Hsu , MEMS and Microsystems Design and Manufacture ,Tata Mcraw Hill, 2002.
2. Chang Liu, —Foundations of MEMS‖, Pearson education India limited, 2006,
3. Sergey Edward Lyshevski, —MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002.

COURSE OUTCOMES:

CO1 Ability to understand the operation of micro devices, micro systems and their applications.

CO2 Ability to design the micro devices, micro systems using the MEMS fabrication process.

CO3 Gain knowledge of basic approaches for various sensor designs.

CO4 Gain knowledge of basic approaches for various actuator designs.

CO5 Develop experience on micro/nano systems for photonics.

EC1010 **OPTOELECTRONICS** **L T P C**

3 0 0 3

OBJECTIVES

- To review basic semiconductor theory.
- To introduce the concepts ofLED.
- To teach the principle of stimulated emission and devices based on it.
- To equip the student with the knowledge of Photovoltaics and display devices.
- To introduce the knowledge of optolectronic modulators.

UNIT I SEMICONDUCTOR THEORY 9

Basic quantum mechanics, semiconductor statistics, carrier transport, optical processes, and junction theory, Properties of simple and compound semiconductors, Optical absorption, Optical recombination, Recombination and carrier lifetime.

UNIT II LIGHT EMITTING DIODES 9

Energy Bands. Direct and Indirect Bandgap Semiconductors: E-k Diagrams. pn Junction Principles. The pn Junction Band Diagram. Light Emitting Diodes. LED Materials. Heterojunction High Intensity LEDs. LED Characteristics. LEDs for Optical Fiber Communications, White LED for display and lightingapplications.

UNIT III STIMULATED EMISSION DEVICES 9

Stimulated Emission and Photon Amplification. Stimulated Emission Rate and Einstein Coefficients. Optical Fiber Amplifiers. LASER Oscillation Conditions. Principle of the Laser Diode. Heterostructure Laser Diodes. Rate Equation- Characteristics. Light Emitters for Optical Fiber Communications. Quantum Well and Quantum dot Devices. Vertical Cavity Surface Emitting Lasers (VCSELs). Optical Laser Amplifiers.

UNIT IV PHOTOVOLTAICS AND DISPLAY DEVICES 9

Photovoltaic Device Principles. pn Junction Photovoltaic I-V Characteristics. Solar Cells Materials, Devices and Efficiencies. Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Liquid crystal displays, Reflective and Trans reflective types, TFT displays, Plasma displays, LED TV.

UNIT V POLARIZATION AND MODULATION OF LIGHT 9

Polarization. Light Propagation in an Anisotropic Medium: Birefringence. Electro-Optic Effects.. Acousto-Optic Modulator. Magneto-Optic Effects. Integrated Optical Modulators Electro- absorption modulators.Non-Linear Optics and Second Harmonic Generation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices", Pearson,2013.
2. Michael Parker, "Physics of optoelectronics", CRC press,2018.

REFERENCE BOOKS

1. P. N. Prasad, "Nanophotonics", John Wiley & Sons,2004.
2. Deng-Ke Yang , Shin Tson Wu, "Fundamentals of Liquid Crystal Devices", Revised edition, John Wiley and sons,2015.
3. Saleh and Teich, "Fundamentals of Photonics", Wiley Interscience, 2nd Edition,2013.
4. J. Singh, "Electronic and Optoelectronic Properties of Semiconductor Structures Cambridge university press,2007.

COURSE OUTCOMES:

CO1 Understand various kinds of semiconductor materials used in optoelectronics

CO2 Understand the mechanisms of light absorption and emission in p-n junctions

CO3 Understand the principles of stimulated emission devices.

CO4 Understand about various photo voltaics and display devices.

CO5 Understand the process and use of polarization and modulation of light.

EC1011 CMOS ANALOG IC DESIGN

	L	T	P	C
EC1011 CMOS ANALOG IC DESIGN	**3**	**0**	**0**	**3**

OBJECTIVES:

- To study the fundamentals of analog circuits and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation,
- Capacitor switches and PLLs

UNIT I INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS 9

Concepts of Analog Design-General consideration of MOS devices–MOS I/V Characteristics–Secondordereffects – OS device models. Basic currentmirrors, Cascode current mirrors- Active current mirrors- Large and Small signal analysis-Common mode properties.

UNIT II AMPLIFIERS AND FEEDBACK 9

Basic Concepts–Common source stage-Source follower-Common gate stage-Cascode stage. Single ended and differential operation-Basic Differential pair-Common mode response- Differential pair with MOS loads-Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading-Effect of feedback on Noise.

UNIT III FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE 9

General considerations-Miller Effect and Association of Poles with Nodes, Common source stage-Source followers-Common gate stage-Cascode stage-Differential pair. Noise-Statistical characteristics of noise- Types of noise-Representation of noise in circuits-Noise in single stage amplifiers-Noise in differential pairs- Noise Bandwidth.

UNIT IV OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION 9

General Considerations-One and Two Stage Op Amps-Gain Boosting-Comparison-Common mode feedback-Input range limitations-Slew rate-Power Supply Rejection-Noise in Op Amps- General consideration of stability and frequency compensation-Multi pole system-Phase margin- Frequency compensation-Compensation of two stage op Amps- Other compensation techniques.

UNIT V SWITCHED CAPACITOR CIRCUITSAND PLLS 9

General Considerations- Sampling switches-Switched Capacitor Amplifiers-Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL- Charge pump PLLs- Non ideal Effects in PLLs- Delay locked loops- its Applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Behzad Razavi,-Design of Analog CMOS Integrated Circuits ‖,Tata Mc Graw Hill, 2001,33rd re-print,2016.

REFERENCES:

1. PhillipAllenandDouglasHolmberg-CMOSAnalogCircuitDesign‖SecondEdition,Oxford University Press,2004.
2. PaulR.Gray,PaulJ.Hurst,StephenH.Lewis,RobertG.Meyer,Analysis andDesignof Analog IntegratedCircuits,5th Edition,Wiley,2009
3. Grebene,-Bipolar and MOS Analog Integrated circuit design, John Wiley & sons, Inc., 2003

COURSE OUTCOMES:

CO1 Realize the concepts of Analog MOS devices and current mirror circuits.

CO2 Design different configuration of Amplifiers and feedback circuits.

CO3 Analyze the characteristics of frequency response of the amplifier and its noise.

CO4 Analyzetheperformanceofthestabilityandfrequencycompensation techniquesofOp- Amp Circuits.

CO5 Construct switched capacitor circuits and PLLs

EC1012	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLL

UNIT I SUBMICRON CMOS CIRCUIT DESIGN 9

Introduction to analog VLSI and mixed signal issues in CMOS technologies MOS transistor.Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

UNIT II INTEGRATOR BASED CMOS FILTERS 9

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, g_m- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

UNIT III DATA CONVERTER ARCHITECTURES 9

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Multi-stage flash ADC, Pipeline ADC, Integrating ADC‘s, Successive Approximation ADC.

UNIT IV DATA CONVERTER MODELING AND SNR 9

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

UNIT V SPECIALIZED IC'S AND PLL 9

Specialized IC's: 555 Timer-Monostable, multivibrator, astable multivibratorLC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. D. A. Johns and K. Martin, Analog Integrated Circuit Design, Wiley Student Edition, 2002.
2. P. R. Gray and R. G. Meyer, Analysis and design of Analog Integrated circuits 4th Edition,Wiley Student Edition, 2001.

REFERENCES:

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.
3. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2016.

COURSE OUTCOMES:

CO1 Apply the concepts for mixed signal MOScircuit

CO2 Analyze the characteristics of IC based CMOSfilters.

CO3 Design of various data converter architecturecircuits.

CO4 Analyze the signal to noise ratio and modeling of mixedsignals.

CO5 Design of oscillators and phase lock loopcircuit.

EC1013 LOW POWER VLSI DESIGN

	L	T	P	C
	3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand physics of power dissipation in an IC.
- Understand various power optimization techniques for computing circuits.
- Identify suitable techniques to reduce the power dissipation and design memory circuits with low power dissipation.
- Understand power analysis and power estimation methods.
- Understand concepts of synthesis and software design for low power.

UNIT I POWER DISSIPATION IN CMOS 9

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design.

UNIT II POWER OPTIMIZATION 9

Logic level power optimization – Circuit level low power design – Standard Adder Cells, CMOS Adders Architectures-BiCMOS adders - Low Voltage Low Power Design Techniques, Current Mode Adders -Types of Multiplier Architectures, Braun, Booth and Wallace Tree Multipliers and their performance comparison.

UNIT III DESIGN OF LOW POWER CMOS CIRCUITS 9

Computer arithmetic techniques for low power system – low voltage low power static Random access and dynamic Random access memories – low power clock, Inter connect and layout design – Advanced techniques – Special techniques.

UNIT IV POWER ESTIMATION 9

Power Estimation techniques – logic power estimation – Simulation power analysis –Probabilistic power analysis.

UNIT V SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER 9

Synthesis for low power – Behavioural level transform – software design for low power.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.
2. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

REFERENCES:

1. AbdelatifBelaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995.
2. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995.
3. DimitriosSoudris, C.Pignet, Costas Goutis,“Designing CMOS Circuits for Low Power”Kluwer, 2002.
4. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001.
5. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999.
6. Kiat-send Yeo, Kaushik Roy “Low-Voltage, Low-power VLSI Subsystem”, Tata McGraw-Hill, 2009

COURSE OUTCOMES:

Upon completion of course, students will be able to

CO1: Identify sources of power consumption in VLSI circuits

CO2: Design power optimized computing circuits.

CO3: Use suitable techniques to reduce the power dissipation and design memory circuits with low power dissipation.

CO4: Analyze and estimate power in VLSI circuits

CO5: Synthesize VLSI circuits and develop software code for low power consumption.

EC1014 SPACE TIME MIMO WIRELESS COMMUNICATION **L T P C**

3 0 0 3

OBJECTIVES

- To acquire the knowledge on various modulation and coding schemes for space-time wireless communications.
- To understand the capacity of multiple antenna channels in wireless communications.
- To understand the concept of spatial diversity in wireless communications.
- To understand transmission and decoding techniques associated with wireless communications.
- To understand the combination of multi-user system and multiple-antenna techniques.

UNIT I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION 9

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Fading measurements, ST multiuser and ST interference channels, ST channel estimation.

UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS 9

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

UNIT III SPATIAL DIVERSITY 9

Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.

UNIT IV MULTIPLE ANTENNA CODING AND RECEIVERS 9

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Iterative MIMO receivers, exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre- filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

UNIT V ST OFDM AND MIMO MULTIUSER DETECTION 9

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO OFDM, MIMO MAC, MIMO- BC, Performance of MIMO-MU, MIMO-MU with OFDM.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. A. Paulraj, Rohit Nabar, Dhananjay Gore., “Introduction to Space Time Wireless Communication Systems”, Cambridge University Press, 2003.

2. Sergio Verdu, “Multi User Detection”, Cambridge University Press, 2011.

REFERENCES: Don Tarrieri, “Principles of Spread Spectrum Communication Systems”, Springer, Third edition, 2015.

COURSE OUTCOMES:

CO1 To be able to design and analyze the channel characterization.
CO2 To be able to calculate capacity of MIMO systems.
CO3 To be able to design and analyze the order diversity and channel variability.
CO4 To be able to analyze the multiple antenna coding and receivers.
CO5 To be able to analyze the MIMO multi user detection.

EC1015 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand basic concepts of Electromagnetic Interference and Compatibility
- To learn Coupling mechanism
- To design and study the different methods used to prevent interference.
- To teach the importance of Electromagnetic Compatible designs
- To explain the existing standards for Electromagnetic Compatibility

UNIT I EMI/EMC CONCEPTS 9

EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans.

UNIT II EMI COUPLING PRINCIPLES 9

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling; Field to cable coupling; Power mains and Power supply coupling; Transient EMI, ESD.

UNIT III EMI CONTROL 9

Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables.

UNIT IV EMC DESIGN FOR CIRCUITS AND PCBS 9

Noise from Relays and Switches; Nonlinearities in Circuits; Cross talk in transmission line and cross talk control; Component selection and mounting; PCB trace impedance; Routing; Power distribution decoupling; Zoning; Grounding; VIAs; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS 9

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Line impedance stabilization networks; EMI Rx and spectrum analyzer; Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

TOTAL : 45 PERIODS

TEXT BOOKS

1. V.P.Kodali, —Engineering EMC Principles, Measurements and Technologies, IEEE Press,Newyork, 1996.

2. Henry W.Ott., Noise Reduction Techniques in Electronic Systems, A Wiley Inter SciencePublications, John Wiley and Sons, Newyork, 1988.

REFERENCE BOOKS

1. C.R.Paul,Introduction to Electromagnetic Compatibility , John Wiley and Sons, Inc, 1992.

2. Bemhard Keiser, —Principles of Electromagnetic Compatibility, 3rd Ed, Artech house,Norwood, 1986.

3. Don R. J.White Consultant Incorporate, —Handbook of EMI/EMC, Vol I-V, 1988.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Identify the various types and mechanisms of Electromagnetic Interference

CO2 Study the different methods by which interference can occur.

CO3 Propose a suitable EMI mitigation technique

CO4 Learn the importance of Electromagnetic Compatible designs

CO5 Describe the various EMC Standards and methods to measure them

CS1729 INTRODUCTION TO OPERATING SYSTEMS L T P C

	3	0	0	3

OBJECTIVES

- To understand the overview of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I OPERATING SYSTEM OVERVIEW 9

Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

UNIT II PROCESS MANAGEMENT 9

Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

UNIT III MEMORY MANAGEMENT 9

Basic Memory Management, Physical address map , Contiguous Memory allocation , Fixed and variable partition , Internal and External fragmentation and Compaction , Paging -Page allocation ,Protection and sharing , Disadvantages of paging. Virtual Memory, Locality of reference, Page fault , Working Set , Dirty page/Dirty bit , Demand paging, Page Replacement policies

UNIT IV FILE AND I/O MANAGEMENT 9

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

UNIT V CASE STUDY 9

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

TOTAL : 45 PERIODS

TEXT BOOKS:

1.Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, —Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCES:

1. RamazElmasri, A. Gil Carrick, David Levine, —Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, —Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, —Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach",

Second Edition, Tata McGraw-Hill Education

6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.

7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.

8. http://nptel.ac.in/.

9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Analyze various scheduling algorithms.

CO2 Understand deadlock, prevention and avoidance algorithms.

CO3 Compare and contrast various memory management schemes.

CO4 Understand the functionality of file systems.

CO5 Perform administrative tasks on Linux Servers and Compare iOS and Android

EC1016 UNDERWATER ACOUSTICS SIGNAL PROCESSING

	L	T	P	C
	3	0	0	3

OBJECTIVES

- To understand the characteristics of Underwater Channel
- To understand the principles of SONAR
- To understand the challenges in underwater signal processing

UNIT I UNDERWATER ACOUSTIC CHANNEL 9

Underwater Channel Characterization – Sound Transmission Losses- Acoustic Characteristics of surface layer-Ambient Noise in the ocean-Correlation properties of Ambient Noise.

UNIT II SONAR 9

Basics of SONAR- correlation and ambiguities-Wideband Synthetic Aperture SONAR processing-Discrete Spatial arrays-Beam stearing- Target Angle Estimation –Array Shading:

UNIT III TARGET DETECTION 9

Passive Acoustic signatures of Ships and Submarines-Target strength for Active Systems Hypothesis testing- receiver operating Characteristics-estimation of signal Parameters.

UNIT IV STATISTICAL PROCESSING & ADAPTIVE SPATIAL FILTERING 9

Monostatic Sounding of Single point Targets-Target strength estimation from Echo ensemble Optimum Filter for Maximum SNR-High Resolution Beam Forming.

UNIT V UNDERWATER ACOUSTIC COMMUNICATION 9

Underwater Bio Telemetry System -system Design principle-Speech Coding and Decoding Transmission and Detection of speech.

TOTAL : 45 PERIODS

REFERENCES:

1. Robert S.H. Istepanian and MilicaStojanovic, Underwater Acoustic Digital signal processing & communication system, Kluwer academic Publisher, 2002

2. William S. Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.

COURSE OUTCOMES:

Upon completion of the course, the students will gain knowledge on

CO1 Able to analyze the characteristics of underwater acoustic channel

CO2 Analyze the characteristics of SONAR processing

CO3 To be able to analyze the performance of underwater signal processing systems

CO4 Able to analyze and estimate the target strength using statistical means

CO5 Able to design underwater signal processing systems

EC1017	ADVANCED WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the importance of improving capacity of wireless channel using MIMO
- To enable understanding of channel impairment mitigation using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

UNIT I CAPACITY OF WIRELESS CHANNELS 9

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II RADIO WAVE PROPAGATION 9

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading. Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channelsounding, Antenna Diversity – Diversity combining methods.

UNIT III SPACE TIME BLOCK CODES 9

Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.

UNIT IV SPACE TIME TRELLIS CODES 9

Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

UNIT V LAYERED SPACE TIME CODES 9

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems

– Capacity of MIMO multi user systems.

TOTAL : 45 PERIODS

REFERENCES:

1. Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London. www.artech house.com, ISBN 1-58053-865-7-2004

2. Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, Cambridge University Press, 2003.

3. David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication Cambridge University Press, 2005

4. Sergio Verdu ― Multi User Detection‖ Cambridge University Press, 1998

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1 Comprehend and appreciate the significance and role of this course in the present contemporary world

CO2 Apply the knowledge about the importance of MIMO in today's communication

CO3 Appreciate the various methods for improving the data rate of wireless communication system

CO4 Design system with STBC and STTC

CO5 Design wireless communication systems and investigate further researches in relevant topics

EC1018 UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the fundamental components of optical imaging
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of underwater signal processing
- To Learn the SONAR systems and various applications

UNIT I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM 9

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera: Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle. Image File format: JPEG, PNG, TIFF, BMP, GIF.

UNIT II OPTICAL IMAGE PROCESSING 9

Light Propagation in the Water medium and Image Formation, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Defogging, Color Correction, Morphology, Image segmentation, Pattern Recognition Challenges involved in underwater optical imaging, Underwater Image Datasets.

UNIT III FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems.

UNIT IV SONAR SIGNAL PROCESSING 9

Spatial Signals-Signals in space and time, Co-ordinate systems, propagating waves, Wave number- frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, transmitting signals, Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion.

UNIT V DIFFERENT TYPES OF SONAR SYSTEMS 9

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, forward looking sonar.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Bernd Jahne, “Digital Image processing, Sixth Edition, Springer, 2005
2. William S Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.

REFERENCES:

1. Tinku&Ajoy K. Ray,”Image Processing principles & Applications, First Edition, WileyInterscience,2005
2. Xavier Lurton,”An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer,2010
3. Don H. Johnson and Dan E. Dudgeon,”Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
4. Harry L. Van Trees,”Optimum Array Processing, First Edition, Wiley-Interscience,2002
5. Richard O. Nielsen,”Sonar Signal Processing, First Edition, Artech House,1991 6. A. D. Waite,”SONAR for Practicing Engineers, Third Edition, Wiley,2002

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1	Understand the techniques of underwater imaging
CO2	Understand the fundamentals of underwater acoustics and ambient noise
CO3	Understand array processing techniques for underwater imaging applications
CO4	Design of Filters and impedance matching circuits
CO5	Know about SONAR systems and its applications

EC1019	WEARABLE DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To identify the motivation, guiding principles, and challenges of Wearable Computing.
- To provide the basic understanding of measurement and instrumentation systems.
- To introduce the concept of the reactive sensors and self-generating sensors.
- To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING & ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges – sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

UNIT IV SMART TEXTILE 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques-Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters – ECG, respiration.

UNIT V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011

2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013

3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014

4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCE BOOKS

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.

2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COURSE OUTCOMES:

Upon completion of the course, the students will gain knowledge on

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Illustrate the concept of smart textile

CO5: Compare the various wearable devices in healthcare system

EC1020 5G COMMUNICATION TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES

- To understand the evolution of cellular networks and the road map for 5G, including key standards and specifications.
- To familiarize students with the design principles of the 5G NR air interface, including spectrum allocation, modulation schemes, and multiplexing techniques.
- To provide insights into advanced concepts such as MIMO, beamforming, and 5G radio access network architecture.

UNIT I INTRODUCTION TO 5G STANDARDS AND 5G USE CASES 09

Evolution of Cellular Networks (1G to 5G) - AMPS, GSM, GPRS and EDGE, UMTS, LTE, and LTE-A; Road map for 5G - 5G Standards and Specifications - Key capabilities for IMT 2020, Usage Scenarios; 5G Use Cases – eMBB, URLLC & mMTC, Technical Performance Requirements, 3GPP and 3GPP Releases, 3GPP 5G Architecture - Service-Based System Architecture and Reference Point System Architecture.

UNIT II 5G NR AIR INTERFACE DESIGN 09

5G NR Spectrum – FR1 & FR2, Radio Propagation Issues for mm Waves, Numerology for the Carrier, Frame Structure, Modulation Schemes – ASK, FSK, BPSK, QPSK, QAM and π/2-BPSK, 5G-NR Waveforms - OFDM, CP-OFDM, DFT-S-OFDM, WOLA, FBMC, UFMC and GFDM, Multiplexing Techniques –FDD and TDD Modes, Multiple Access Techniques – OFDMA, SC-FDMA, RMSA, MUSA and NOMA, Channel Coding – LDPC and Polar Coding, HARQ.

UNIT III MIMO AND BEAMFORMING 09

Multiple-Input/Multiple-Output (MIMO) Antennas, MIMO Principles - Spatial diversity and Spatial multiplexing, SU-MIMO, Multiple-User MIMO – UL MU-MIMO and DL MU-MIMO, Advanced Cellular Antennas; Beamforming - Basic Principles and Beam Management, Beamforming Types – Analog, Digital and

Hybrid Beamforming, FD-MIMO, mMIMO, Comparison between SISO, SU - MIMO, MU – MIMO and mMIMO.

UNIT IV 5G RADIO ACCESS NETWORK 09

Overall RAN Architecture, RAN Interfaces, EN-DC Overall Architecture, RAN–Core Functional Split, RAN Channel Structure and signals - Logical Channels, Transport Channels and Physical Channels; RAN Protocol Architecture for user plane and control plane traffic – PHY, MAC, RLC, PDCP, SDAP/RRC - RRC State Transition Model (RRC Inactive, RRC Idle and RRC Connected) and NAS, Channel Structure, RAN – Core Network Interface Protocol Architecture, Xn Interface Protocol Architecture, NG RAN Transport Network - Possible CU, DU, and RU Combinations, vRAN, Cell Acquisition, Random Access, Link Adaptation, Data Transmission and Reception.

UNIT V 5G CORE NETWORK AND B5G 09

Core Network Requirements, Core Network Functional Architecture, Quality of Service, Network Slicing, Registration Management, Connection Management, Session Management, Policy and Charging, Software-Defined Networking, Network Functions Virtualization, SDN and NFV Support for 5G, Multi-Access Edge Computing and 5G, 5G-Advanced and Journey to 6G.

TEXT BOOKS

1. Dr. William Stallings, "5G Wireless - A Comprehensive Introduction", Addison-Wesley Professional, June 2021.
2. Christopher Cox, "An Introduction to 5G - The New Radio, 5G Network and Beyond", Wiley, December 2020.
3. Douglas H. Morais, "Key 5G Physical Layer Technologies - Enabling Mobile and Fixed Wireless Access", Springer, 2020.
4. Mojtaba Vaezi, Zhiguo Ding, H. Vincent Poor, "Multiple Access Techniques for 5G Wireless Networks and Beyond", Springer, 2019.
5. Jun Xu and Yifei YuanChannel, "Channel Coding in 5G New Radio", CRC Press, 2023.

REFERENCES:

1. Jyrki T. J. Penttinen, "5G Explained", Wiley, April 2019.

2. Harri Holma & Antti Toskala and Takehiro Nakamura, "5G Technology - 3GPP Evolution to 5G-Advanced", Second Edition, Wiley, February 2024.

3. Shyam Varan Nath, Ananya Simlai and Oğuzhan Kara, "Mastering 5G Network Design, Implementation, and Operations", Packt Publishing, June 2023.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Understand the evolution of cellular networks to 5G, including standards and key capabilities. Analyze 5G use cases and scenarios, such as eMBB, URLLC, and mMTC.

CO2: Explain 5G NR air interface design, covering spectrum considerations, modulation schemes, and multiple access techniques.

CO3: Demonstrate understanding of MIMO principles and beamforming techniques in 5G systems, including SU-MIMO, MU-MIMO and mMIMO.

CO4: Analyze the architecture and protocols of the 5G Radio Access Network (RAN), including channel structure and RAN–Core functional split.

CO5: Describe the functional architecture of the 5G Core Network, including quality of service, network slicing, SDN, NFV, and advancements towards 5G-Advanced and 6G.

EC1021 MEDICAL IMAGING SYSTEMS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To understand the generation of X-ray and its uses in Medical imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety

UNIT I X RAYS 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT II COMPUTED TOMOGRAPHY 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method

UNIT III MAGNETIC RESONANCE IMAGING MRI 9

Fundamentals of magnetic resonance- properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR IMAGING 9

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET

UNIT V RADIATION THERAPY AND RADIATION SAFETY 9

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1: Describe the working principle of the X-ray machine and its application.

CO2: Illustrate the principle of computed tomography

CO3: Interpret the technique used for visualizing various sections of the body using MRI

CO4: Demonstrate the applications of radionuclide imaging.

CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000

2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000

3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi “Medical Imaging Technology”, Springer Singapore, 2015

REFERENCE BOOKS

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.

2. Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “, Springer-Verlag New York, 2011.

EC1022 WIRELESS BROADBAND NETWORKS

	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

OBJECTIVES:

The student should be made:

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To learn about evolution of 4G Networks, its architecture and applications
- To explore the architecture of 5G, 5G Modulation Schemes and to analyse the concept of MIMO and other research areas in 5G

UNIT I WIRELESS LAN 9

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a, 802.11ax – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART

UNIT II MOBILE NETWORK LAYER 9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III 3G OVERVIEW 9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA

UNIT IV 4G NETWORKS 9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

UNIT V 5G NETWORKS 9

Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, 5G Use Cases – eMBB, URLLC, mMTC, Ultra-Dense Network Architecture and Technologies for 5G-Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM)- Principles, 5G RAN and Core Network – NSA and SA deployments, Transceiver Block diagram-MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Understand wireless LAN technologies

CO2: Know about the internet protocol

CO3: Conversant with the 3G networks and its architecture

CO4: Design and implement wireless network environment for any application using latest wireless protocols and standards

CO5: Conversant with the latest 5G networks and its architecture

TEXT BOOKS:

1. Jochen Schiller, Mobile Communications‖, Second Edition, Pearson Education 2012.
2. Vijay Garg, ―Wireless Communications and networking‖, First Edition, Elsevier 2007.
3. Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.

2. Anurag Kumar, D.Manjunath, Joy kuri, ―Wireless Networking, First Edition, Elsevier 2011.

3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016

4. Saad Z Asif, "5G Mobile Communication,Concepts and Challenges", CRC Press

5. Thomas L. Marzetta , Erik G. Larsson , Hong Yang , Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018.

EC1039 INDUSTRIAL AUTOMATION

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of industrial automation and its applications.
- To Learn about different types of sensors and actuators used in industrial environments.
- To Gain proficiency in PLC programming and ladder logic design
- To Design and implement HMI interfaces for industrial control systems.
- To Explore various industrial communication protocols such as Modbus, Profibus, and Ethernet/IP.

UNIT - I Introduction to Industrial Automation 9

Introduction - fundamental concepts, historical evolution of automation technology, Principles and strategies of automation, Basic elements of an automated system, Impact on manufacturing processes -Applications of automation in industries - automotive, aerospace, and pharmaceuticals.

UNIT -II Sensors and Actuators 9

Sensors and Transducers – Principles, Classifications, Characteristics and applications of sensors used in industrial environment: proximity sensors, temperature sensors, pressure sensors and smart sensors- Selection criteria for sensors – Sensors applications: Automotive, Home appliance and sensors for industrial environment. Actuators: Definition, types and selection of actuators, Role of actuators- solenoids, motors and valves controlling physical processes.

UNIT - III Programmable Logic Controllers (PLCs) 9

Programmable Logic Controllers (PLCs): Principles and functionalities - Architecture, I/O modules, PLC programming languages: Ladder Logic and Function Block Diagram, practical exercises in PLC programming, case studies in PLCs: design and implementation of logic control systems.

UNIT - IV Human-Machine Interface (HMI) 9

HMI: Design principles, Architecture, types, interface elements, layout, interface between human and automated system. HMI Programming and configuration, interfaces for monitoring and controlling industrial processes.

UNIT - V Industrial Communication Protocols 9

Introduction: Open System Interconnection model (OSI) of International Organization for Standardization (ISO). Industrial Communication Protocols types; Characteristics, advantages, and industrial applications of RS-232, RS-485, Modbus, Profibus, Ethernet/IP, and CAN bus – Case study: Implement and troubleshoot communication networks within automated systems.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Krishna Kant, “Computer Based Industrial Control”, Prentice-Hall Of India Pvt Limited 2nd edition, 2011.
2. D. Patranabis,”Sensors and Transducers”, 2nd edition, PHI Learning Private Limited,2004.
3. Petruzella, F.D., “Programmable Logic Controllers”, 5th Edition, McGraw-Hill Education, 2016.
4. Bill Hollifield, Dana Oliver, Ian Nimmo, Eddie Habibi, “The High Performance HMI Handbook: A Comprehensive Guide to Designing, Implementing and Maintaining Effective HMIs for Industrial Plant Operations”, Plant Automation Services, 2008
5. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, “Practical Industrial Data Networks Design, Installation and Troubleshooting” Newnes Publication, Elsevier First Edition, 2004

REFERENCES:

1. D. Popovic and V.P.Bhatkar, “Distributed computer control for industrial Automation” Marcel Dekker, Inc., Newyork ,1990.

2. Bela G.Liptak, “Instrument Engineers' Handbook, Process Measurement and Analysis”, 4th Edition, Vol. 1, ISA/CRC Press, 2003.

3. W. Bolton, “Programmable Logic Controllers”, sixth Edition , Newnes, 2015

4. Mikell P Groover, “Automation Production Systems and Computer-Integrated Manufacturing” Pearson Education, New Delhi, 2001.

5. Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Understand industrial automation principles and applications.

CO2: Select and integrate sensors and actuators effectively.

CO3: Program PLCs proficiently using various languages.

CO4: Design and program HMIs for efficient system control.

CO5: Utilize industrial communication protocols for data exchange.

EC1023 PHOTONIC NETWORKS

	L	T	P	C
	3	0	0	3

OBJECTIVES

- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.
- To give thorough understanding about high frequency line, power and impedance measurements
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light Propagation in optical fibers — Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components— Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks— Topologies for Broadcast Networks, Media- Access Control Protocols, Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations - Linear Light wave networks, Logically Routed Networks.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching– OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks– Network Architecture overview, Optical Access Network Architectures and OTDM networks.

UNIT V NETWORKDESIGNANDMANAGEMENT 9

Transmission System Engineering— System model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management — Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Photonics Optoelectronics (pb2017) Kakani S.L . Cbs publications
2. Photonics : Optical Electronics in Modern Communications – by Variv Second Edition

REFERENCE BOOKS

1. Rajiv Ramaswami and Kumar N. Sivarajan, ―Optical Networks: APracticalPerspective‖,HarcourtAsiaPteLtd.,SecondEdition2004.
2. C.SivaRamMoorthyandMohanGurusamy,―WDMOpticalNetworks: Concept,Designand Algorithms‖,Prentice HallofIndia,IstEdition,2002.
3. P.E.Green,Jr.,―FiberOpticNetworks‖,PrenticeHall,NJ,1993.
4. BiswanathMukherjee,OpticalWDMNetworks‖,SpringerSeries,2006

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Use the backbone infrastructure for our present and future communication needs

CO2 Analyze the architectures and the protocol stack

CO3 Compare the differences in the design of data plane, control plane, routing

CO4 Acquiring knowledge in switching and accessing of Optical Networks

CO5 Able to design RF system transceiver employing active RF components

EC1024	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the basics of satellite orbits
- Understand the satellite segment and ear
- th segment
- Analyze the various methods of satellite multiple access methods
- Understand the applications of satellites
- Understand the basics of satellite Networks

UNIT I SATELLITE ORBITS 9

Orbits and launching methods of satellite: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, Look Angle Determination-Limits of visibility– eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem- antenna polarization, polarization of satellite signals.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING METHODS 9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT- Calculation of link margins for a VSAT star network. Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System, Satellite radio broadcasting. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH), installation of DBS-TV antennas.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Dennis Roddy, ―Satellite Communication‖, 4th Edition, Mc Graw Hill International, 2006.

2. Timothy, Pratt, Charles, W. Bostain, Jeremy E.Allnutt, "Satellite Communication", 2nd Edition, Wiley Publications,2002.

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyder houd, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.

2. N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.

3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book,Artech House Bostan London, 1997.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Analyze the satellite orbits.

CO2: Analyze the earth segment and space segment.

CO3: Analyze the satellite Link design.

CO4: Understand Various multiple access techniques.

CO5: Design various satellite applications.

EC1025 IoT ENABLED SYSTEMS DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To understand the basic concepts of IoT.
- To acquire knowledge about the various protocols of IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications and case studies in IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Internet of Things-Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – Physical Design- Logical Design, IoT Enabling Technologies – IoT Architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects- IoT levels and deployment templates – A panaromic view of IoT applications.

UNIT II MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M – Interoperability challenges of IoT -Protocols for RFID,WSN,SCADA,M2M Zigbee, KNX,B ACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT III COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory

Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation& dissemination.

UNIT IV IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT V APPLICATIONS AND CASE STUDIES 9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – participatory sensing - Data Analytics for IoT– Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.

2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.

REFERENCE BOOKS

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.

2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.

3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2: Identify the architecture, infrastructure models of IoT.

CO3: Analyze the networking and how the sensors are communicated in IoT .

CO4: Analyze and design different models for IoT implementation.

CO5: Identify and design the new models for market strategic interaction.

EC1026 SATELLITE REMOTE SENSING AND IMAGE ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES

- To describe the electromagnetic remote sensing process and the data capturing mechanisms of satellite data.
- To analyze the performance of different image enhancement techniques.
- To analyze the performance of different feature extraction and classification techniques.
- To understand the different satellite data fusion and compression techniques.
- To understand the principles of microwave remote sensing techniques.

UNIT I INTRODUCTION TO REMOTE SENSING 9

Remote Sensing -Definition, Process, Types, Radiation principles. Spectral reflectance curve- EMR interactions with atmosphere, earth surface features. Satellite Data: Satellite Image Characteristics, Types of Resolutions. Data capturing mechanisms: Along track scanning, across track scanning.

UNIT II SATELLITE IMAGE ENHANCEMENT TECHNIQUES 9

Image Preprocessing- Geometric Correction, Radiometric Correction. Satellite Image Enhancement: Radiometric Enhancement - Histogram Based Enhancements, Density Slicing, Stretching, Geometric Enhancement- Neighborhood Operations, Template Operators.

UNIT III FEATURE EXTRACTION AND CLASSIFCATION 9

Types of Feature Extraction- Statistical, Structural and Spectral based approaches. Types of Classification –Supervised and Unsupervised Classification Algorithms.

UNIT IV SATELLITE IMAGE FUSION AND IMAGE COMPRESSION 9

Data Fusion: Feature Space fusion, Spatial domain fusion, Scale space fusion. Data Compression: Compression by coding, Fractal Compression, Wavelet Compression.

UNIT V MICROWAVE REMOTE SENSING 9

Microwave remote sensing, Side Looking Radar Systems, Synthetic Aperture Radar, Radar Image Characteristics, Radar Image Interpretation techniques, Microwave Radiometers, Microwave Scanners.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas M.Lillesand, Ralph W.Kiefer, “Remote Sensing and Image Interpretation”, Fifth Edition, 2004.
2. Robert A. Schowengerdt, Remote Sensing Models & Methods For Image Processing, III Edition, 2004.

REFERENCE BOOKS

1. J. A. Richards “Remote Sensing Digital Image Analysis: An Introduction”, Second Revised Edition, 1993.
2. John R. Jensen, “Remote Sensing Of The Environment – An Earth Resource Perspective”, Pearson Education Series, 2003.
3. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing” (3rd Edition), Prentice Hall, 2007.
4. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011.

COURSE OUTCOMES:

Upon completion of the course, the students will gain knowledge on

CO1: Able to understand electromagnetic remote sensing process and the data capturing mechanisms of satellite data.

CO2: Analyse the performance of different image enhancement techniques.

CO3: Analyse the performance of different feature extraction and classification techniques.

CO4: Able to uunderstand the different satellite data fusion and compression techniques.

CO5: Able to understand the principles of microwave remote sensing techniques.

EC1027	**COGNITIVE RADIO**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities
- To study the basic architecture and standard for cognitive radio
- To understand and design different algorithms for spectrum sensing and dynamic spectrum access
- To understand the physical, MAC and Network layer design of cognitive radio
- To expose the student to evolving applications and advanced features of cognitive radio

UNIT I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio..

UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, ―Cognitive Radio Communications and Networks‖, Academic Press, Elsevier, 2010. (Unit I to IV)
2. Huseyin Arslan (Ed.), ―Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. (Unit V)

REFERENCES:

1. Bruce Fette, ―Cognitive Radio Technology‖, Newnes, 2006.
2. Kwang-Cheng Chen, Ramjee Prasad, ― Cognitive Radio Networks‖, John Wiley and Sons, 2009.

3. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, ―Principles of Cognitive Radio‖ , Cambridge University Press, 2012.

COURSE OUTCOMES:

CO1: Gain knowledge on the design principles on software defined radio and cognitive radio.

CO2: Explain the basic standards of cognitive radio.

CO3: Develop the ability to design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access.

CO4: Build experiments and projects with real time wireless applications.

CO5: Apply the knowledge of advanced features of cognitive radio for real world applications.

EC1028 INDUSTRIAL IOT AND INDUSTRY 4.0

	L	T	P	C
EC1028 INDUSTRIAL IOT AND INDUSTRY 4.0	3	0	0	3

OBJECTIVES:

- To attain knowledge about IoT Nodes & Sensors
- To provide depth of knowledge of IoT Gateways
- To understand and analyse the concepts of IoT Cloud Systems
- To identify and study IoT Cloud Dashboards
- To implement real field problem by gained knowledge of Industrial applications with IoT capability

UNIT I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM 9

IOT Definition, Importance of IoT - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics.

UNIT II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM 9

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.

UNIT III IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python- IoT Physical Devices and Endpoints - Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT IV CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM 9

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; IoT Cloud Storage Models & Communication APIs - Exploring the web services like mail, Messaging (SMS) and Twitter etc.; Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; - Amazon Web Services for IoT.

UNIT V CHALLENGES AND REAL - WORLD APPLICATIONS OF IOT 9

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation. Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCES

1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895

2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.

3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications

CO2: Use processors & peripherals to design & build IoT hardware

CO3: Assess, select, and customize technologies for IoT application

CO4: Connect numerous IOT applications with the physical world of humans and reallife problem solving

CO5: Design and implement IOT applications that manage big data

EC1029 THERAPEUTIC EQUIPMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the principles of cardiac assist devices and the Types of Ventilators
- To comprehend the working of different Methods of Diathermy
- To understand the principle and working of Body Care Equipment
- To Understand the principle of Biomedical lasers and their Applications
- To enable the students to gain knowledge on the working of therapeutic clinical equipment

UNIT I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators .Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.

UNIT II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators,

Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Principle and operation of endoscopy- Parts of an endoscope - Types of endoscopy with applications.

UNIT IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques:Vacuum tecniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT V HEAT & PHOTON THERAPY EQUIPMENT 9

Principle, working and modes of operation of Short wave diathermy, Microwave diathermy, Ultrasonic diathermy, Lithotripsy - Principle and operation of extra corporeal shock wave lithotripter and ultrasonic lithotripter. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2 laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.

2. John.G.Webster. “Medical Instrumentation, Application and Design”. Fourth Edition.Wiley &s ons, Inc., NewYork. 2009.

REFERENCES

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.P feiffer. “Biomedical Instrumentation and Measurements”. Second Edition. Prentice Hall Inc.2000.

2. John Low & Ann Reed. “Electrotherapy Explained, Principles and Practice”. Second Edition. Butterworth Heinemann Ltd. 2000.

3. Joseph. J. Carr, John Michael Brown, “Introduction to Biomedical Equipment Technology”, Prentice Hall and Technology, 2008.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc.,

CO2: Comprehend the principles of body care equipment.

CO3: Understand the operation of dental care equipment.

CO4: Analyze the different types of therapies for suitable applications.

CO5: Appreciate the application of lasers in biomedical applications.

EC1030	ASIC & FPGA BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.
- To learn the architecture of different types of FPGA.
- To understand the applications of FPGA and SoC Design.

UNIT I OVERVIEW OF ASIC AND PLD 9

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs.

UNIT II ASIC PHYSICAL DESIGN 9

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing – circuit extraction - DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation –DFT- boundary scan test - fault simulation - automatic test pattern generation.

UNIT IV FIELD PROGRAMMABLE GATE ARRAYS 9

FPGA Design: FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization. FPGA Applications- Embedded system design using FPGAs, DSP using FPGAs.

UNIT V SOC DESIGN 9

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies: Canonical Signed Digit Arithmetic, Knowledge Crunching Machine, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

TOTAL : 45 PERIODS

REFERENCES:

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan. M. Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, New york.
6. P.K.Chan & S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall.
7. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
8. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Pub.
9. S.Brown,R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray, Kluwer Pub.
10. Richard FJinder , “Engineering Digital Design,”Academic press

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand architectures of ASIC and programmable logic devices

CO2: Understand various ASIC Physical Design

CO3: To analyse the Synthesis, Simulation and Testing of systems using VHDL and Verilog HDL

CO4: Develop the FPGA based system for various applications

CO5: Discuss the design issues of SOC.

EC1031 BODY AREA NETWORKS

	L	T	P	C
EC1031 BODY AREA NETWORKS	3	0	0	3

OBJECTIVES:

- To learn the BAN architecture and sensors for wearable devices.
- To know the hardware requirement of BAN.
- To understand the BAN communication and networking technologies.
- To study the interference and security aspects of BAN.
- To know the implementation of UWB WBAN and applications.

UNIT I INTRODUCTION 9

BAN architecture-Technical challenges- sensor design, biocompatibility, energy supply, optimal node placement, number of nodes, system security and reliability, sensors for wearable devices - implementation issues.

UNIT II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna - PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-stand alone BAN, Wireless personal area network technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Countermeasures on physical layer and data link layer, Regulatory issues - Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V ULTRA WIDEBAND FOR WBAN 9

UWB hardware development – PHY layer – advantages and limitations - Design and Implementation – UWB WBAN applications

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCES:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
4. Huan-Bang Li, Kamya Yekeh Yazdandoost, Bin Zhen, “Wireless body area networks”, River Publishers, 2010.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: Design a BAN for appropriate application in medicine.

CO3: Assess the efficiency of communication and the security parameters.

CO4: Understand the need for medical device regulation and regulations followed in various regions.

CO5: Understand the UWB WBAN implementation.

EC1032	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of drone concepts.
- To learn and understand the fundaments of design, fabrication and programming of drone.
- To impart the knowledge of a flying and operation of drone.
- To know about the various applications of drone.
- To understand the safety risks and guidelines of fly safely.

UNIT I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept -Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses -Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

UNIT II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications.

UNIT IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture-

Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing.

UNIT V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.

2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016.

REFERENCES:

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.

2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Know about a various type of drone technology, drone fabrication and programming.

CO2: Execute the suitable operating procedures for functioning a drone.

CO3: Select appropriate sensors and actuators for Drones.

CO4: Develop a drone mechanism for specific applications.

CO5: Create the programs for various drones.

EI1851	FUNDAMENTALS OF SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Develop the skills to gain a basic understanding of neural network theory.
- Understand the advanced neural networks and its applications.
- Understand fuzzy logic and reasoning to handle and solve engineering problem.
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- Introduce Genetic algorithms from an engineering perspective.

UNIT I ARCHITECTURES – ANN 9

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL 9

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network – Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS 9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules – Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system – liquid level control – aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS 9

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding – constraint handling methods – applications to economic dispatch and unit commitment problems.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks',Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003
3. M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.

COURSE OUTCOMES:

CO1: To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations

CO2: To understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications

CO3: To comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.

CO4: To apply Fuzzy logic concepts to engineering problems

CO5: To understand basics of Evolution algorithm and swarm intelligence

EC1033	**SPEECH AND AUDIO SIGNAL PROCESSING**	**L T P C** **3 0 0 3**

OBJECTIVES:

- To study basic concepts of processing speech and audio signals
- To study and analyze various M-band filter-banks for audio coding
- To understand audio coding based on transform coders.
- To study time and frequency domain speech processing methods
- To study predictive analysis of speech

UNIT I MECHANICS OF SPEECH AND AUDIO 9

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Nonsimultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS 9

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies

UNIT III AUDIO CODING AND TRANSFORM CODERS 9

Lossless Audio Coding – Lossy Audio Coding - ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding -Optimum Coding in the Frequency Domain - Perceptual Transform Coder –Brandenburg – Johnston Hybrid Coder - CNET Coders Adaptive Spectral Entropy Coding –Differential Perceptual Audio Coder

- DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization

UNIT IV TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING 9

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders

UNIT V PREDICTIVE ANALYSIS OF SPEECH 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP

TOTAL : 45 PERIODS

REFERENCES:

1. B.Gold and N.Morgan, “Speech and Audio Signal Processing”, Wiley and Sons, 2000
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech Signals", Prentice Hall,1978.
3. Mark Kahrs, Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustic", Kluwer Academic Publishers
4. UdoZölzer, "Digital Audio Signal Processing", Second Edition, A John Wiley& sons Ltd
5. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana “Fundamentals of Speech Recognition”, Pearson Education, 2009
6. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons,1999

7. Donglos O shanhnessy “Speech Communication: Human and Machine “, 2nd Ed. University press 2001.

COURSE OUTCOMES:

CO1 To understand basic mechanics of speech and audio

CO2 To explain different filter bank and transform analysis in time-frequency domain

CO3 To evaluate audio coding and transform coders

CO4 To discuss about time and frequency domain methods for speech processing

CO5 To explain predictive analysis of speech

CS1827	CLOUD ESSENTIALS	L T P C
		3 0 0 3

OBJECTIVES

- To understand the concept of cloud computing.
- To learn about the concepts of virtualization and virtual machines.
- To understand the principles of cloud architecture, models and storage.
- To learn about the resource provisioning and security issues in the cloud environment.
- To understand the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics –Benefits and Disadvantages of Cloud Computing-Elasticity in Cloud – On-demand Provisioning

UNIT II VIRTUALIZATION BASICS 9

Virtual Machine Basics –Taxonomy of Virtual Machines-Hypervisor-Key Concepts- Virtualization Structure--Implementation Levels of Virtualization - Virtualization Types: Full Virtualization-Para Virtualization– Hardware Virtualization–– Virtualization of CPU, Memory and I/O Devices.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Deployment Models – Cloud Service Models– Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security

Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

UNIT V CLOUD ADVANCEMENT TECHNOLOGIES 9

Hadoop – Map Reduce – Virtual Box –Google App Engine –Amazon AWS-- Microsoft Azure- Cloud Software Environments - Eucalyptus – Open Stack.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
3. Ritting house, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017

REFERENCES :

1. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. James E. Smith,Ravi Nair,”Virtual Machines:Versatile Platforms for Systems and Processes”,Elsevier/Morgan Kaufmann,2005.
3. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O’Reilly, 2009.
4. https://docs.openstack.org/train/install/
5. https://aws.amazon.com/documentdb/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2 Apply the concept of virtualization and its types.

CO3 Understand the architecture of compute and storage cloud, service and delivery models.

CO4 Explain the core issues of cloud computing such as resource management and security.

CO5 Install and use current cloud technologies and choose the appropriate technologies, approaches for implementation.

GE1003 PROFESSIONAL ETHICS IN ENGINEERING

	L	T	P	C
	3	0	0	3

OBJECTIVES

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT – I HUMAN VALUES 9

Morals, values and Ethics; Integrity; Work ethics; Service learning; Civic virtue; Respect for others; Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character; Spirituality; Introduction to Yoga and meditation for professional excellence and stress management.

UNIT – II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory; Gilligan's theory; Consensus and Controversy; Models of professional roles; Theories about right action; Self–interest; Customs and Religion; Uses of Ethical Theories.

UNIT – III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law.

UNIT – IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk; Respect for Authority; Collective Bargaining; Confidentiality; Conflicts of Interest; Occupational Crime; Professional Rights; Employee Rights; Intellectual Property Rights (IPR), Discrimination.

UNIT – V GLOBAL ISSUES 9

Multinational Corporations; Environmental Ethics; Computer Ethics; Weapons Development; Engineers as Managers – Consulting Engineers, Engineers as Expert Witnesses and Advisors; Moral Leadership; Code of Conduct; Corporate Social Responsibility.

TOTAL 45 PERIODS

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.

2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2012.

3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.

4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd, New Delhi, 2013.

COURSE OUTCOMES

CO1 To define the dimensions or senses of engineering ethics and describe the various theories of moral development.

CO2 To describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.

CO3 To understand significance of safety and risk assessment when developing engineering products.

CO4 To understand the social responsibilities and intellectual property rights of engineers.

CO5 To understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development.

GE1004	FUNDAMENTALS OF NANOSCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVE:

To learn about basis of nanomaterial science, preparation method, types and application.

UNIT – I INTRODUCTION 9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT - II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT - III NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT - IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation

UNIT – V APPLICATIONS 9

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL 45 PERIODS

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES (CO)

CO1 Ability to understand the concept of Nano scale Science and Technology and various types of nano materials.

CO2 Ability to acquire knowledge in general methods of preparation of nano materials.

CO3 Ability to understand the Nano forms of Carbon and methods of synthesis

CO4 Ability to acquire knowledge in characteristic nanomaterial on various technique.

CO5 Ability to gain knowledge on various application of nano materials.

EC1034	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for video Analytics
- To understand the basic configuration of video analytics
- To understand the functional blocks of a video analytic system
- To understand how video analytics is used for security
- To get exposed to the various applications of video analytics

UNIT I VIDEO ANALYTIC COMPONENTS 9

Need for Video Analytics-Overview of video Analytics- Foreground extraction-Feature extraction classifier - Pre-processing- edge detection- smoothening-Feature space-PCA-FLD-SIFT features

UNIT II FOREGROUND EXTRACTION 9

Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation Tracking in a multiple camera environment

UNIT III CLASSIFIERS 9

Neural networks (back propagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier

UNIT IV VIDEO ANALYTICS FOR SECURITY 9

Abandoned object detection- human behavioral analysis -human action recognition- perimeter security crowd analysis and prediction of crowd congestion

UNIT V VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE & TRAFFIC MONITIRING AND ASSISTANCE 9

Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestionidentification for route planning- driver assistance- lane change warning

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001

2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016

3. Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014

4. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012

COURSE OUTCOMES:

CO1: To understand the components used for video analytics

CO2: To analyze the classifiers used for video analytics design

CO3: To study the design of video analytic algorithms for security applications

CO4: To study the design of video analytic algorithms for business intelligence

CO5: To analyze the design of custom made video analytics system for the given target application

EC1035	COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods- Medical Image Segmentation.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV 3D RECONSTRUCTION 9

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering- Video based animation – Video textures-Object detection - Face recognition – Eigen faces – Active appearance and 3D shape model- Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: understand basic knowledge about image formation and processing.

CO2: understand about feature detection, matching and detection algorithms.

CO3: describe a feature-based based image alignment, segmentation and motion estimations.

CO4: describe 3D image reconstruction techniques

CO5: design and develop image-based rendering and recognition applications.

EC1036	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface
- To Learn the various electrophysiological sources
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI
- To Learn the various applications of BCI

UNIT I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI , EEG, ECoG, MEG, fMRI. EEG signal acquisition - Signal Pre-processing – Artifacts removal.

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms.

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA,ARMA models – Principal Component Analysis (PCA), Independent Component Analysis (ICA), – Linear and Non-Linear Features.

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot, Emotion detection, P300 Mind Speller.

TOTAL : 45 PERIODS

TEXTBOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces:
2. Revolutionizing Human-Computer Interaction”, Springer, 2010.
3. Rajesh.P.N.Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition, 2013
4. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practice, Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Describe BCI system and its major categorization

CO2: Analyze event related potentials and sensory motor rhythms.

CO3: Compute features suitable for BCI.

CO4: Design classifier modelling for a BCI system.

CO5: Apply BCI across diverse applications.

EC1037	Sensors, Actuators & Interface Electronics	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the purpose and techniques of signal conditioning
- Sensors based on the variation of the electric resistance
- Gain knowledge in self-generating sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and other sensing methods

UNIT - I INTRODUCTION TO MEASUREMENT SYSTEMS 9

Introduction to measurement systems: general concepts and terminology, Classification of sensor, general input-output configuration, methods of correction. Analog signal conditioning: Principles, passive circuits, Operational Amplifier circuits, Digital signal conditioning: Digital fundamentals, converters, Data-Acquisition Systems.

UNIT -II RESISTIVE AND REACTIVE SENSORS 9

Resistive sensors: potentiometers, strain gauges, resistive temperature detectors, magneto resistors, Light-Dependent Resistors (LDRs), Signal conditioning for resistive sensors, capacitive sensors, inductive sensors, Electromagnetic sensors, Signal conditioning for reactance-based sensors.

UNIT - III SELF-GENERATING SENSORS 9

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer and transimpedance amplifiers, charge amplifiers, noise in amplifiers.

UNIT - IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS 9

Final control operation, Signal conversions: Analog electrical signals, Digital electrical signals, Pneumatic signals, Industrial electronics: SCR, TRIAC, Actuators: Electrical actuators, Pneumatic actuators, Hydraulic actuators. Control Elements: Mechanical, Electrical and Fluid Valves.

UNIT – V DIGITAL SENSORS AND OTHER SENSING METHODS 9

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters. Direct sensor – Microcontroller Interfacing, Communication Systems for Sensors. Sensors based on semiconductor junctions, MOSFET, CCD imaging sensors, ultrasonic sensors, fiber-optic sensors, Biosensors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. D. Johnson, "Process Control Instrumentation Technology", John Wiley and Sons.6th Edition, 2000.
2. Ramon Pallas-Areny, John G. Webster, Sensors and signal conditioning, John Wiley & Sons, INC, 2nd Edition, 2001
3. Nathan Ida, Sensors, Actuators, and their Interfaces-A Multidisciplinary Introduction, SciTech publishing, Edison, NJ, 2014

REFERENCES:

1. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
2. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.
3. D.Patranabis, "Sensors and Transducers", TMH 2003.
4. E.O. Doeblin, "Measurement System : Applications and Design", McGraw Hill Publications
5. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
6. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press, 2007.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1	Design signal conditioning system to convert a given input variation into a required output.
CO2	Classify sensors by the physical quantity being measured and develop signal conditioning circuits.
CO3	Implement signal conditioning system using self-generating sensors for various applications.
CO4	Select suitable actuators for various applications.
CO5	Develop Microcontroller based interfacing systems and communication systems.

EC1038 RADAR TECHNOLOGIES

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To understand the basics of Radar and Radar equation
- To study the types of Radar
- To understand the tracking of Radar
- To understand the various signal processing in Radar
- To understand the Subsystems in Radar and Navigational aids

UNIT I INTRODUCTION TO RADAR EQUATION 9

The Origins of Radar, Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

UNIT II CW, MTI AND PULSE DOPPLER RADAR 9

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target 163 Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT III TRACKING RADAR 9

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

UNIT IV RADAR SIGNAL PROCESSING 9

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non- fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.

UNIT V RADAR TRANSMITTERS AND RECEIVERS, NAVIGATIONAL AIDS 9

Aspects of radar transmitters & receivers, linear beam power tubes solid state RF power sources. Receiver noise figure, super heterodyne receiver duplexers and receiver protectors, radar displays. Navigational Aids Introduction, Four Methods of Navigation, Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation, Aids to approach and Landing.

TOTAL 45 PERIODS

TEXT BOOKS:

1. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors “Principles of Modern Radar, Basic Principles”, SciTech Publishing, 2012

REFERENCES:

1. Nathansan, “Radar design principles-Signal processing and environment”, PHI, 2nd Edition,2007.
2. M.I.Skolnik , “Introduction to Radar Systems”, Tata McGraw Hill 2006.
3. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw-Hill, 2005.
4. Sen & Bhattacharya, “Radar Systems and Radio Aids to Navigation”, Publisher: Khanna publishers.

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1 Identify the Radar parameters

CO2 Differentiate various radar types

CO3 Evaluate different tracking and filtering schemes

CO4 Apply signal processing in target detection

CO5 Design Radar transmitter and receiver blocks

OMB104	QUALITY FOR MANAGEMENT SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To facilitate the understanding of Quality Management principles and process.

UNIT - I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, customer retention.

UNIT - II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT - III TQM TOOLS AND TECHNIQUES - I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to benchmark, Bench marking process - FMEA - Stages, Types.

UNIT - IV TQM TOOLS AND TECHNIQUES - II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT - V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector- Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements — Implementation— Documentation—Internal Audits—Registration-- ENVIRONMENTAL MANAGEMENTSYSTEM: Introduction—ISO 14000 Series Standards — Concepts of ISO 14001— Requirements of ISO 14001— Benefits of EMS.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dale H. Besterfiled, Carol B. Michna,Glen H. Besterfield,Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, First Indian Edition, Cengage Learning, 2012.

2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.Ltd., 2006.

4. ISO 9001-2015 standards

COURSE OUTCOMES (CO)

CO1	The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO3	Students can understand the organisational, communication and teamwork requirements for effective quality management.
CO4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans.
CO5	The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

OEE102	RENEWABLE ENERGY SOURCES	L	T	P	C
	(Common to ECE,CHEMICAL & CIVIL)	3	0	0	3

OBJECTIVES

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources

UNIT I BASICS OF SOLAR RADIATION 9

Environmental aspects of energy utilization- importance of renewable energy sources - physics of the sun - solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on tilted surface; Instruments for measuring solar radiation and sun shine - solar radiation data.

UNIT II SOLAR ENERGY COLLECTORS 9

Non-Concentrating and concentrating collectors - classification - orientation and thermal analysis- advanced collectors.

UNIT III SOLAR ENERGY STORAGE AND APPLICATIONS 9

Storage methods- Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying. Photovoltaic energy conversion.

UNIT IV WIND ENERGY AND BIOMASS 9

Wind: Sources and potentials- horizontal and vertical axis windmills- performance characteristics-Types of wind Turbine generators- Betz criteria; BIO-MASS: Principles of Bio-Conversion- Anaerobic/aerobic digestion- types of Bio-gas digesters- gas yield- combustion characteristics of bio-gas- utilization for cooking.

UNIT V GEOTHERMAL AND OCEAN ENERGY 9

Geothermal: Geothermal Resources- types of wells- methods of harnessing the energy- potential in India. OCEAN ENERGY: OTEC- Principles utilization- setting of OTEC plants- thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques- mini-hydel power plants and their economics.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Rai G.D, "Non-Conventional Energy Sources", Khanna Publishers, 2011.
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

REFERENCE BOOKS

1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2004.
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to understand the physics of solar radiation and possible energy conversion.

CO2 Ability to understand the operation of various solar energy collectors.

CO3 Ability to learn the methodologies of storing solar energy.

CO4 Acquire Knowledge in wind and biomass energy conversion techniques.

CO5 Acquire Knowledge in geothermal and ocean energy conversion techniques.

OEI103 BASICS OF BIOMEDICAL INSTRUMENTATION

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements

UNIT I BIO POTENTIAL GENERATION AND ELECTRODES TYPES 9

Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS 9

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven‟s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III SIGNAL CONDITIONING CIRCUITS 9

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV **MEASUREMENT OF NON-ELECTRICALPARAMETERS** **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V **BIO-CHEMICAL MEASUREMENT** **9**

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To Learn the different bio potential and its propagation.
- To get Familiarize the different electrode placement for various physiological recording
- Students will be able design bio amplifier for various physiological recording
- Students will understand various technique non electrical physiogical measurements
- Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:

1. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw Hill, 2003.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”,Pearson Education, 2004.

OEE106	ENERGY CONSERVATION AND MANAGEMENT	L	T	P	C
	(Common to Chemical Engineering, ECE)	3	0	0	3

OBJECTIVES

- To understand and analyse the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings
- To utilise the available resources in optimal ways

UNIT – I ENERGY SCENARIO 9

Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future

UNIT – II FINANCIAL MANAGEMENT AND ENERGY MONITORING AND TARGETING 9

Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs)

UNIT – III ENERGY MANAGEMENT & AUDIT 9

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

UNIT – IV ENERGY EFFICIENCY IN THERMAL UTILITIES AND SYSTEMS 9

Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation, Thermic fluid heaters, super critical boilers.

UNIT – V ENERGY AND ENVIRONMENT, AIR POLLUTION, CLIMATE CHANGE 9

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

TOTAL:45PERIODS

TEXT BOOKS & REFERENCE BOOKS:

1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press Bureau of Energy Efficiency
3. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication

COURSE OUTCOMES (CO)

CO1 To understand the Classification of Energy, Indian energy scenario

CO2 To understand the energy pricing, energy

CO3 To understand the Introduction internal rate of return, cash

CO4 To understand the performances evaluation, analysis of losses

CO5 To understand the United Nations Framework Convention on Climate Change

OCE102 INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM **L T P C**

(COMMON TO AIDS, AIML, CSE, ECE AND IT) 3 0 0 3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

UNIT I FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT II SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

UNIT III DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser –Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT IV DATA ANALYSIS 9

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT V APPLICATIONS 9

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 HavebasicideaaboutthefundamentalsofGIS.

CO2 Understandthetypesofdatamodels.

CO3 Getknowledgeaboutdatainputandtopology.

CO4 Gainknowledgeondataqualityandstandards.

CO5 Understanddatamanagementfunctionsanddataoutput

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

The course is aimed to

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT – I BASICS OF NANOTECHNOLOGY 9

Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.

UNIT – II DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon based nano materials (buckyballs, nanotubes, graphene)- Metal based nanomaterials (nanogold, nanosilver and metal oxides) -Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.

UNIT – III SYNTHESIS OF NANOMATERIALS 9

Chemical Methods:Metal Nanocrystals by Reduction -Sol - gel processing -Solvothermal Synthesis-Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods:Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).

UNIT – IV CHARACTERIZATION OF NANOSTRUCTURES 9

Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)-Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).

UNIT – V APPLICATIONS 9

Solar energy conversion and catalysis - Molecular electronics and printed electronics -Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices - Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS:

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)

2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994

3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007.

COURSE OUTCOMES

CO1 Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology

CO2 Understand the different classes of nanomaterials.

CO3 Identify the CVD, MOCVD

CO4 Outline the applications of nanotechnology and

CO5 develop an ability to critically evaluate the promise of a nanotechnology device.

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003.

REFERENCES:

1. Safety Manual, "EDEL Engineering Consultancy", 2000.
2. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

COURSE OUTCOMES:

CO1 understand the basic safety concepts in Industrial boilers, pressure vessels

CO2 understand the hazardous effects caused and prevention methods of chemicals used in industry

CO3 understand the environmental measures and controls towards safety

CO4 understand the analysis of safety preventions and hazards in industry

CO5 understand the safety regulations and safety management.

OEI101 SENSORS AND TRANSDUCERS

	L	T	P	C
	3	0	0	3

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

UNIT I INTRODUCTION 9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III FORCE, MAGNETIC AND HEADING SENSORS 9

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS 9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Expertise in various calibration techniques and signal types for sensors.
CO2	Apply the proximity and ranging sensors in the automotive and mechatronics applications.
CO3	Understand the principles of various magnetic and heading sensors.
CO4	Understand the functioning of optical, pressure, temperature and smart sensors.
CO5	Implement the DAQ systems with different sensors for real time applications.

OCS104	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of Transaction Processing and concurrency
- To have a basic knowledge about the Storage implementation and query processing
- To understand database security concepts and database programming

UNIT I INTRODUCTION 9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL-Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL

UNIT II DATABASE DESIGN 9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III TRANSACTION CONCEPTS AND CONCURRENCY CONTROL 9

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery

UNIT IV IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation

UNIT V ADVANCED TOPICS AND DATABASE PROGRAMMING 9

Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools

TOTAL : 45 PERIODS

TEXT BOOKS:

1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

COURSE OUTCOMES:

CO1 To understand relational data model, evolve conceptual model of a given problem and SQL

CO2 To understand Relational model and normalization to perform database design effectively

CO3 Apply and relate the concept of transaction, concurrency control and recovery in database

CO4 To understand the implementation technique and query processing

CO5 To understand the concepts of database security and database programming

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT I INTRODUCTION TO DATA ANALYSIS 9

Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics

UNIT II R PROGRAMMING BASICS 9

Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages

UNIT III DATA VISUALIZATION USING R 9

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.

Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts

UNIT IV STATISTICS WITH R 9

Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression

UNIT V PRESCRIPTIVE ANALYTICS 9

Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning

TOTAL : 45 PERIODS

TEXT BOOKS:

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.

2. URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCES:

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.

2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.

3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)

4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer

5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.

COURSE OUTCOMES:

CO1 Understand the basics of data analytics

CO2 Understand and apply the R-Programming concepts

CO3 Apply R-Programming for data visualization

CO4 Implement various classification techniques using R

CO5 Apply R programming to perform perspective analytics on data

OEI105	SCADA SYSTEM AND APPLICATIONS MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applications in power system

UNIT I INTRODUCTION TO SCADA 9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II SCADA SYSTEM COMPONENTS 9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels.

UNIT III SCADA COMMUNICATION 9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV SCADA MONITORING AND CONTROL 9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V SCADA APPLICATIONS IN POWER SYSTEM 9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning. **CASE STUDIES:** SCADA

Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations

TOTAL : 45 PERIODS

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,‟ Distributed computer control for industrial Automation‟ Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Ability to understand the basics of SCADA and various components.

CO2 To understand various system components of SCADA

CO3 Ability to develop communications and interface of SCADA

CO4 Able to select and use most appropriate automation technologies for a given application.

CO5 Ability to gain knowledge on the recent developments in industrial automation.

OBT107	INTRODUCTION TO CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on cell structure and its function.

UNIT I CELL STRUCTURE 9

Cell organization, structure of organelles, extra cellular matrix and cell junctions.

UNIT II CELL ORGANELLE AND FUNCTION 9

Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT III CELL DIVISION 9

Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis.

UNIT IV BIO-MOLECULES 9

DNA, RNA and Proteins – basic units, architectural hierarchy and organization, functions

UNIT V ENZYMES 9

Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Enzymes of plant and Animal origin used in industries, Biosensors and its applications.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Lodish, Harvey etal., “Molecular Cell Biology”, 5 th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman “The Cell : A Molecular Approach”, 4 th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., “Molecular Biology of the Cell”, 4 th Edition, Garland Science (Taylors Francis), 2002.

REFERENCES:

1. McDonald, F etal., " Molecular Biology of Cancer" 2nd Edition, Taylor & Francis, 2004.

2. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996

COURSE OUTCOMES:

CO1 Would have deeper understanding of cell at structural and functional level.

CO2 Would have broad knowledge on cell division mechanisms

CO3 Would demonstrate a clear understanding of Biomolecules such DNA, RNA and Protein

CO4 Would develop skill on employing enzymes for various applications

CO5 Would have deeper understanding of cell at structural and functional level.

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

Students will be able to :

- Understand the premises informing the twin themes of liberty and freedom from a civil Rightsperspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism Let the should know about the importance of character
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and ImportanceMunicipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

1. REFERENCES:

2. The Constitution of India,1950(Bare Act),Government Publication.

3. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.

4. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.

5. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes (CO)

CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualizationof social reforms leading to revolution in India.

CO3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal

Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4 Discuss the passage of the Hindu Code Bill of 1956.

AD1002	**VALUE EDUCATION**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

OBJECTIVES:

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT III

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT IV

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

TOTAL: 30 PERIODS

REFERENCES:

1. Chakroborty,S.K.“ValuesandEthicsfororganizations Theoryand practice”,Oxford UniversityPress, New Delhi

Course Outcomes (CO)

CO1 Knowledge of self-development.

CO2 Learn the importance of Human values.

CO3 Developing the overall personality Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models

CO4 Using discrete time Markov chains to model computer systems

CO5 Knowledge of self-development.

AD1003 PEDAGOGY STUDIES

	L	T	P	C
	2	0	0	0

OBJECTIVES:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DFLD, other agencies and researchers
- Identify critical evidence gaps to guide the development

UNIT I INTRODUCTION AND METHODOLOGY 5

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching

UNIT II INTRODUCTION AND METHODOLOGY 5

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching

UNIT III THEMATIC OVERVIEW 5

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

UNIT IV EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 5

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies

UNIT V PROFESSIONAL DEVELOPMENT 5

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

SUGGESTED READING

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245-261.
2. Agrawal M (2004)Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1.London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M(2003) Read India: Amass scale, rapid, 'learning to read' campaign.

Course Outcomes (CO)

CO1 Understand What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2 Understand What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3 Understand How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AD1004 STRESS MANAGEMENT BY YOGA

	L	T	P	C
	2	0	0	0

OBJECTIVES:

- To achieve overall health of body and mind
- To overcome stress

UNIT I

Definitions of Eight parts of yoga.(Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

REFERENCES:

1. ‘Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes (CO)

CO1 Develop healthy mind in a healthy body thus improving social health alsoImprove efficiency

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTNMENT SKILL	L T P C 2 0 0 0

OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

REFERENCES:

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

Course Outcomes (CO)

CO1 Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life

CO2 The person who has studied Geeta will lead the nation and mankind to peace and prosperity

CO3 Study of Neet is hatakam will help in developing versatile personality of students.

AD1006 UNNAT BHARAT ABHIYAN

	L	T	P	C
	2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN 9

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area.

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II RURAL ECONOMY AND LIVELIHOOD 9

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market .

Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT - III RURAL INSTITUTIONS 9

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles.

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT - IV RURAL DEVELOPMENT PROGRAMMES 9

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.

UNIT - V FIELD WORK 9

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)

- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization
- Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings, and interview school drop outs
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.
- Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing.

Total Periods: 45

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015

2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002

3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers

2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

Course Outcomes (CO)

CO1 Able to understand of rural life, culture and social realities

CO2 Able to understand the concept of measurement by comparison or balance of parameters.

CO3 Able to develop a sense of empathy and bonds of mutuality with local community

CO4 Able to appreciate significant contributions of local communities to Indian society and economy

CO5 Learned to value the local knowledge and wisdom of the community

AD1007 **ESSENCE OF INDIANKNOWLEDGETRADITION** **L P T C**

3 0 0 3

OBJECTIVES

- Get a knowledge about IndianCulture
- Know Indian Languages and Literature religion and philosophy and the fine arts inIndia
- Explore the Science and Scientists of Ancient, Medieval and ModernIndia
- Understand education systems inIndia

UNIT I INTRODUCTIONTOCULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, ModernIndia

UNIT II INDIAN LANGUAGESANDLITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages &Literature

UNIT III RELIGIONANDPHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART,TECHNOLOGY&ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medievaland modern India

UNIT V EDUCATION SYSTEMININDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of ModernIndia

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375,2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333,2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X,200
4. Narain, “Examinations in ancient India”, Arya Book Depot,1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher,1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990,2014.

Course Outcomes

CO1 Understand philosophy of Indianculture.

CO2 Distinguish the Indian languages andliterature.

CO3 Learn the philosophy of ancient, medieval and modernIndia.

CO4 Acquire the information about the fine arts inIndia.

CO5 Know the contribution of scientists of differenteras.

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Faculty of Electrical Engineering

REGULATIONS – 2021
(CURRICULUM)

B.E.-ELECTRICAL AND ELECTRONICS ENGINEERING

Choice Based Credit System (CBCS)

I-VIII Semesters

Vision of the department

- To promote the department of Electrical and Electronics Engineering as a pioneer in education and research by imparting quality education, creating and upgrading the academic facilities and inculcating professional values to the students to face the challenges in the dynamic global society.

Mission of the department

- To attain utmost qualities of teaching-learning process and provide a vibrant environment for the students to exhibit their fullest potential in the field of Electrical and Electronics Engineering.
- To improve research and development skills among students towards providing technical solutions with ethical values to meet social challenges.
- To develop the students to face the technological requirements of the industry with professional values and make them employable and to impart the spirit of entrepreneurship for their successful career.

Program Education Objectives (PEOs)

PEO1: To provide a strong foundation for students to have a successful career in electrical and its related fields and to pursue higher education and research.

PEO2 : To improve their mathematical and scientific knowledge to solve emerging real world problems related to power, electronics, control systems, field theory and signal processing and will use their communication and intellectual skills for execution of complex technological solutions.

PEO3: Tofulfil the needs of society in solving technical problems using engineering principles, tools and practices, in an ethical and responsible manner, in service to the society.

PEO4: To develop their self-learning capability and adaptability to encounter various complex practical problems in multi-disciplinary engineering projects effectively and undertake leadership roles when appropriate.

PEO5: To promote students' awareness of lifelong learning to enhance and maintain professional skills.

Program Specific Outcomes (PSOs)

Our Graduate will be able to:

PSO1: Identify, understand and analyze the problems in the field of electrical and electronics engineering by applying the principles of mathematics, science and engineering.

PSO2: Apply the acquired knowledge of hardware and software tools along with the analytical skills to work with electrical and electronic equipment and arrive at optimal solutions to suit industrial needs.

PSO3: Demonstrate core competencies and solve engineering problems by performing research in the areas of electrical drives, control and power systems for the sustainable development of the society.

PSO4: To take up roles in a team, develop managerial skills, and contributes towards the electrical community globally.

Program Outcomes (POs):

a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b) **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d) **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engieering practice.

i) **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

PO/UNDERGRADUATE SUBJECTS MAPPING

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES (PO)											
		a	b	c	d	e	f	g	h	i	j	k	l
SEM I	**THEORY**												
	Communicative English									✓	✓		✓
	Engineering Mathematics- I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Problem solving and Python Programming	✓	✓	✓	✓	✓							
	Engineering Graphics			✓	✓								
	Heritage of Tamils												
	PRACTICALS												
	Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
SEM II	**THEORY**												
	Professional English									✓	✓		✓
	Engineering Mathematics – II	✓	✓	✓		✓							✓
	Physics for Electronics Engineering	✓	✓	✓		✓		✓					✓
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Principles of Electrical, Electronics and Communication Engineering	✓	✓	✓	✓	✓							✓
	Tamils and Technology												
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Principles of Electrical and Electronic devices Laboratory	✓	✓	✓	✓	✓							✓
SEM III	**THEORY**												
	Transforms and Partial Differential Equations	✓	✓			✓							✓
	Electromagnetic Theory	✓	✓	✓	✓	✓					✓		✓
	Measurements and Instrumentation	✓	✓	✓	✓	✓							✓
	Electric Circuit Analysis	✓	✓	✓	✓	✓							✓
	Analog Electronics	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	PRACTICALS												
	Electric Circuits Laboratory	✓	✓	✓	✓	✓							✓

	Analog and Digital Electronics Laboratory	✓			✓	✓						✓	✓
SEM IV	**THEORY**												
	Statistics & Numerical Methods	✓	✓	✓									✓
	Electrical Machines – I	✓	✓	✓	✓	✓					✓		
	Generation,Transmission and Distribution	✓	✓	✓	✓	✓		✓					✓
	Control Systems	✓	✓	✓	✓	✓							✓
	Fundamentals of Data Structures in C (Integrated Lab)			✓	✓	✓							✓
	Open Elective - I												
	Audit Course*												
	PRACTICALS												
	Electrical Machines Laboratory – I	✓			✓	✓						✓	✓
	Control and Instrumentation Laboratory			✓	✓	✓	✓			✓	✓		
	Professional Skills Lab									✓	✓	✓	
SEM V	**THEORY**												
	Electrical Machines – II	✓	✓	✓	✓	✓		✓					✓
	Power System Analysis	✓	✓	✓	✓	✓		✓					✓
	Power Electronics	✓	✓	✓	✓	✓		✓					
	Microprocessors and Microcontrollers	✓		✓		✓			✓	✓		✓	✓
	Professional Elective- I												
	PRACTICALS												
	Electrical Machines Laboratory– II	✓	✓	✓	✓	✓							✓
	Power Electronics and Drives Laboratory	✓		✓	✓						✓	✓	✓
	Microprocessors and Microcontrollers Laboratory	✓		✓	✓						✓	✓	✓
SEM VI	**THEORY**												
	Solid State Drives	✓	✓	✓	✓	✓		✓					
	Renewable Energy Systems	✓	✓	✓	✓	✓		✓					✓
	Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Embedded Systems(Integrated Lab)	✓		✓		✓			✓	✓		✓	✓
	Object Oriented Programming (Integrated Lab)			✓	✓	✓							✓
	Professional Elective- II												
	PRACTICALS												
	Renewable Energy Systems Laboratory	✓		✓	✓						✓	✓	✓
	Mini Project	✓		✓	✓						✓	✓	✓

SEM VII	**THEORY**												
	High Voltage Engineering	✓	✓	✓	✓	✓		✓					✓
	Power System Operation and Control	✓	✓	✓	✓	✓		✓					✓
	Protection and Switchgear	✓		✓		✓	✓					✓	✓
	Electric Vehicle Mechanics and Control(Integrated Lab)	✓	✓	✓	✓	✓		✓					✓
	Professional Elective- III												
	Open Elective - II												
	PRACTICALS												
	Power System Simulation Laboratory	✓		✓	✓						✓	✓	✓
	Project Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VIII	**THEORY**												
	Professional Elective- IV												
	Professional Elective- V												
	PRACTICALS												
	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVE

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES (PO)											
		a	b	c	d	e	f	g	h	i	j	k	l
ELECTIVE I	Biomedical Instrumentation	✓		✓	✓	✓	✓						
	Advanced Control System		✓	✓					✓	✓			
	Principles of Robotics	✓		✓		✓							
	Power plant Engineering			✓	✓	✓		✓	✓	✓			
	Visual Programming	✓	✓		✓	✓							
	Fundamentals of Operating Systems												
	Intellectual Property Rights								✓		✓		✓
	Disaster Management			✓	✓	✓	✓						
ELECTIVE II	Design of Electrical Apparatus	✓		✓	✓	✓		✓					
	Special Electrical Machines	✓		✓	✓	✓			✓				
	Modern Power Converters	✓		✓	✓	✓		✓					
	EHVAC Transmission	✓		✓	✓	✓			✓				✓
	Power Systems Stability				✓	✓							
	Line Commutated and Active Rectifiers	✓		✓	✓	✓			✓				✓
	Soft Computing Techniques	✓		✓		✓							
	Human Rights	✓	✓	✓					✓	✓			✓

ELECTIVE III	System Identification and Adaptive Control	✓	✓	✓		✓							
	Advanced Electrical Drives	✓	✓	✓	✓	✓		✓					✓
	Power Systems Transients		✓		✓	✓							
	Artificial Intelligence and Machine Learning	✓		✓		✓							
	Computer Architecture	✓		✓		✓							
	CMOS VLSI Design	✓	✓	✓			✓	✓					
	Operational Research		✓	✓					✓	✓			
ELECTIVE IV	Electric Energy Utilization and Conservation	✓	✓	✓	✓	✓		✓					✓
	Flexible AC Transmission Systems	✓	✓	✓		✓					✓		✓
	Power Quality	✓		✓	✓	✓			✓				✓
	SMPS and UPS	✓		✓		✓							
	Micro Electro Mechanical Systems	✓		✓		✓							
	Professional Ethics in Engineering	✓	✓		✓			✓				✓	✓
	Principles of Management					✓	✓			✓			
ELECTIVE V	Energy Management and Auditing		✓			✓	✓	✓	✓	✓	✓		
	High Voltage Direct Current Transmission	✓	✓	✓					✓	✓			✓
	Microcontroller Based System Design	✓	✓	✓					✓	✓			✓
	Smart Grid	✓	✓	✓					✓	✓			✓
	Testing of Electric Vehicles												
	Intelligent Control of Electric Vehicles												
	Data Visualisation	✓	✓	✓			✓	✓					
	Fundamentals of Nano Science	✓	✓	✓			✓	✓					

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	4	0	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
7.	GE3152	Heritage of Tamils	HSMC	1	1	0	0	1
PRACTICALS								
8.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
9.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**31**	**19**	**0**	**12**	**25**
Induction Training			**MAC**	**2 Weeks**				

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6.	EE1271	Principles of Electrical, Electronics and Communication Engineering	PCC	3	3	0	0	3
7.	GE3252	Tamils and Technology	HSMC	1	1	0	0	1
PRACTICALS								
8.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
9.	EE1278	Principles of Electrical and Electronic devices Laboratory	PCC	4	0	0	4	2

TOTAL			28	20	0	8	24
Personality & Character Development	MAC		1 Week				

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1301	Transforms and Partial Differential Equations	BSC	4	4	0	0	4
2.	EE1301	Electromagnetic Theory	PCC	3	2	1	0	3
3.	EE1302	Measurements and Instrumentation	PCC	3	3	0	0	3
4.	EE1371	Electric Circuit Analysis	PCC	3	2	1	0	3
5.	EE1372	Analog Electronics	PCC	3	3	0	0	3
6.	EE1373	Digital Logic Circuits	PCC	3	2	1	0	3
PRACTICALS								
7.	EE1381	Electric Circuits Laboratory	PCC	4	0	0	4	2
8.	EE1391	Analog and Digital Electronics Laboratory	PCC	4	0	0	4	2
TOTAL				27	16	3	8	23
Career Competency Development- I: BEC Training				1 Week				

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1401	Statistics and Numerical Methods	BSC	4	4	0	0	4
2.	EE1401	Electrical Machines – I	PCC	3	2	1	0	3
3.	EE1402	Generation, Transmission and Distribution	PCC	3	3	0	0	3
4.	EE1471	Control Systems	PCC	3	2	1	0	3
5.	CS1406	Fundamentals of Data structures in C (Integrated Lab)	ESC	5	3	0	2	4
6.		Open Elective- I	OEC	3	3	0	0	3
7.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
PRACTICALS								
8.	EE1481	Electrical Machines Laboratory– I	PCC	4	0	0	4	2
9.	EE1482	Control and Instrumentation	PCC	4	0	0	4	2

		Laboratory						
10.	HS1310	Professional Skills Lab	HSMC	2	0	0	2	1
TOTAL				33	18	3	12	25
Career Competency Development- II: C Programming				1 Week				

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1501	Electrical Machines – II	PCC	3	2	1	0	3
2.	EE1502	Power System Analysis	PCC	3	2	1	0	3
3.	EE1571	Power Electronics	PCC	3	3	0	0	3
4.	EE1572	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
5.		Professional Elective- I	PEC	3	3	0	0	3
PRACTICALS								
6.	EE1581	Electrical Machines Laboratory– II	PCC	4	0	0	4	2
7.	EE1582	Power Electronics and Drives Laboratory	PCC	4	0	0	4	2
8.	EE1591	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
9.	EE1592	Internship –I (2 Weeks)	EEC					1
TOTAL				27	13	2	12	22
Career Competency Development- III:(Advanced C Programming)						1 Week		

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1601	Solid State Drives	PCC	3	3	0	0	3
2.	EE1602	Renewable Energy Systems	PCC	3	3	0	0	3
3.	EE1671	Digital Signal Processing	PCC	3	2	1	0	3
4.	EE1672	Embedded Systems (Integrated Lab)	ESC	5	3	0	2	4
5.	DS1302	Object Oriented Programming (Integrated Lab)	ESC	5	3	0	2	4
6.		Professional Elective- II	PEC	3	3	0	0	3
PRACTICALS								

7.	EE1681	Renewable Energy Systems Laboratory	PCC	4	0	0	4	2
8.	EE1682	Mini Project	EEC	4	0	0	4	2
TOTAL				**28**	**17**	**1**	**10**	**24**
Value Added Course						**1 Week**		**2**
Career Competency Development-IV:(Aptitude & Data Structures)						**4 Weeks**		

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1701	High Voltage Engineering	PCC	3	3	0	0	3
2.	EE1702	Power System Operation and Control	PCC	3	3	0	0	3
3.	EE1703	Protection and switchgear	PCC	3	3	0	0	3
4.	EE1704	Electric Vehicle Mechanics and Control (Integrated Lab)	PCC	3	3	0	2	4
5.		Professional Elective- III	PEC	3	3	0	0	3
6.		Open Elective – II	OEC	3	3	0	0	3
PRACTICALS								
7.	EE1781	Power System Simulation Laboratory	PCC	4	0	0	4	2
8.	EE1782	Project Phase I	EEC	2	0	0	4	2
TOTAL				**24**	**18**	**0**	**6**	**23**
Career Competency Development- V: (Company specific Training)					**1 Week**			

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective- IV	PEC	3	3	0	0	3
2.		Professional Elective- V	PEC	3	3	0	0	3
PRACTICALS								
3.	EE1881	Project Phase II	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL CREDITS-182

PROFESSIONAL ELECTIVE - I (V SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1501	Biomedical Instrumentation	PE	3	3	0	0	3
2.	EE1512	Advanced Control System	PE	3	3	0	0	3
3.	EE1513	Principles of Robotics	PE	3	3	0	0	3
4.	ME1703	Power Plant Engineering	PE	3	3	0	0	3
5.	CS1516	Visual Programming	PE	3	3	0	0	3
6.	CS1520	Fundamentals of Operating systems	PE	3	3	0	0	3
7.	GE1001	Intellectual Property Rights	PE	3	3	0	0	3
8.	CE1025	Disaster Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - II (VI SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1621	Design of Electrical Apparatus	PE	3	3	0	0	3
2.	EE1622	Special Electrical Machines	PE	3	3	0	0	3
3.	EE1623	Modern Power Converters	PE	3	3	0	0	3
4.	EE1624	EHVAC Transmission	PE	3	3	0	0	3
5.	EE1625	Power Systems Stability	PE	3	3	0	0	3
6.	EE1626	Line Commutated and Active Rectifiers	PE	3	3	0	0	3
7.	EE1627	Soft Computing Techniques	PE	3	3	0	0	3
8.	GE1002	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - III (VII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1731	System Identification and Adaptive Control	PE	3	3	0	0	3
2.	EE1732	Advanced Electrical Drives	PE	3	3	0	0	3
3.	EE1733	Power Systems Transients	PE	3	3	0	0	3
4.	EE1734	Artificial Intelligence and Machine Learning	PE	3	3	0	0	3
5.	CS1304	Computer Architecture	PE	3	3	0	0	3
6.	EC1731	CMOS VLSI Design	PE	3	3	0	0	3
7.	MG1002	Operational Research	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - IV (VIII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1841	Electric Energy Utilization and Conservation	PE	3	3	0	0	3
2.	EE1842	Flexible AC Transmission Systems	PE	3	3	0	0	3
3.	EE1843	Power Quality	PE	3	3	0	0	3
4.	EE1844	SMPS and UPS	PE	3	3	0	0	3
5.	EE1845	Micro Electro Mechanical Systems	PE	3	3	0	0	3
6.	GE1003	Professional Ethics in Engineering	PE	3	3	0	0	3
7.	MG1001	Principles of Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE - V (VIII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE1851	Energy Management and Auditing	PE	3	3	0	0	3
2.	EE1852	High Voltage Direct Current Transmission	PE	3	3	0	0	3
3.	EE1853	Microcontroller Based System Design	PE	3	3	0	0	3
4.	EE1854	Smart Grid	PE	3	3	0	0	3
5.	EE1855	Testing of Electric Vehicles	PE	3	3	0	0	3
6.	EE1856	Intelligent control of Electric Vehicles	PE	3	3	0	0	3
7.	DS1603	Data Visualisation	PE	3	3	0	0	3
8.	GE1004	Fundamentals of Nano Science	PE	3	3	0	0	3

OPEN ELECTIVE - I (IV SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEE101	Introduction to PLC Programming	OE	3	3	0	0	3
2.	OCS103	Introduction to Cloud Computing	OE	3	3	0	0	3
3.	OCS104	Fundamentals of Database Design	OE	3	3	0	0	3
4.	OEC101	Introduction to Signals and Systems	OE	3	3	0	0	3
5.	OME101	Automotive Systems	OE	3	3	0	0	3

6.	OEI101	Sensors and Transducers	OE	3	3	0	0	3
7.	OEI104	Internet of Things	OE	3	3	0	0	3
8.	OCE101	Air Pollution and Control	OE	3	3	0	0	3

OPEN ELECTIVE - II (VII SEMESTER)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OEE102	Drone Technologies	OE	3	3	0	0	3
2.	OEE103	Industrial IoT and Industry 4.0	OE	3	3	0	0	3
3.	OCS105	Data Analytics with R Programming	OE	3	3	0	0	3
4.	OCS106	Data Communications and Networking	OE	3	3	0	0	3
5.	OEC102	Communication Systems	OE	3	3	0	0	3
6.	OME102	Design of Experiments	OE	3	3	0	0	3
7.	OME105	Product Design and Development	OE	3	3	0	0	3
8.	OME106	Testing of Materials	OE	3	3	0	0	3
9.	OME107	Vibration and Noise Control	OE	3	3	0	0	3
10.	OCH102	Process Modelling and Simulation	OE	3	3	0	0	3
11.	OMB101	Total Quality Management	OE	3	3	0	0	3

AUDIT COURSE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC		2	0	0	0
2.	AD1002	Value Education	AC		2	0	0	0
3.	AD1003	Pedagogy Studies	AC		2	0	0	0
4.	AD1004	Stress Management by Yoga	AC		2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC		2	0	0	0
6.	AD1006	Unnat Bharat Abhiyan	AC		2	0	0	0
7.	AD1007	Essence of Indian knowledge Tradition	AC		2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC		2	0	0	0

SUMMARY

B.E.-ELECTRICAL AND ELECTRONICS ENGINEERING											
S.No	Subject Area	Credits Per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1.	HSMC	4	7	--	1	--	--	--	--	**12**	**6.59**
2.	BSC	12	7	4	4	--	--	--	--	**27**	**14.83**
3.	ESC	9	5	--	4	--	8	--	--	**26**	**14.28**
4.	PCC	--	5	19	13	18	11	15	--	**81**	**44.50**
5.	PEC	--	--	--	--	3	3	3	6	**15**	**8.24**
6.	OEC	--	--	--	3	--	--	3	--	**6**	**3.29**
7.	EEC	--	--	--	--	1	2	2	10	**15**	**8.24**
8.	AC	--	--	--	--	--	--	--	--	**--**	**--**
	TOTAL	**25**	**24**	**23**	**25**	**22**	**24**	**23**	**16**	**182**	**100**

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DEPARTMENT OF CIVIL ENGINEERING

B.E. CIVIL ENGINEERING

CURRICULUM & SYLLABUS
(1st to 8th Semester)

under

REGULATIONS 2021

(Approved in the Fourth Board of Studies meeting held on 9th May 2024 and Academic Council Meeting held on 25th May 2024)

FOR THE STUDENTS ADMITTED IN THE
ACADEMIC YEAR 2021 - 2022

DEPARTMENT OF CIVIL ENGINEERING

B.E. CIVIL ENGINEERING

REGULATIONS – 2021

(CHOICE BASED CREDIT SYSTEM)

CURRICULUM AND SYLLABI

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO:1 Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO:2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO:3 Design/development of solutions: Design solution for complex engineering problems and design systems components or process that meet the specified needs with appropriate consideration for the public health and safety , and the cultural, societal, and environmental considerations.

PO:4 Conduct investigations of complex problems: Use research- based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO:5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO:6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO:7 Environmental and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO:8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO:9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO:10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as , being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO:11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work , as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO:12 Life-Long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Engineering Graduates will be able to

PEO:1 Graduates of the programme will apply principles of basic and engineering sciences in analysis, design and operation of Civil Engineering systems

PEO:2 Graduates of the programme will contribute to the development of sustainable Infrastructure for the betterment of society.

PEO:3 Graduates of the programme will engage in lifelong learning and adapt to changing professional and societal needs with focus on research & development and industry interaction.

PEO:4 Graduates of the programme will discharge their duties as professional Civil Engineers with quality and ethics.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO 1: The students graduating in Civil Engineering will have profound foundation in Mathematical, Scientific and Engineering domains necessary to achieve professional and productive excellence in technical and non-technical problem solving and analyzing engineering problems.

PSO 2: The students graduating in Civil Engineering will have the ability to Create, select, and apply appropriate techniques, resources, and modern engineering tools such as CAD, STAAD-Pro and GIS including prediction and modelling to complex Civil Engineering activities with an understanding of the limitations.

PSO 3: The students graduating in Civil Engineering will have the ability to Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage Civil Engineering projects and in multidisciplinary environments.

Vision of the Department

To educate the new generation Civil Engineers to meet the future technological needs by imparting sound technical knowledge and to improve professional leadership and management quality in public service.

Mission of the Department

- To enhance and enrich the technical knowledge in civil engineering through teaching-learning process.
- To educate the students about the significance of professional and ethical practices.
- To facilitate the understanding and implementation of innovative ideas through research and development.
- To develop personal competence among students which will improve their entrepreneurial and managerial skills.

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DEPARTMENT OF CIVIL ENGINEERING

B.E. CIVIL ENGINEERING

REGULATIONS – 2021

(CHOICE BASED CREDIT SYSTEM)

CURRICULUM AND SYLLABI

FOR THE STUDENTS ADMITTED IN THE ACADEMIC YEAR 2021 - 2022

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English **(Common for all Branches of B.E. / B. Tech Programmes)**	HSC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I **(Common for all Branches of B.E. / B. Tech Programmes)**	BSC	4	3	1	0	4
3	PH1103	Engineering Physics **(Common for all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry **(Common for all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming **(Common for all Branches of B.E. / B. Tech Programmes)**	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics **(Common for all Branches of B.E. / B. Tech Programmes)**	ESC	6	2	0	4	4
PRACTICAL								
8	GE1107	Python Programming Laboratory **(Common for all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
9	BS1108	Physics and Chemistry Laboratory **(Common for all Branches of B.E. / B. Tech Programmes)**	BSC	4	0	0	4	2
Total				**30**	**17**	**1**	**12**	**24**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English **(Common for all Branches of B.E. / B. Tech Programmes)**	HSC	3	3	0	0	3
2	MA1202	Engineering Mathematics -II **(Common for all Branches of B.E. / B. Tech Programmes Except AI-DS& AI-ML)**	BSC	4	3	1	0	4
3	PH1251	Physics for Civil Engineering	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering **(Common for all Branches of B.E. / B. Tech Programmes)**	HSC	3	3	0	0	3
5	BE1253	Basic Electrical and Electronics Engineering	ESC	3	3	0	0	3
6	GE1206	Engineering Mechanics **(Common for Civil & Mechanical)**	ESC	4	3	1	0	4
PRACTICAL								
7	GE1207	Engineering Practices Laboratory **(Common for all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
8	CE1208	Computer aided drafting Laboratory	PCC	4	0	0	4	2
Total				**28**	**18**	**2**	**8**	**24**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1301	Transforms and Partial Differential Equations	BSC	4	3	1	0	4
2	CE1302	Engineering Geology and Construction Materials	PCC	3	3	0	0	3
3	CE1303	Strength of Materials	PCC	3	3	0	0	3
4	CE1304	Concrete Technology	PCC	3	3	0	0	3
5	CE1305	Fluid Mechanics	PCC	3	3	0	0	3
6	CE1306	Surveying	PCC	3	3	0	0	3
PRACTICAL								
7	CE1307	Strength of Materials Laboratory	PCC	4	0	0	4	2
8	CE1308	Surveying laboratory	PCC	4	0	0	4	2
Total				**27**	**18**	**1**	**8**	**23**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1455	Numerical Methods	BSC	4	3	1	0	4
2	CE1402	Water Supply Engineering	PCC	3	3	0	0	3
3	CE1403	Highway Engineering	PCC	3	3	0	0	3
4	CE1404	Applied Hydraulic Engineering	PCC	3	3	0	0	3
5	CE1405	Structural Analysis – I	PCC	3	3	0	0	3
6	CE1406	Geotechnical Engineering - I	PCC	3	3	0	0	3
PRACTICAL								
7	CE1407	Advanced Surveying Laboratory	PCC	4	0	0	4	2
8	CE1408	Hydraulic Engineering Laboratory	PCC	4	0	0	4	2
9	HS1310	Professional Skills laboratory	EEC	1	0	0	1	1
Total				**28**	**18**	**1**	**9**	**24**

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CE1501	Structural Analysis – II	PCC	3	3	0	0	3
2	CE1502	Geotechnical Engineering - II	PCC	3	3	0	0	3
3	CE1503	Railways, Airports and Harbour Engineering	PCC	3	3	0	0	3
4	CE1504	Wastewater Engineering	PCC	3	3	0	0	3
5	CE1505	Design of Reinforced Concrete Elements	PCC	3	3	0	0	3
6		Professional Elective – I	PEC	3	3	0	0	3
PRACTICAL								
7	CE1507	Environmental Engineering Laboratory	PCC	4	0	0	4	2
8	CE1508	Soil Mechanics Laboratory	PCC	4	0	0	4	2
Total				**26**	**18**	**0**	**8**	**22**

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CE1601	Irrigation Engineering	PCC	3	3	0	0	3
2	CE1602	Construction Management	PCC	3	3	0	0	3
3	CE1603	Design of Steel Structures	PCC	3	3	0	0	3
4		Professional Elective – II	PEC	3	3	0	0	3
5		Professional Elective – III	PEC	3	3	0	0	3
6		Open Elective – I	OEC	3	3	0	0	3
PRACTICAL								
7	CE1607	Construction Materials and Highway Engineering Laboratory	PCC	4	0	0	4	2
8	CE1608	Irrigation and Environmental Engineering Drawing	PCC	4	0	0	4	2
Total				**26**	**18**	**0**	**8**	**22**
9	CVAxxx	Value Added Course (6^{th} / 7^{th} / 8^{th} Semester)		One Week	0	0	0	2

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	CE1701	Estimation, Costing and Valuation Engineering	PCC	3	3	0	0	3
2	CE1702	Structural Design and Drawing (Lab Integrated)	PCC	5	3	0	2	4
3		Open Elective – II	OEC	3	3	0	0	3
4		Professional Elective – IV	PEC	3	3	0	0	3
5		Professional Elective – V	PEC	3	3	0	0	3
PRACTICAL								
6	CE1707	Summer Internship / Industrial training # (2 weeks during 6th Semester – Summer)	EEC	0	0	0	0	1
7	CE1708	Design Project	EEC	4	0	0	4	2
8	CE1709	Survey Training #	EEC	2	0	0	2	1
MANDATORY COURSE								
9	AD100X	Audit Course $	AC	2	2	0	0	-
Total				**25**	**17**	**0**	**8**	**20**

 # Evaluation is fully internal **$ Non-Credit Course**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective – VI	PEC	3	3	0	0	3
2		Professional Elective – VII	PEC	3	3	0	0	3
PRACTICAL								
3	CE1807	Project Work	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

COURSE CREDITS – SEMESTER WISE

Branch	I	II	III	IV	V	VI	VII	VIII	TOTAL
Civil	24	24	23	24	22	22	20	16	175

CHAIRMAN - BOS **DEAN ACADEMICS** **PRINCIPAL**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1001	Remote Sensing	PEC	3	3	0	0	3
2	CE1002	Geographic Information System	PEC	3	3	0	0	3
3	CE1003	Geo informatics Applications for Civil Engineers	PEC	3	3	0	0	3
4	CE1004	Advanced Surveying Techniques	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE - II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1005	Air Pollution and Control Engineering	PEC	3	3	0	0	3
2	CE1006	Environmental and Social Impact Assessment	PEC	3	3	0	0	3
3	CE1007	Industrial Wastewater Treatment	PEC	3	3	0	0	3
4	CE1008	Municipal Solid Waste Management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE - III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1009	Pavement Engineering	PEC	3	3	0	0	3
2	CE1010	Traffic Engineering and Management	PEC	3	3	0	0	3
3	CE1011	Transportation Planning and Systems	PEC	3	3	0	0	3
4	CE1012	Urban Planning and Development	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1013	Hydrology and Water Resources Engineering	PEC	3	3	0	0	3
2	CE1014	Integrated Water Resources Management	PEC	3	3	0	0	3
3	CE1015	Groundwater Engineering	PEC	3	3	0	0	3
4	CE1016	Water Resources Systems Engineering	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE - V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1017	Design of Plate and Shell Structures	PEC	3	3	0	0	3
2	CE1018	Prestressed Concrete Structures	PEC	3	3	0	0	3
3	CE1019	Industrial Structures	PEC	3	3	0	0	3
4	CE1020	Maintenance, Repair and Rehabilitation of Structures	PEC	3	3	0	0	3
5	CE1021	Powerplant Structures	PEC	3	3	0	0	3
6	CE1022	Prefabricated Structures	PEC	3	3	0	0	3
7	CE1023	Tall Structures	PEC	3	3	0	0	3
8	CE1024	Aseismic Design of Structures	PEC	3	3	0	0	3
9	CE1025	Disaster management	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE - VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1026	Geo-Environmental Engineering	PEC	3	3	0	0	3
2	CE1027	Ground Improvement Techniques	PEC	3	3	0	0	3
3	CE1028	Soil Dynamics and Machine Foundations	PEC	3	3	0	0	3
4	CE1029	Rock Mechanics	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE - VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	CE1030	Coastal Engineering	PEC	3	3	0	0	3
2	CE1031	Coastal Zone Management	PEC	3	3	0	0	3
3	CE1032	Global Climate Change	PEC	3	3	0	0	3
4	CE1033	Climate Change and Vulnerability Assessment	PEC	3	3	0	0	3

LIST OF OPEN ELECTIVES

OPEN ELECTIVE - I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OME103	Energy Conservation in Thermal and Electrical Utilities	OEC	3	3	0	0	3
2	OCH103	Environment and Agriculture	OEC	3	3	0	0	3
3	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
4	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
5	OME107	Vibration and Noise Control	OEC	3	3	0	0	3

OPEN ELECTIVE - II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OCH104	Textile effluent treatments	OEC	3	3	0	0	3
2	OEI102	Robotics	OEC	3	3	0	0	3
3	OME104	Industrial Safety Engineering	OEC	3	3	0	0	3
4	OCS101	Introduction to C Programming	OEC	3	3	0	0	3
5	OME106	Testing of Materials	OEC	3	3	0	0	3

AUDIT COURSE

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	AC	2	2	0	0	0
2	AD1002	Value Education	AC	2	2	0	0	0
3	AD1003	Pedagogy Studies	AC	2	2	0	0	0
4	AD1004	Stress Management by Yoga	AC	2	2	0	0	0
5	AD1005	Personality Development Through Life Enlightenment Skills	AC	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	AC	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	AC	2	2	0	0	0
8	AD1008	Sanga Tamil Literature Appreciation	AC	2	2	0	0	0

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	OCE101	Air Pollution and Control	OEC	3	3	0	0	3
2	OCE102	Introduction to Geographic Information System	OEC	3	3	0	0	3
3	OCE103	Environmental impact assessment	OEC	3	3	0	0	3
4	OCE104	Green Building Design	OEC	3	3	0	0	3

VALUE ADDED COURSES

S.No.	COURSE CODE	COURSE TITLE	L	T	P	C
1	CVA001	Construction Technology	2	0	0	2
2	CVA002	AUTOCAD	1	0	2	2
3	CVA003	Structural Analysis and Design	1	0	2	2
4	CVA004	3D’s MAX	1	0	2	2
5	CVA005	STAAD PRO Analysis and Design	1	0	2	2
6	CVA006	Project Management using Primavera	1	0	2	2
7	CVA007	TEKLA Structures	1	0	2	2
8	CVA008	E TABS Software	1	0	2	2
9	CVA009	Building Modelling using 3D Revit Architecture	1	0	2	2
10	CVA010	Advanced Field Surveying	1	0	2	2
11	CVA011	Building information modelling and MS Project	2	0	0	2
12	CVA012	Practical Valuation	2	0	0	2
13	CVA013	Vastu in Construction	2	0	0	2
14	CVA014	Automation in Construction	2	0	0	2
15	CVA015	Green Building Concepts	2	0	0	2
16	CVA016	Interior Design	2	0	0	2
17	CVA017	In-Situ Soil testing and instrumentation	2	0	0	2
18	CVA018	Architectural Acoustics	2	0	0	2
19	CVA019	Smart Cities	2	0	0	2
20	CVA020	Forensic Civil Engineering	2	0	0	2

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	**SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS**	**9**
Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		**CO1**
UNIT II	**GENERAL READING AND FREE WRITING**	**9**
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.		**CO2**
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		**CO3**
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	**9**
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		**CO4**
UNIT V	**EXTENDED WRITING**	**9**
Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	-	-	1
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	1	1
CO3	-	2	-	3	-	-	-	-	-	2	-	-	1	1	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	1	-	1
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	1	1

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	1	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		**CO1**
UNIT II	**CALCULUS OF ONE VARIABLE**	**12**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		**CO2**
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.		**CO3**
UNIT IV	**INTEGRAL CALCULUS**	**12**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		**CO4**
UNIT V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS
1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016. 2. Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007. 3. Narayanan, S. and Manicavachagom Pillai, T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007. 4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015. 5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**	**1**	**2**	**3**	**-**	**-**	**3**	**2**	**3**	**3**	1	2	1
CO2	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	1	-	1
CO3	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	2	1	1
CO4	**3**	**3**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	1	1	1
CO5	**3**	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	2	2	2

<table>
<tr><td>PH1103</td><td>ENGINEERING PHYSICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td>(Common for all branches of B.E. / B. Tech Programmes)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">OBJECTIVES
❖ To make the students to understand about the elastic property and stress strain diagram.
❖ To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
❖ To teach the students about the heat transfer through solids and liquids.
❖ To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
❖ To make the students to understand the importance of various crystal structures and various growth techniques.</td></tr>
<tr><td>UNIT I</td><td colspan="4">PROPERTIES OF MATTER</td><td>9</td></tr>
<tr><td colspan="5">Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">LASER AND FIBER OPTICS</td><td>9</td></tr>
<tr><td colspan="5">Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">THERMAL PHYSICS</td><td>9</td></tr>
<tr><td colspan="5">Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="4">QUANTUM PHYSICS</td><td>9</td></tr>
<tr><td colspan="5">Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td colspan="4">CRYSTAL PHYSICS</td><td>9</td></tr>
<tr><td colspan="5">Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).</td><td>CO5</td></tr>
<tr><td colspan="6" align="right">TOTAL : 45 PERIODS</td></tr>
</table>

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2019.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	2	2	1
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	2	2

<table>
<tr><td>CY1104</td><td>ENGINEERING CHEMISTRY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td>(Common for all branches of B.E. / B. Tech Programmes)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">OBJECTIVES
❖ Principles of water characterization and treatment for industrial purposes.
❖ Principles and applications of surface chemistry and catalysis.
❖ Phase rule and various types of alloys.
❖ Various types of fuels, applications and combustion.
❖ Conventional and non–conventional energy sources and energy storage device.</td></tr>
<tr><td>UNIT I</td><td colspan="4">WATER AND ITS TREATMENT</td><td>9</td></tr>
<tr><td colspan="5">Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">SURFACE CHEMISTRY AND CATALYSIS</td><td>9</td></tr>
<tr><td colspan="5">Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC.
Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">PHASE RULE AND ALLOYS</td><td>9</td></tr>
<tr><td colspan="5">Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process.
Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="4">FUELS AND COMBUSTION</td><td>9</td></tr>
<tr><td colspan="5">Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel.
Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td colspan="4">NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES</td><td>9</td></tr>
<tr><td colspan="5">Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.</td><td>CO5</td></tr>
</table>

TOTAL : 45 PERIODS

TEXT BOOKS
1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).   2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).   3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).   4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).
REFERENCE BOOKS
1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).   2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).   3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).   4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).   5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media., New Delhi., (2010).   6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	1	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	1	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		**CO1**
UNIT II	**INTRODUCTION TO PYTHON**	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		**CO2**
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		**CO4**
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist ", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, — An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	2	0	4	4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	2	2	-
CO2	3	1	2	2	1	1	-	-	3	3	2	3	2	2	-
CO3	3	1	1	3	1	1	-	-	3	3	2	3	2	2	-
CO4	3	1	1	3	1	1	-	-	3	3	2	3	2	2	-
CO5	3	1	2	3	1	1	-	-	3	3	2	3	2	2	-

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.	CO1
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	CO2
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	CO3
11. Demonstrate Exceptions in Python.	
12. Applications**:** Implementing GUI using turtle, pygame.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES

1. http://www.edx.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	2	3

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
(Common for all branches of B.E. / B. Tech Programmes)		0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of wavelength of mercury spectra using Spectrometer and grating.
4. Determination of dispersive power of prism using Spectrometer.
5. (a) Determination of wavelength and particle size using a laser.
   (b) Determination of numerical aperture and acceptance angle of an optical fibre.
   (c) Determination of width of the groove of compact disc using laser.
6. Determination of Young's modulus of the material of the given beam by uniform bending method.
7. Determination of energy band gap of the semiconductor.
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method

LIST OF EXPERIMENTS - CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Estimation of HCl using Na2CO3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Conductometric titration of strong acid vs strong base.

DEMONSTRATION EXPERIMENTS

1. Estimation of iron content of the water sample using spectrophotometer (1,10- Phenanthroline / thiocyanate method).
2. Estimation of sodium and potassium present in water using flame photometer.

COURSE OUTCOMES **Upon completion of the course, the students should be**	
CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli. Able to understand the procedure to estimate the amount of dissolved oxygen present in the water.
CO2	Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating. Able to understand the concept about measuring the conductance of strong acid and strong base and mixture of acids by using conductivity meter.
CO3	Able to understand the thermal properties of solids and to calculate thermal conductivity of a bad conductor. Able to understand the principle and procedure involved in the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of microscope and its applications in determining the moduli. Able to understand the concept of determining the emf values by using potentiometer.
CO5	Able to calculate the particle size of poly crystalline solids. Able to understand the concept of determining the pH value and strength of a given acid sample by using pH meter.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	1	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	1	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	1	2
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	2	1
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	2	1

<table>
<tr><td>HS1201</td><td colspan="2">PROFESSIONAL ENGLISH</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3">(Common for all branches of B.E. / B. Tech Programmes)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
❖ Foster their ability to write convincing job applications and effective reports.
❖ Develop their speaking skills to make technical presentations, participate in group discussions.
❖ Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO PROFESSIONAL ENGLISH</td><td>9</td></tr>
<tr><td colspan="6">Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations- Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="5">READING AND STUDY SKILLS</td><td>9</td></tr>
<tr><td colspan="6">Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="5">TECHNICAL WRITING AND GRAMMAR</td><td>9</td></tr>
<tr><td colspan="6">Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.</td><td>CO3</td></tr>
<tr><td>UNIT IV</td><td colspan="5">REPORT WRITING</td><td>9</td></tr>
<tr><td colspan="6">Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.</td><td>CO4</td></tr>
<tr><td>UNIT V</td><td colspan="5">GROUP DISCUSSION AND JOB APPLICATIONS</td><td>9</td></tr>
<tr><td colspan="6">Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.</td><td>CO5</td></tr>
<tr><td colspan="7" align="right">TOTAL : 45 PERIODS</td></tr>
</table>

TEXT BOOKS	
	1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020. 2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006. 3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.
REFERENCE BOOKS	
	1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014. 2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015 3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014. 4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007 5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007. 6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021. 7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	1	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	1	-	2
CO4	-	-	-	-	-	-	-	-	2	2	-	-	1	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1202	ENGINEERING MATHEMATICS - II	L	T	P	C
(Common for all branches of B.E. / B. Tech Programmes Except AI-DS & AI-ML)		3	1	0	4

OBJECTIVES

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform.
- The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines

UNIT I	ORDINARY DIFFERENTIAL EQUATIONS	12
Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous linear differential equations with constant coefficients		**CO1**
UNIT II	**VECTOR CALCULUS**	**12**
Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and application in evaluating line, surface and volume integrals		**CO2**
UNIT III	**COMPLEX VARIABLES**	**12**
Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function – Conformal mapping – Mapping by functions $w = Z + C$, CZ, $1/Z$ - Bilinear transformation		**CO3**
UNIT IV	**COMPLEX INTEGRATION**	**12**
Cauchy‘s integral theorem – Cauchy‘s integral formula – Taylor‘s and Laurent‘s series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi circular contour(excluding poles on the real line)		**CO4**
UNIT V	**LAPLACE TRANSFORMS**	**12**
Existence conditions – Transforms of elementary functions –Basic properties – Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals –– Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients		**CO5**

TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016

REFERENCE BOOKS	

1. G Bali N., Goyal M. and Watkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., ― Advanced Engineering Mathematics ‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. ―Advanced Engineering Mathematics‖, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, ―Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd,4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics – II, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course,

CO1	The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems
CO2	The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrotational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.
CO3	The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
CO4	The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.
CO5	Students will understand the purpose of using transforms to create new domain which can give easier ways to handle the problem that is being investigated.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	0	0	0	0	1	2	2	1	2
CO2	3	3	3	1	1	1	0	0	0	0	2	1	1	1	1
CO3	3	3	3	2	1	1	0	1	0	0	1	1	2	1	2
CO4	3	3	3	1	0	0	0	0	0	0	1	0	1	2	2
CO5	3	3	3	1	0	0	0	0	0	0	1	0	2	1	1

PH1252	PHYSICS FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the principles of thermal, acoustics, optics and new materials for civil engineering applications.

UNIT I	THERMAL PERFORMANCE OF BUILDINGS	9
Heat transfer through fenestrations, thermal insulation and its benefits- heat gain and heat loss estimation - factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices-central heating. Principles of natural ventilation- ventilation measurements, design for natural ventilation-Window types and packaged air conditioners-chilled water plant-fan coil systems-Water piping –cooling load-Air conditioning systems for different types of buildings-Protection against fire to be caused by A.C. Systems.		**CO1**
UNIT II	**ACOUSTICS**	**9**
Classification of sound-decibel- Weber–Fechner law–Sabine's formula- derivation using growth and decay method– Absorption Coefficient and its determination–factors affecting acoustics of buildings and their remedies. Methods of sound absorptions-absorbing materials-noise and its measurements, sound insulation and its measurements, impact of noise in multi-storeyed buildings.		**CO2**
UNIT III	**LIGHTING DESIGNS**	**9**
Radiation quantities–spectral quantities– photometry: cosines law, inverse square law. Vision–photobic, mesophic, scotopic visions - Vision Defects (near-sightedness, farsightedness, Presbyobia, astigmatism, higher order defects(aberrations)) - Colour–luminous efficiency function- Visual field glare, colour- day light calculations-daylight design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting, supplementary artificial lighting – lighting for different buildings.		**CO3**
UNIT IV	**NEW ENGINEERING MATERIALS**	**9**
Composites- definition and classification-Fibre reinforced plastics (FRP) and fibre reinforced metals(FRM)-Metallic glasses-Shape memory alloys-Ceramics-Classification-Crystalline- Non Crystalline-Bonded ceramics, Manufacturing methods- Slip casting- Isostatic pressing- Gas pressure bonding- Properties- thermal, mechanical, electrical and chemical ceramic fibres-ferroelectric and ferromagnetic ceramics- High Aluminium ceramics- Polymer nanocomposites in construction.		**CO4**
UNIT V	**HAZARDS**	**9**
Seismology and Seismic waves-Earth quake ground motion-Basic concepts and estimation techniques- site effects- Cyclone and flood hazards-Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment –Prevention and safety measures - Disaster Management: Fundamental concept of Disaster Management, government, NGOs and peoples participation disaster management		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Alexander, D. "Natural disaster", Springer (1993).
2. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2009.
3. Severns, W.H. & Fellows, J.R. "Air conditioning and Refrigeration", John Wiley and Sons, London, 1988.
4. Stevens, W.R., "Building Physics: Lighting: Seeing in the Artificial Environment, Pergaman Press, 2013.

REFERENCE BOOKS

1. Gaur R.K. and Gupta S.L., Engineering Physics. Dhanpat Rai publishers, 2012.
2. Reiter, L. "Earthquake hazard analysis – Issues and insights", Columbia University Press, 1991.
3. Shearer, P.M. "Introduction to Seismology", Cambridge University Press, 1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Knowledge on the thermal performance of buildings,
CO2	Knowledge on the acoustic properties of buildings,
CO3	Knowledge on various lighting designs for buildings,
CO4	Knowledge on the properties and performance of engineering materials,
CO5	Knowledge on the hazards of buildings and disaster management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	2	3	3	3	3	3	1	-	2
CO2	3	3	3	3	2	3	2	3	2	2	3	2	1	-	2
CO3	3	3	3	3	3	2	2	3	3	3	2	3	1	-	2
CO4	3	2	2	2	2	2	3	2	2	3	3	3	1	-	2
CO5	2	2	3	3	2	3	2	3	3	3	3	3	1	-	2

<table>
<tr><td>GE1204</td><td>ENVIRONMENTAL SCIENCE AND ENGINEERING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="2">(Common for all branches of B.E. / B. Tech Programmes)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">OBJECTIVES
❖ To study the inter relationship between living organism and environment.
❖ To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
❖ To find and implement scientific, technological, economic and political solutions to environmental problems.
❖ To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
❖ To study the dynamic processes and understand the features of the earth's interior and surface.</td></tr>
<tr><td>UNIT I</td><td colspan="4">ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY</td><td>9</td></tr>
<tr><td colspan="5">Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega–diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity.</td><td>CO1</td></tr>
<tr><td>UNIT II</td><td colspan="4">ENVIRONMENTAL POLLUTION</td><td>9</td></tr>
<tr><td colspan="5">Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.</td><td>CO2</td></tr>
<tr><td>UNIT III</td><td colspan="4">NATURAL RESOURCES</td><td>9</td></tr>
<tr><td colspan="5">Forest resources: Use and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Use and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.</td><td>CO3</td></tr>
</table>

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		**CO4**
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	3	3	3	3	3	2	2	2	3	3	1	1
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	1	3
CO3	3	3	2	2	3	3	2	2	1	2	1	3	1	2	1
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	3	3
CO5	3	2	3	2	3	3	3	2	2	2	2	3	1	2	1

BE1253	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To explain the basic laws used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics.
- To impart knowledge of communication.

UNIT I	**ELECTRICAL CIRCUITS & MEASURMENTS**	**9**
Fundamental laws of electric circuits– Steady State Solution of DC Circuits – Introduction to AC Circuits –Sinusoidal steady state analysis– Power and Power factor – Single Phase and Three Phase Balanced Circuits. Classification of instruments – Operating Principles of indicating Instruments.		**CO1**
UNIT II	**ELECTRICAL MACHINES**	**9**
Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.		**CO2**
UNIT III	**SEMICONDUCTOR DEVICES AND APPLICATIONS**	**9**
Introduction - Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation-Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics.		**CO3**
UNIT IV	**DIGITAL ELECTRONICS**	**9**
Binary Number System – Boolean Algebra theorems– Logic Gates, Digital circuits – Combinational circuits- Half adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer/ Demultiplexer, Introduction to sequential Circuits– Flip-Flops – Registers and Counters.		**CO4**
UNIT V	**FUNDAMENTALS OF COMMUNICATION ENGINEERING**	**9**
Introduction – Elements of Communication Systems– Need for Modulation, Principles of Amplitude and Frequency Modulations- Communication Systems: TV, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mittle N., “Basic Electrical Engineering”, Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., “Applied Electronics”, S. Chand & Co., 2006.

REFERENCE BOOKS

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, 2006.
2. Nagsarkar T K and Sukhija M S, “Basics of Electrical Engineering”, Oxford press 2005.
3. Mehta V K, “Principles of Electronics”, S.Chand & Company Ltd, 1994.
4. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
5. Premkumar N, “Basic Electrical Engineering”, Anuradha Publishers, 2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to understand the basic laws used in Electrical circuits and principle of measuring Instruments.
CO2	Ability to identify the electrical components explain the characteristics of electrical machines.
CO3	Ability to identify semiconductor devices and its applications.
CO4	Understand the design principles of digital electronics circuits.
CO5	Able to impart the knowledge of various communication systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	1	1	1	1	1	3	2	2
CO2	3	3	1	1	1	1	1	1	1	1	1	2	3	2	2
CO3	3	3	3	1	3	3	2	1	2	2	3	3	3	2	2
CO4	3	3	3	2	1	2	2	2	2	2	3	3	3	2	2
CO5	3	3	2	1	2	1	1	1	1	2	2	3	3	2	2

GE1206	ENGINEERING MECHANICS	L	T	P	C
	(Common to Civil and Mechanical Engineering)	3	1	0	4

OBJECTIVES

- To develop capacity to predict the effect of force.
- To develop motion in the course of carrying out the design functions of Engineering.

UNIT I	**STATICS OF PARTICLES**	**9+3**
Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces - additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.		**CO1**
UNIT II	**EQUILIBRIUM OF RIGID BODIES**	**9+3**
Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.		**CO2**
UNIT III	**PROPERTIES OF SURFACES AND SOLIDS**	**9+3**
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.		**CO3**
UNIT IV	**DYNAMICS OF PARTICLES**	**9+3**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		**CO4**
UNIT V	**FRICTION AND RIGID BODY DYNAMICS**	**9+3**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere		**CO5**

TOTAL : 45 + 15 PERIODS

TEXT BOOKS

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi(2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press(2010).

REFERENCE BOOKS

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers,1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley &Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	illustrate the vectorial and scalar representation of forces and moments
CO2	analyse the rigid body in equilibrium
CO3	evaluate the properties of surfaces and solids
CO4	calculate dynamic forces exerted in rigid body
CO5	determine the friction and the effects by the laws of friction

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	-	1	2	1	-	2	3	2	2	3	2	-
CO2	3	3	2	-	1	2	1	-	2	3	2	2	3	2	-
CO3	3	3	1	-	1	2	1	-	2	3	2	2	3	2	-
CO4	3	3	1	-	1	2	1	-	2	3	2	2	3	2	-
CO5	3	3	1	-	1	2	1	-	2	3	2	2	3	2	-

<table>
<tr><td>GE1207</td><td colspan="2">ENGINEERING PRACTICES LABORATORY</td><td>L</td><td>P</td><td>T</td><td>C</td></tr>
<tr><td colspan="3">(Common for all branches of B.E. / B. Tech Programmes)</td><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering</td></tr>
<tr><td colspan="7">LIST OF EXPERIMENTS</td></tr>
<tr><td colspan="7">GROUP A (CIVIL & MECHANICAL)</td></tr>
<tr><td>I</td><td colspan="2">CIVIL ENGINEERING PRACTICE
Buildings:
(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.
Plumbing Works:
(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
(e) Demonstration of plumbing requirements of high-rise buildings.
Carpentry using Power Tools only:
(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.</td><td colspan="2">13</td><td colspan="2">CO1</td></tr>
<tr><td>II</td><td colspan="2">MECHANICAL ENGINEERING PRACTICE
Welding:
(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice
Basic Machining:
(a) Simple Turning and Taper turning
(b) Drilling Practice
Sheet Metal Work:
(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.
Machine assembly practice:
(a) Study of centrifugal pump
(b) Study of air conditioner
Demonstration on:
(a) Smithy operations, upsetting, swaging, setting down and bending. Example –Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.</td><td colspan="2">18</td><td colspan="2">CO2</td></tr>
</table>

GROUP B (ELECTRICAL & ELECTRONICS)	
III ELECTRICAL ENGINEERING PRACTICE 13 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	**CO3**
5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.	**CO4**
IV ELECTRONICS ENGINEERING PRACTICE 16 1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	**CO5**
TOTAL: 60 PERIODS	

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	**15 sets**
2.	Carpentry vice (fitted to work bench)	**15 Nos**
3.	Standard woodworking tools 15 Sets.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	**5 Nos**
2.	Welding booth with exhaust facility.	**5 Nos**
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	**5 Sets**
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	**2 Nos**

5.	Centre lathe.	**2 Nos**
6.	Hearth furnace, anvil and smithy tools.	**2 Sets**
7.	Moulding table, foundry tools.	**2 Sets**
8.	Power Tool: Angle Grinder.	**2 Nos**
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	**1 each**
	ELECTRICAL	
1.	Assorted electrical components for house wiring.	**15 Sets**
2.	Electrical measuring instruments.	**10 Sets**
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	**1 each**
4.	Megger (250V/500V).	**1 No.**
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	3	-	-	-	-	-	3	1	-	-
CO2	3	2	3	-	-	3	-	-	-	-	-	3	1	-	-
CO3	3	1	2	-	-	2	-	-	-	-	-	3	1	-	-
C04	3	1	3	-	-	3	-	-	-	-	-	3	1	-	-
C05	3	2	2	-	-	2	-	-	-	-	-	3	1	-	-

CE1208	COMPUTER AIDED DRAFTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To understand the regulations as per National Building Code and to identify the functional requirements of buildings.
- To make the students learn the various elements of Residential / Institutional / Workshop buildings
- To impart fundamental knowledge on AutoCAD software.
- To enable the student to develop the drafting skills in drawing plan, section and elevation of various types of buildings using AutoCAD software as per National Building Code.

LIST OF EXPERIMENTS

1. Introduction to building Components and Their Functions	CO1
2. Introduction to CAD (Computer Aided Drafting) software, General commands and their practices.	
3. Elevation and cross section of Partly Panelled and Glazed Window	
4. Elevation and cross section of Framed and Panelled Double Leaf Door	
5. Plan and Sectional Elevation of Dog legged staircase	CO2
6. Plan, Section and Elevation of Building with Load Bearing Wall	
7. Plan, Section and Elevation -A Single Bed Room House with R.C.C Roof	
8. Plan, Section and Elevation – Storied residential building with Dog legged staircase	
9. Plan, Section and Elevation of Framed office building	
10. Plan, Section and Elevation of an Industrial building	

TOTAL : 60 PERIODS

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To Develop drafting skills in drawing building components like Doors, windows and staircase using AutoCAD software
CO2	To Develop drafting skills in drawing plan, section and elevation of various types of buildings using AutoCAD software

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	3	3	3	-	-	2	1	-	3	3	3	2
CO2	3	-	-	3	3	3	-	-	2	1	-	3	3	3	2

MA1301	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
	(Common to CIVIL, EEE, EIE, MECH and BIO)	3	1	0	4

OBJECTIVES

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of difference equations that model several physical processes and to develop transform techniques for discrete time systems.

UNIT I	PARTIAL DIFFERENTIAL EQUATIONS	12
Formation of partial differential equations – Singular integrals – Solutions of standard types of first order partial differential equations (except $f(x^m z^k p, y^n z^k q) = 0$) – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types		**CO1**
UNIT II	**FOURIER SERIES**	**12**
Dirichlet's conditions -Necessary and sufficient condition for existence of Fourier series – General Fourier series – Odd and even functions – Half range sine series –Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.		**CO2**
UNIT III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Classification of PDE – Method of separation of variables – Fourier Series Solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.		**CO3**
UNIT IV	**FOURIER TRANSFORMS**	**12**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.		**CO4**
UNIT V	**Z – TRANSFORMS AND DIFFERENCE EQUATIONS**	**12**
Z-transforms – Elementary properties – Inverse Z-transform (using partial fraction and residues) –Initial and final value theorems – Convolution theorem – Formation of difference equations – Solution of difference equations using Z – transform		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
3. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.

REFERENCE BOOKS

1. Dass, H.K., and Er.RajnishVerma, “Higher Engineering Mathematics”, S.Chand Private Ltd.,2011.
2. Peter V.O’Neil, “Advanced Engineering Mathematics”, 7th Edition, Cengage learning,2012
3. James, G., “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2012.
4. Ramana. B.V., “Higher Engineering Mathematics”, McGraw Hill Education Pvt. Ltd, New Delhi,2016.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand how to solve the partial differential equations and apply these concepts in the field of engineering.
CO2	Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two-dimensional heat flow problems and one-dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer, quantum mechanics and also extensively in physical phenomenon.
CO4	Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.
CO5	Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals etc.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	2	0	2	1	2	0	3	1	1
CO2	3	3	2	2	1	2	1	0	1	0	2	0	3	2	1
CO3	3	3	2	2	0	1	0	0	1	0	2	0	3	1	1
CO4	3	2	1	2	1	0	1	1	0	0	3	0	2	2	2
CO5	3	3	2	2	1	0	1	0	2	1	2	0	3	1	2

CE1302	ENGINEERING GEOLOGY AND CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- The students will be able to understand the importance of geological knowledge such as earth, earthquake, volcanism and to apply this knowledge in projects such as dams, tunnels, bridges, roads, airport and harbor.
- To introduce students to various materials commonly used in civil engineering construction and their properties.

UNIT I	**PHYSICAL GEOLOGY**	**9**
Geology in civil engineering – branches of geology – structure of earth and its composition weathering of rocks – scale of weathering – soils - landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics – Earth quakes – Seismic zones in India.		**CO1**
UNIT II	**MINEROLOGY AND PETROLOGY**	**9**
Physical , Chemical and Optical Properties of minerals – Crystal System Physical Properties of Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals. Classification of rocks, Introduction to Index and Engineering properties of rocks. Description, occurrence, engineering properties, Distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist – Test on rocks- Rock Mass Rating (RMR), Rock Quality Designation (RQD), Geological Strength Index (GSI), Q system for rock mass classification.		**CO2**
UNIT III	**STRUCTURAL GEOLOGY AND APPLICATION OF GEOLOGICAL INVESTIGATIONS**	**9**
Geological maps – Attitude of rocks –Study of Geological Structures – folds, faults and joints – relevance to civil engineering. Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings - Hydrogeological investigations and mining - Coastal protection structures. Investigation of Landslides, causes and mitigation- Tsunami – causes and mitigation. Case studies from India.		**CO3**
UNIT IV	**CONSTRUCTION MATERIALS**	**9**
Introduction, Types, Properties, Testing and Applications of -Bricks – stones – sand – cement – concrete – steel – timber.		**CO4**
UNIT V	**MODERN CONSTRUCTION MATERIALS**	**9**
Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geomembranes and Geotextiles for earth reinforcement.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Venkat Reddy. D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2010.
2. Parbin Singh. A "Text book of Engineering and General Geology", Katson publishing house, Ludhiana 2013.

3. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.

REFERENCE BOOKS

1. Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2017.
2. Bell .F.G.. "Fundamentals of Engineering Geology", B.S. Publications. Hyderabad 2011.
3. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
4. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
5. IS383–1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011
6. IS1542–1992: Indian standard specification for sand for plaster, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire the knowledge of the topographical formation, interior earth, gradational activities and weathering and also the theory of plate tectonics which answers the reason for the occurrence of earthquake, landslides in an area.
CO2	Interpret the minerals and Rocks & assess its physical, chemical and mechanical properties.
CO3	Determine geological structures, its exploration and its relevance on Civil Engineering Projects.
CO4	Gain knowledge on the properties and tests to be conducted for various construction materials.
CO5	Introduce the knowledge of modern materials

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	2	-	2	-	-	3	-	-	3	3	-	3
CO2	2	-	-	2	-	2	-	-	2	-	-	2	3	-	3
CO3	3	-	2	2	-	2	-	-	3	-	-	3	3	-	3
CO4	3	-	2	1	-	2	-	-	2	-	-	2	2	-	2
CO5	3	-	2	1	-	2	-	-	2	-	-	2	2	-	2

CE1303	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamental concepts of Stress in simple and complex states.
- To know the mechanism of load transfer in beams and the induced stresses due to simple
- bending and unsymmetrical bending
- To determine the deformation in determinate beams
- To know the basic concepts of analysis of indeterminate beams

UNIT I	**SIMPLE AND COMPOUND STRESSES**	**9**
Stresses in simple and compound bars – Thermal stresses – Elastic constants - Thin cylindrical and spherical shells – Biaxial state of stress – Principal stresses and principal planes – Mohr's circle of stresses - Torsion on circular shafts.		**CO1**
UNIT II	**BENDING OF BEAMS**	**9**
Types of beams and transverse loadings– Shear force and bending moment for Simply supported, cantilever and over-hanging beams - Theory of simple bending – Bending stress distribution –Shear stress distribution		**CO2**
UNIT III	**DEFLECTION OF BEAMS**	**9**
Double Integration method – Macaulay's method – Area moment method – Conjugate beam method - Strain energy method for determinate beams.		**CO3**
UNIT IV	**INDETERMINATE BEAMS**	**9**
Propped Cantilever and Fixed Beams – Fixed end moments reactions, slope and deflection for standard cases of loading –– Continuous beams – support reactions and moments – Theorem of three moments – Shear Force and Bending Moment Diagrams.		**CO4**
UNIT V	**UNSYMMETRICAL BENDING AND THEORIES OF FAILURE**	**9**
Unsymmetrical bending of beams - shear centre - Thick cylinders - Theories of failure – Principal stress, principal strain, shear stress, strain energy and distortion energy theories – application problems.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Vazirani.V.N, Ratwani.M.M, Duggal .S.K Analysis of Structures: Analysis, Design and Detailing of Structures-Vol.1, Khanna Publishers, New Delhi 2014.
2. Rajput.R.K. Strength of Materials, S.Chand& Company Ltd., New Delhi 2014.

REFERENCE BOOKS

1. Irwing H.Shames, James M.Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, New Delhi, 2002
2. Beer. F.P. &Johnston.E.R."Mechanics of Materials", Tata McGraw Hill, Sixth Edition, New Delhi 2010.
3. James M.Gere., Mechanics of Materials, Thomas Canada Ltd., Canada, 2006.
4. Egor. P.Popov, Engineering Mechanics of Solids, Prentice Hall of India, Second Edition New Delhi 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Understand the concepts of stress and strain, principal stresses and principal planes.
CO2	Determine Shear force and bending moment in beams and understand concept of theory of simple bending.
CO3	Calculate the deflection of beams by different methods and selection of method for determining slope or deflection.
CO4	Analyze propped cantilever, fixed beams and continuous beams for external loadings and support settlements.
CO5	Determine the stresses due to Unsymmetrical bending of beams, locate the shear center, and study the various theories of failure

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	3	-	1	1	-	-	2	3	3
CO2	-	2	-	2	2	3	-	-	-	-	-	-	3	2	2
CO3	-	3	3	3	2	3	-	-	-	-	2	-	2	3	3
CO4	-	3	2	2	2	-	-	2	-	-	2	1	2	2	1
CO5	-	-	3	3	-	-	-	2	-	-	2	1	2	2	1

CE1304	CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge to the students on the properties of materials for concrete by suitable tests, mix design for concrete and special concretes

UNIT I	**CONSTITUENT MATERIALS**	**9**
Cement - Different types - Chemical composition and Properties – Hydration of cement - Tests on cement - IS Specifications - Aggregates – Classification - Mechanical properties and tests as per BIS - Grading requirements – Water - Quality of water for use in concrete.		**CO1**
UNIT II	**CHEMICAL AND MINERAL ADMIXTURES**	**9**
Accelerators – Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline - Effects on concrete properties.		**CO2**
UNIT III	**FRESH AND HARDENED PROPERTIES OF CONCRETE**	**9**
Workability - Tests for workability of concrete - Segregation and Bleeding - Determination of strength Properties of Hardened concrete - Compressive strength – split tensile strength - Flexural strength - Stress-strain curve for concrete - Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance.		**CO3**
UNIT IV	**CONCRETE MIX DESIGN**	**9**
Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - BIS Method of Mix Design – ACI Method of Mix Design - Mix Design Examples		**CO4**
UNIT V	**SPECIAL CONCRETES**	**9**
Light weight concretes - foam concrete- self compacting concrete – vacuum concrete - High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete – SIFCON - Shotcrete – Polymer concrete - High performance concrete - Geopolymer Concrete		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003
3. Bhavikatti.S.S, “ Concrete Technology”, I.K.International Publishing House Pvt. Ltd., New Delhi, 2015
4. Santhakumar. A.R., “Concrete Technology”, Oxford University Press India, 2006.

REFERENCE BOOKS

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995
2. Gambhir, M.L; "Concrete Technology", 3rd Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007
3. IS10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.
4. Job Thomas, “Concrete Technology”, Cengage Learning India Pvt. Ltd., Delhi, 2015
5. Kumar P Mehta., Paulo J M Monterio., “Concrete - Microstructure, Properties and Materials”, McGraw Hill Education (India) Private Limited, New Delhi, 2016.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	The various requirements of cement, aggregates and water for making concrete
CO2	The effect of admixtures on properties of concrete
CO3	The properties of concrete at fresh and hardened state
CO4	The concept and procedure of mix design as per IS method
CO5	The importance and application of special concretes.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	-	3	3	3	1	-	1	3	1	2	1
CO2	2	1	3	1	-	3	3	3	1	-	1	3	3	3	3
CO3	2	1	3	1	1	2	3	3	1	-	1	3	2	2	1
CO4	2	1	3	1	-	2	3	3	1	-	1	3	2	2	2
CO5	2	1	1	1	1	3	3	3	1	-	1	3	2	2	3

CE1305	FLUID MECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basic concepts of fluid statics, kinematics and dynamics and enable them to solve practical problems.
- To study about flow through pipes and pipe networks and boundary layer concepts.
- To understand the application of Dimensional analysis in similitude and model study with respect to engineering problems.

UNIT I	**FLUID PROPERTIES AND STATICS**	**10**
Scope of fluid mechanics - Definitions of a fluid - Methods of analysis – Continuum hypothesis - System and Control volume approach – Fluid properties - Fluid statics – Manometry (Simple manometer, Piezometer, U-tube manometer, Differential Manometer: U-Tube Differential manometer, Inverted U-tube differential Manometer) – Forces on plane and curved surfaces - Buoyancy and floatation - Stability of floating bodies.		**CO1**
UNIT II	**BASIC CONCEPTS OF FLUID FLOW**	**10**
Kinematics - Classification of flows - Streamline, streak-line and path-lines - Stream function and velocity potentials - Flow nets; Dynamics - Application of control volume to continuity, energy and momentum - Euler's equation of motion along a stream line - Bernoulli's equation - Applications to velocity and discharge measurements - Linear momentum equation – Application to Pipe bends - Moment-of momentum equation.		**CO2**
UNIT III	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**7**
Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.		**CO3**
UNIT IV	**INCOMPRESSIBLE VISCOUS FLOW**	**10**
Reynolds experiment - Laminar flow in pipes and between parallel plates - Development of laminar and turbulent flows in pipes - Darcy-Weisbach equation - Moody diagram - Major and minor losses of flow in pipes - Pipes in series and parallel – Equivalent pipes.		**CO4**
UNIT V	**BOUNDARY LAYERS**	**9**
Definition of boundary layers - Laminar and turbulent boundary layers - Displacement, momentum and energy thickness - Momentum integral equation - Applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th Ed.) Tata McGraw Hill, New Delhi, 2002.
2. Modi P.N and Seth Hydraulics and Fluid Mechanics including Hydraulic Machines, Standard Book House New Delhi. 2003 (22nd edition, 2019)

REFERENCE BOOKS

1. Bansal R K, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi, 2018.
2. Rajput, R K, "A text book of Fluid Mechanics", S Chand & Co., New Delhi, 2007(Reprint 2019).
3. Subramanya, K, "Fluid Mechanics and Hydraulic Machines Problems and Solutions" Tata McGraw Hill Publishing Company Ltd, New Delhi, 2010.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Demonstrate the difference between solid and fluid, its properties and behaviour in static conditions.
CO2	Apply the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.
CO3	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.
CO4	Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel.
CO5	Explain the concept of boundary layer and its application to find the drag force excreted by the fluid on the flat solid surface.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	3	3	3	-	-	2	1	-	3	3	3	3
CO2	3	-	-	3	3	3	-	-	2	1	-	3	3	3	3
CO3	3	-	-	3	3	3	-	-	2	1	-	3	3	3	3
CO4	3	-	-	3	3	3	-	-	2	1	-	3	3	3	3
CO5	3	-	-	3	3	3	-	-	2	1	-	3	3	3	3

CE1306	SURVEYING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals and various methods of plane and geodetic surveying for solve the real world problems.
- To introduce the concepts of Control Surveying.
- The student is also exposed to the Modern Surveying.
- To learn the various applications of Civil Engineering Surveys.

UNIT - I	FUNDAMENTALS OF CONVENTIONAL SURVEYING	9
Classifications and basic principles of surveying – Equipment and accessories for ranging and chaining – Basic principles Compass surveying - Plane Table Surveying accessories and methods - Levels and staves - Methods of levelling - Booking - Reduction – Curvature and refraction correction – Contouring.		**CO1**
UNIT - II	**THEODOLITE SURVEYING AND COMPUTATIONS**	**9**
Horizontal and vertical angle measurements by Theodolite – Heights and distances– Tacheometric surveying – Trigonometric levelling - Computation of cross sectional areas and volumes – Earthwork calculations - Mass haul diagrams.		**CO2**
UNIT - III	**CONTROL SURVEYING AND ADJUSTMENT**	**9**
Horizontal and vertical control- Methods – Triangulation - Traversing - Gale‘s table - Trilateration - Concepts of measurements and errors – error propagation and linearization – adjustment methods – least square methods – angles, lengths and levelling network.		**CO3**
UNIT - IV	**ROUTE AND HYDROGRAPHIC SURVEYING**	**9**
Route Surveying - Reconnaissance - Route surveys for highways, railways and waterways - Simple curves – Compound and reverse curves – Transition curves - Setting out different methods of simple curve - Vertical curves - Hydrographic surveying – Tides - MSL - Sounding methods - Three-point problem – Determination of depth and position using multi-beam sounder and GPS		**CO4**
UNIT - V	**MODERN SURVEYING**	**9**
Total Station: Digital Theodolite, EDM, Electronic field book - Advantages – Parts and accessories - working principle – Observables – Errors - COGO functions – Field procedure and applications. GPS: Advantages - System components – Signal structure – Selective availability and Anti-spoofing – receiver components and antenna – Planning and data acquisition – Data processing - Errors in GPS – Field procedure and applications.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. T.P. Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. S.S.Bhavikatti, Surveying Theory and Practice, I.K.International Publishing House Pvt. Ltd, New Delhi, 2010

REFERENCE BOOKS

1. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

2. James M.Anderson and Edward M. Mikhail, Surveying Theory and Practice, Tata McGraw Hill Education Private Limited, New Delhi, 2012
3. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004
4. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice' Hall of India 2004
5. K.R. Arora, Surveying Vol I & II, Standard Book house , Twelfth Edition. 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Introduce the rudiments of various surveying and its principles.
CO2	Imparts concepts of Theodolite Surveying and computation of area and volume calculation.
CO3	Understand the procedure for establishing horizontal and vertical control and its adjustment procedure.
CO4	Initiate the knowledge in Route surveying, Hydrographic surveying
CO5	Introduce the basics of Electronic Surveying

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2	2	1	1	2	1	1	1	1	2	2
CO2	3	2	2	1	2	2	1	1	2	1	1	1	2	2	2
CO3	3	2	1	1	3	1	1	1	1	1	1	2	2	1	2
CO4	1	2	2	1	3	2	1	1	2	1	1	2	3	3	2
CO5	3	2	2	1	3	2	1	1	3	1	1	2	2	2	1

CE1307	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To make the students understand the mechanical properties of materials when subjected to different types of loading viz., tension, compression, torsion and bending.
- To know the impact strength and the hardness number of the given material.

EXERCISES

1. Tension test on mild steel & RTS rods.
2. Torsion test on metals.
3. Hardness Test on metals.
    - Rockwell Hardness Test
    - Brinell Harness Test
4. Compression test on helical spring.
5. Double shear Test on metal.
6. Impact test on metal specimen.
    - Izod Test
    - Charpy Test
7. Deflection test on metal beam.
8. Compression test on wood.

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Bansal, R.K., "A Text Book of Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 2010.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.
3. James M. Gere and Stephen P. Timoshenko, "Mechanics of Materials, (3rd edition), McGraw Hill Book Company, Singapore, 2002.
4. Rattan SS, "Strength of Material", McGraw Hill Educational Private Limited, India, 2011.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.NO	Description of Equipment	Quantity
1	UTM of minimum 400 kN capacity	1
2	Torsion testing machine	1
3	Hardness testing machine (Rockwell and Brinell)	1 (Each)

4	Impact testing machine	1
5	Beam deflection test apparatus	1
6	Extensometer	1
7	Compressometer	1
8	Dial gauges	Few

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire required knowledge on torsion and tension test on mild steel rod.
CO2	Acquire required knowledge on hardness of different metals.
CO3	Acquire required knowledge on stiffness characteristics of open and closed coil spring.
CO4	Acquire required knowledge about double shear test on metal and impact test on metal.
CO5	Acquire required knowledge on compressive strength of wood and deflection characteristics on steel beam.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	-	2	-	1	2	-	-	3	3	3	-
CO2	3	2	-	3	-	2	-	1	2	-	-	3	3	3	-
CO3	3	2	-	3	-	2	-	1	2	-	-	3	3	3	-
CO4	3	2	-	3	-	2	-	1	2	-	-	3	3	3	-
CO5	3	2	-	3	-	2	-	1	2	-	-	3	3	3	-

CE1308	SURVEYING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To familiarize with the various surveying instruments and methods.

EXERCISES

1. Finding Pace Value of Surveyor using Chaining and Ranging.
2. Mapping of Building with cross staff and without cross staff using Offset.
3. Mapping and Area Calculation by using Chain Surveying.
4. Setting out works – Foundation marking using tapes single Room and Double Room.
5. Computation of Included Angle after adjustment of Local Attraction.
6. Mapping and Area Calculation by using Compass Surveying.
7. Plane Table Surveying (Radiation and Intersection Method)
8. Fly leveling using dumpy level.
9. Transfer of Bench Mark using Check Levelling.
10. Observation of Angles by method of Repetition.
11. Observation of Angles by method of Reiteration.
12. Determination of elevation of an object using single plane method when base is accessible.
13. Determination of elevation of an object using single plane method when base is inaccessible.
14. Determination of Tacheometric Constants.
15. Heights and distances by stadia Tacheometry.
16. Heights and distances by Tangential Tacheometry.

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. James M.Anderson and Edward M. Mikhail, Surveying Theory and Practice, Tata McGraw Hill Education Private Limited, New Delhi, 2012
4. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1	Chain	6
2	Cross Staff	6
3	Ranging rod	6
4	Metal arrows	6
5	Metallic tape	6
6	Prismatic Compass with stand	3
7	Surveyor Compass with stand	1

8	Dumpy level with aluminum stand and accessories	6
9	Aluminum Leveling staff	6
10	Theodolite with aluminum stand and accessories	6

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Use conventional surveying tools such as chain/tape, compass, plane table in the field of civil engineering applications.
CO2	Prepare planimetric map
CO3	Gain knowledge on Height determination by levelling
CO4	Imparts knowledge in computation of Distance and Elevation using horizontal and vertical angles
CO5	Establish horizontal and vertical control points.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	1	-	-	-	-	-	1	2	1	-	2
CO2	3	3	1	3	-	1	-	-	-	1	-	3	1	-	2
CO3	3	1	1	3	1	-	-	-	-	-	1	2	1	-	2
CO4	3	1	1	3	1	-	-	-	-	-	1	2	1	-	2
CO5	3	3	1	3	-	1	-	-	-	1	-	3	1	-	2

MA1455	NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life
- To acquaint the student with understanding of numerical techniques of differentiation and
- integration this plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations

UNIT I	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	12
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method.		**CO1**
UNIT II	**INTERPOLATION AND APPROXIMATION**	**12**
Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.		**CO2**
UNIT III	**NUMERICAL DIFFERENTIATION ANDINTEGRATION**	**12**
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule and 3/8 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.		**CO3**
UNIT IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Single step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations-Multistep methods-Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.		**CO4**
UNIT V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Finite difference methods for solving second order two - point linear boundary value problems – Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.		**CO5**
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 10th Edition, Cengage Learning, 2017.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi,2015.

REFERENCE BOOKS

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia,New

Delhi,2007.

2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia,7th Edition, New Delhi, 2007.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall,1992.
4. Sankara Rao.K.,"Numerical Methods for Scientists and Engineers", PrenticeHallofIndiaPvt. Ltd, 4th Edition, New Delhi,2018.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Solve algebraic, transcendental equation and system of linear equations compute eigenvalues numerically.
CO2	Interpolate using standard methods like finite difference methods and cubic splines
CO3	Apply Numerical differentiation and integration for the observed data
CO4	Have an insight of finding the numerical solution of first order differential equation by Standard single step methods and multi-step methods.
CO5	Understand the finite difference solution of second order ordinary differential equation and get the solution of the standard engineering partial differential equation by explicit method and implicit method

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	1	0	0	0	0	0	2	2	1	1
CO2	3	2	3	1	2	1	0	0	0	0	1	2	1	2	0
CO3	3	2	2	1	2	1	0	0	0	0	1	2	2	1	1
CO4	3	3	3	2	2	1	0	0	0	0	0	2	1	2	1
CO5	3	3	2	1	2	1	0	0	0	0	0	2	2	1	0

CE1402	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To equip the students with the principles and design of water treatment and distribution

UNIT I	SOURCES OF WATER	9
Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.		CO1
UNIT II	**CONVEYANCE FROM THE SOURCE**	**9**
Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.		CO2
UNIT III	**WATER TREATMENT**	**9**
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, flash mixers, Coagulation and flocculation –Clarifloccuator- -sedimentation - filtration - Disinfection – Ground water treatment – aerators, Iron and Manganese removal – Hardness - Softening - Residue Management – Construction, Operation and Maintenance aspects.		CO3
UNIT IV	**ADVANCED WATER TREATMENT**	**9**
Adsorption - Desalination - R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems – RO Reject Management - Iron and Manganese removal - Defluoridation - Construction and Operation & Maintenance aspects – Recent advances.		CO4
UNIT V	**WATER DISTRIBUTION AND SUPPLY**	**9**
Requirements of water distribution – Components – Selection of pipe material – Service reservoirs – Functions – Network design – Economics – Analysis of distribution networks – Computer applications – Appurtenances – Leak detection. Principles of design of water supply in buildings – House service connection – Fixtures and fittings, systems of plumbing and types of plumbing.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Garg, S.K. Environmental Engineering, Vol.IKhanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
3. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2014.

REFERENCE BOOKS

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Create an insight into the structure of drinking water supply systems, including water transport, treatment and distribution
CO2	Attain the knowledge in various unit operations and processes in water treatment
CO3	To design the various functional units in water treatment
CO4	To understand water quality criteria and standards, and their relation to public health
CO5	To design and evaluate water supply project alternatives on basis of chosen criteria

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	1	1	1	3	-	-	2	-	-	-	1	-	1
CO2	-	-	1	1	1	2	-	-	1	-	-	-	1	-	1
CO3	-	-	3	1	1	3	-	-	3	-	-	-	3	-	2
CO4	-	-	1	1	1	1	-	-	1	-	-	-	1	-	1
CO5	-	-	3	1	1	1	-	-	1	-	-	-	3	-	1

CE1403	HIGHWAY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give an overview on the basics of highway engineering and to impart the various process and methods involved in the planning, development, design, construction and Maintenance of highways.

UNIT - I	HIGHWAY PLANNING AND ALIGNMENT	9
History of road development in India – Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment – Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods.		**CO1**
UNIT - II	**GEOMETRIC DESIGN OF HIGHWAYS**	**9**
Typical cross sections of Urban and Rural roads — Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients, hairpin bends – Lateral and vertical clearance at underpasses – IRC standards-Road signs and safety. Urban utility services.		**CO2**
UNIT - III	**DESIGN OF FLEXIBLE AND RIGID PAVEMENTS**	**9**
Design principles – pavement components and their role - Design practice for flexible and rigid pavements (IRC methods only).		**CO3**
UNIT - IV	**HIGHWAY MATERIALS, CONSTRUCTION AND MAINTENANCE**	**9**
Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavements including modern materials and methods, Highway drainage – Special considerations for hilly roads; Evaluation and Maintenance of pavements.		**CO4**
UNIT - V	**HIGHWAY ECONOMICS AND FINANCE**	**9**
Introduction, Highway User Benefits, Highway Costs, Vehicle Operation Costs, Economic analysis, Highway projects under Public-Private Sector Participation, Bidding process, Highway finance.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Veeraragavan. A, Khanna.K and Justo.C.E.G. Highway Engineering, Nem Chand & Bros Publishers, 2014
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010
3. C.Venkatramaiah., Transportation Engineering-Highway Engineering, Universities Press (India) Private Limited, Hyderabad, 2015
4. Subhash C Saxena, Textbook of Highway and Traffic Engineering. CBS Publishers, 2017.
5. R.Srinivasa Kumar., Textbook of Highway Engineering Universities Press (India) Private Limited, Hyderabad, 2011

REFERENCE BOOKS

1. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2005
2. Kadiyali. L. R. Principles and Practice of Highway Engineering, Khanna Technical Publications, Delhi, 1997.

3.	Indian Road Congress (IRC), Guidelines and Special Publications on Planning and Design of Highways.
4.	Sharma.S.K Principles , Practices and Design of Highway Engineering, S.Chand and Company Ltd.1995

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts and standards adopted in Planning, Design and construction of Highways and its related infrastructures.
CO2	Apply the knowledge of science and engineering fundamentals in designing the geometrics for an efficient Highway network and design concepts.
CO3	Designing various types of pavements to meet specified needs of safety, efficiency and long-time sustainability by adopting various design standards.
CO4	Select appropriate methods for construction, evaluation and maintenance of roadways.
CO5	Understand the bidding processes and types of highway projects and analyze the economic, financial aspects of the highway projects

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	2	2	3	1	3	1	1	1	1	3	2	2
CO2	3	2	3	1	1	1	1	1	1	1	1	2	3	3	2
CO3	2	3	3	2	2	1	2	3	2	1	2	3	3	3	2
CO4	2	3	2	2	2	3	3	3	1	1	3	3	3	3	3
CO5	1	2	1	1	2	3	1	3	2	1	3	3	2	2	3

CE1404	APPLIED HYDRAULIC ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of open channel flow characteristics.
- To understand the concept of hydraulic jumps and surges.
- To study the concepts of turbo machinery.

UNIT I	**UNIFORM FLOW**	**10**
Definition and differences between pipe flow and open channel flow - Types of Flow – Properties of open channel - Fundamental equations - Sub-critical, Super-critical and Critical flow – Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation – Best hydraulic sections for uniform flow - Computation in Uniform Flow - Specific energy and specific force.		**CO1**
UNIT II	**VARIED FLOW**	**9**
Dynamic equations of gradually varied - Water surface flow profile classifications: Hydraulic Slope, Hydraulic Curve - Profile determination by Numerical method: Direct step method and Standard step method – Change in Grades.		**CO2**
UNIT III	**RAPIDLY VARIED FLOWS**	**8**
Application of the momentum equation for RVF - Hydraulic jumps - Types – Energy dissipation – Positive and Negative surges.		**CO3**
UNIT IV	**TURBINES**	**9**
Turbines - Classification - Impulse turbine – Pelton wheel - Reaction turbines – Francis turbine - Kaplan turbine - Draft tube - Cavitation - Performance of turbine - Specific speed - Runaway speed.		**CO4**
UNIT V	**PUMPS**	**9**
Centrifugal pumps - Minimum speed to start the pump - NPSH - Cavitations in pumps - Operating characteristics - Multistage pumps - Reciprocating pumps - Negative slip – Indicator diagrams and its variations - Air vessels - Savings in work done.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Modi, P.N, and Seth S.M.," Hydraulic and Fluid Mechanics", Standard Book House, 2012.
2. Jain A. K. "Fluid Mechanics including Hydraulic Machines", Khanna Publishers, 1998.

REFERENCE BOOKS

1. Ven Te Chow, Open Channel Hydraulics, McGraw Hill, New York, 2009.
2. Subramanya K., Flow in open channels, Tata McGraw Hill, New Delhi, 2000.
3. Chandramouli P N, Applied Hydraulic Engineering, Yes Dee Publisher, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe the basics of open channel flows, its classifications and analysis of uniform flow in steady state conditions with specific energy concept and its application
CO2	Analyse steady gradually varied flow, water surface profiles and its length calculation using direct and standard step methods with change in water surface profiles due to change in grades.

CO3	Derive the relationship among the sequent depths of steady rapidly varied flow and estimating energy loss in hydraulic jump with exposure to positive and negative surges.
CO4	Design turbines and explain the working principle
CO5	Differentiate pumps and explain the working principle with characteristic curves and design centrifugal and reciprocating pumps.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1	2	2	2	2	1	1	3	1	2	2
CO2	3	3	2	3	2	2	2	2	2	1	1	3	1	2	2
CO3	3	3	2	3	1	2	2	2	2	1	1	3	1	2	3
CO4	3	3	2	3	1	2	2	2	2	1	1	3	1	2	3
CO5	3	3	2	3	1	2	2	2	2	1	1	3	1	2	3

CE1405	STRUCTURAL ANALYSIS – I	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students classical methods such that Slope deflection and Moment distribution method in analysing indeterminate structures.
- To introduce the students matrix methods such as Flexibility method and stiffness method in analysing indeterminate structures.

UNIT I	**STRAIN ENERGY METHOD**		**9**
Determination of Static and Kinematic Indeterminacies – Analysis of continuous beams, plane frames and indeterminate plane trusses by strain energy method (up to two degree of redundancy).		**CO1**	
UNIT II	**SLOPE DEFLECTION METHOD**		**9**
Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements- symmetric frames with symmetric and skew-symmetric loadings.		**CO2**	
UNIT III	**MOMENT DISTRIBUTION METHOD**		**9**
Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings.		**CO3**	
UNIT IV	**FLEXIBLITY METHOD**		**9**
Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.		**CO4**	
UNIT V	**STIFFNESS METHOD**		**9**
Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhavikatti, S.S,Structural Analysis,Vol.1,& 2, Vikas Publishing House Pvt.Ltd., NewDelhi-4,2014.
2. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd.,New Delhi-4, 2014.
3. Vazrani.V.N And Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.
4. Pandit G.S.and Gupta S.P., Structural Analysis–A Matrix Approach, Tata McGraw Hill Publishing Company Ltd.,2006

REFERENCE BOOKS

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, Laxmi Publications, New Delhi, 2004.
2. Hibbeler, R.C., Structural Analysis, VII Edition, Prentice Hall, 2012.
3. Reddy.C.S,“Basic Structural Analysis”, Tata McGraw Hill Publishing Company,2005.
4. Rajasekaran.S, &G.Sankarasubramanian., “Computational Structural Mechanics”, PHI
5. Learning Pvt. Ltd, 2015

6.	Negi L.S.and Jangid R.S.,Structural Analysis, Tata McGraw Hill Publishing Co.Ltd.2004.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyse the continuous beams, pin-jointed indeterminate plane frames and rigid plane frames by strain energy method
CO2	Analyse the continuous beams and rigid frames by slope defection method
CO3	Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway.
CO4	Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.
CO5	Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	2	3	1	2	3	2	2
CO2	3	3	3	2	1	1	-	-	2	3	1	2	3	2	2
CO3	3	2	1	2	1	1	-	-	2	3	1	2	3	2	2
CO4	3	3	2	2	1	1	-	-	2	3	1	2	3	2	2
CO5	3	3	2	2	1	1	-	-	2	3	1	2	3	2	2

CE1406	GEOTECHNICAL ENGINEERING - I	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification.
- To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of soils.
- To impart knowledge of design of both finite and infinite slopes.

UNIT I	**SOIL CLASSIFICATION AND COMPACTION**	**9**
History – formation and types of soil – composition - Index properties – clay mineralogy structural arrangement of grains – description – Classification – BIS – US – Phase relationship – Compaction – theory – laboratory and field technology – field Compaction method – factors influencing compaction.		**CO1**
UNIT II	**EFFECTIVE STRESS AND PERMEABILITY**	**9**
Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Permeability interaction – Hydraulic conductivity – Darcy's law – Determination of Hydraulic Conductivity – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two-dimensional flow – Laplace's equation – Introduction to flow nets – Simple problems. (Sheet pile and Wier)		**CO2**
UNIT III	**STRESS DISTRIBUTION AND SETTLEMENT**	**9**
Stress distribution in homogeneous and isotropic medium – Boussinesq theory – (Point load, Line load and UDL) - Use of New marks influence chart –Components of settlement –– Immediate and consolidation settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. - √t and log t methods– e-log p relationship- consolidation settlement calculation - Normally Consolidated clays – Over Consolidated clays.		**CO3**
UNIT IV	**SHEAR STRENGTH OF SOIL**	**9**
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – Measurement of shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Cyclic mobility – Liquefaction.		**CO4**
UNIT V	**SLOPE STABILITY**	**9**
Stability Analysis - Infinite slopes and finite slopes – Total stress analysis for saturated clay – Friction circle method – Use of stability number – Method of slices – Fellenius and Bishop's method - Slope protection measures.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2015
2. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2006
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 2005

REFERENCE BOOKS

1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations". Prentice-Hall, 2006

2. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2010
3. Das, B.M., “Principles of Geotechnical Engineering”. Brooks / Coles / Thompson Learning Singapore, 8th Edition, 2013
4. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 7th Edition, 2017(Reprint)
5. Palanikumar.M., “Soil Mechanics”, Prentice Hall of India Pvt. Ltd, Learning Private Limited Delhi, 2013
6. Craig.R.F., “Soil Mechanics”, E & FN Spon, London and New York, 2012.
7. Purushothama Raj. P., “Soil Mechanics and Foundations Engineering”,2nd Edition, Pearson Education, 2013
8. Venkatramaiah.C., “Geotechnical Engineering”, New Age International Pvt. Ltd., New Delhi, 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate an ability to identify various types of soils and its properties, familiarize with compaction, formulate and solve engineering Problems
CO2	Show the basic understanding of flow through soil medium and its impact of engineering solution
CO3	Understand about the basic concept of stress distribution in loaded soil medium and soil settlement due to consolidation
CO4	Show the understanding of shear strength of soils and its impact of engineering solutions to the loaded soil medium and also will be aware of contemporary issues on shear strength of soils, and
CO5	Demonstrate an ability to design both finite and infinite slopes, component and process as per needs and specifications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO2	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO3	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO4	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO5	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3

CE1407	ADVANCED SURVEYING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To familiarize with the various surveying instruments and methods in field.
- To impart Hands on experience of basics of Total Station.
- To impart Hands on experience of basics of GPS.
- To acquire practical knowledge in the field of Remote Sensing
- To impart Hands on experience of basics of cartography and GIS.

EXERCISES

1. Contour Mapping using Grid Levelling.
2. Contour Mapping using Radial Levelling.
3. Longitudinal and Cross Sectional Levelling- Cut and fill volume calculation.
4. Curve Setting By Deflection Angle Method and Two theodolite method.
5. Traverse Using Total Station.
6. Use of GPS to determine latitude and longitude.
7. Traverse Using GPS.
8. Preparation of Base Map from Survey of India Topo sheets
9. Data Input – Onscreen Digitisation – Creation of Point, Line and Polygon layers
10. Projection, Reprojection and Coordinate Transformation of Maps
11. Preparation of Land use/land cover map using Satellite Data.
12. Attribute data input and Measurement of Distance, Area
13. Data Conversion – Vector to Raster and Raster to Vector

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. J. Uren and W.F. Price, Surveying for Engineers, Palgrave macmillan, Fifth Edition, 2010.
2. Dr.B.C.Punmia, Ashok K.Jain and Arun K Jain, Surveying Vol.I & II, Lakshmi Publications Pvt Ltd, New Delhi,17th Edition,2016.
3. W. Schofield and M. Breach, Elesevier, Engineering Surveying, Sixth Edition, 2007.
4. R. Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
5. Bannister and S. Raymond, Surveying, Seventh Edition, Longman 2004
6. S.K. Roy, Fundamentals of Surveying, Second Edition, Prentice' Hall of India 2004
7. K.R. Arora, Surveying Vol I & II, Standard Book house , Eleventh Edition. 2013
8. T.P.Kanetkar and S.V.Kulkarni, Surveying and Levelling, Parts1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 24th Reprint,2015.
9. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, VI edition of John Wiley & Sons-2015.
10. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1	Dumpy level with aluminum stand and accessories	6
2	Aluminum Leveling staff	6
3	Theodolite with aluminum stand and accessories	6
4	Theodolite with aluminum stand and accessories	3
5	Hand Held GPS	3
6	Open Source GIS	-

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	To prepare a Contour map using various methods.
CO2	To establish horizontal and vertical control points using Total Station
CO3	To establish horizontal and vertical control points using GPS.
CO4	To input the data in the GIS and prepare the Map Layout Design process.
CO5	To understand the concepts of Map Projection in GIS.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	1	1	1	1	1	1	1	2	2	1	3
CO2	3	3	1	3	2	1	1	1	1	1	1	3	2	1	3
CO3	3	1	1	3	1	1	1	1	1	1	1	2	2	1	3
CO4	3	1	1	3	1	1	1	1	1	1	1	2	2	1	3
CO5	3	3	1	3	2	1	1	1	1	1	1	3	2	1	3

CE1408	HYDRAULIC ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To provide hands on experience in calibration of flow meters, performance characteristics of pumps and turbines.

EXERCISES

A. MEASUREMENT OF FLOW PROPERTY

1. Determination of coefficient of discharge of orifice.
2. Flow measurement in pipe using orificemeter
3. Flow measurement in pipe using venturimeter
4. Flow measurement in open channel using notches
5. Verification of Bernoulli's theorem

B. MEASUREMENT OF LOSSES IN PIPES

6. Determination of minor losses in pipes
7. Determination of frictional loss in pipes

C. DETERMINATION OF METACENTRIC HEIGHT

8. Determination of metacentric height of a floating body

D. TURBINE CHARACTERISTICS

9. Performance test on Pelton wheel turbine
10. Performance test on Francis turbine
11. Study of impact of jet on vanes

E. PUMP CHARACTERISTICS

12. Performance test on multi-stage centrifugal pump
13. Performance test on reciprocating pump
14. Performance test on submersible pump.

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Mechanics. Standard Book House. New Delhi, 2017.
3. Subramanya K, Fluid Mechanics and Hydraulic Machines, Tata McGraw Hill Edu. Pvt. Ltd, 2011

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1	Closed Circuit Bernoulli's theorem – Verification Apparatus	1 No
2	Closed Circuit Flow through Notch Apparatus	1 No
3	Closed Circuit Hydraulic Flume	1 No
4	Closed Circuit Flow through Orifice & Mouth Piece Apparatus	1 No

5	Closed Circuit Apparatus for Determination of Losses in pipeline due to sudden contraction, Enlargement Bends and Elbow	1 No
6	Variable Speed Reciprocating Pump	1 No
7	Constant Speed Centrifugal Pump	1 No
8	Triple Closed Circuit Gear Oil Pump test rig	1 No
9	Triple Open Circuit Deep Well Submergible Pump-Test Rig	1 No
10	Triple Open Circuit Pelton Wheel Turbine Test Rig	1 No
11	Triple Open Circuit Francis Turbine Test Rig	1 No
12	Triple Open Circuit Kaplan Turbine Test Rig	1 No
13	Pipe Friction Apparatus	1 No
14	Orificemeter	1 No
15	Venturimeter	1 No
16	Rotameter	1 No
17	Pitot Tube Test Setup	1 No
18	Triple Apparatus for determination of Metacentric Height	1 No

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Apply Bernoulli equation for calibration of flow measuring devices.
CO2	Measure friction factor in pipes and compare with Moody diagram
CO3	Determine the performance characteristics of rotodynamic pumps.
CO4	Determine the performance characteristics of positive displacement pumps.
CO5	Determine the performance characteristics of turbines.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	1	2	2	2	2	1	1	2	2	1	1
CO2	3	2	1	3	1	2	2	2	2	1	1	2	3	1	1
CO3	3	3	2	3	1	2	2	2	3	1	1	2	3	2	1
CO4	3	3	2	3	1	2	2	2	3	1	1	2	3	2	1
CO5	3	3	2	3	1	2	2	2	3	1	1	2	3	2	1

HS1310	PROFESSIONAL SKILLS LAB	L	T	P	C
	(Common to AI & DS, CIVIL, CHEMICAL , CSE, EEE & EIE)	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I	**6**
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	**CO1**
UNIT II	**6**
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—— Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	**CO2**
UNIT III	**6**
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -— questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc	**CO3**
UNIT IV	**6**
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	**CO4**
UNIT V	**6**
Recognizing differences between groups and teams- managing time managing stress-networking professionally- respecting social protocols understanding career management-developing a long- term career plan making career changes	**CO5**
	TOTAL : 30 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. One Server
2. 30 Desktop Computers
3. One Hand Mike

4. One LCD Projector

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharan et al. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students, Orient BalckSwan: Hyderabad, 2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	0	2	0	2	1	0	0	0	2	3	0	0	1	0	3
CO2	0	2	0	2	0	0	0	0	2	3	0	0	1	0	3
CO3	0	0	0	0	0	0	0	0	2	2	0	0	1	0	2
CO4	0	0	0	0	0	0	0	0	2	2	0	2	1	0	2
CO5	0	2	1	1	2	0	2	0	2	3	0	2	1	0	2

CE1501	STRUCTURAL ANALYSIS – II	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the method of drawing influence lines and its uses in various applications like beams and plane trusses.
- To analyse the arches and suspension bridges.
- Also to learn Plastic analysis of beams and rigid frames.

UNIT I	INFLUENCE LINES FOR DETERMINATE BEAMS	9
Influence lines for reactions in statically determinate beams – Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads – absolute maximum bending moment - influence lines for member forces in pin jointed plane frames.		**CO1**
UNIT II	**INFLUENCE LINES FOR INDETERMINATE BEAMS**	**9**
Muller Breslau's principle– Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one), and fixed beams.		**CO2**
UNIT III	**ARCHES**	**9**
Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.		**CO3**
UNIT IV	**CABLES AND SUSPENSION BRIDGES**	**9**
Equilibrium of cable – length of cable - anchorage of suspension cables – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders.		**CO4**
UNIT V	**PLASTIC ANALYSIS**	**9**
Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – collapse load - Static and kinematic methods – Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt.Ltd.,New Delhi - 4, 2014.
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications, 2004.
3. Vazrani.V.N and Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.

REFERENCE BOOKS

1. Negi.L.S and Jangid R.S., Structural Analysis, Tata McGraw-Hill Publishers, 2004.
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co.Ltd.2002.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHIL earning Pvt. Ltd.,2011.
4. Prakash Rao D.S., Structural Analysis, Universities Press, 1996.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand the method of drawing influence lines and its uses in various applications in statically determinate beams and pin jointed plane frames
CO2	To understand the method of drawing influence lines and its uses in various applications in statically indeterminate beams
CO3	To understand the various forms of arches and the methods of analysis of the types of arches
CO4	To have the knowledge on advanced methods of analysis of structures including cable and suspension bridges
CO5	To analyse and design various indeterminate beams and frames by plastic analysis

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	1	1	3	2	-	2	3	2	2
CO2	3	3	3	2	2	2	1	1	3	2	-	2	3	2	2
CO3	3	3	3	2	2	2	1	1	3	2	-	2	3	2	2
CO4	3	3	3	2	2	2	1	1	3	2	-	2	3	2	2
CO5	3	3	3	2	2	2	1	1	3	2	-	2	3	2	2

CE1502	GEOTECHNICAL ENGINEERING II	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge to plan and execute a detail site investigation programme, to select geotechnical design parameters and type of foundations. Also, to familiarize the students for the geotechnical design of different type of foundations and retaining walls.

UNIT I	**SITE INVESTIGATION AND SELECTION OF FOUNDATION**	**9**
Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters and Evaluation of Liquefaction potential - Selection of foundation based on soil condition- Bore log report.		**CO1**
UNIT II	**SHALLOW FOUNDATION**	**9**
Introduction – Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.		**CO2**
UNIT III	**FOOTINGS AND RAFTS**	**9**
Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum depth for rigid behaviour – Applications – Floating foundation – Special foundations – Seismic force consideration – Codal provision		**CO3**
UNIT IV	**DEEP FOUNDATION**	**9**
Deep foundation- Basics of Caisson and Well Foundation-Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hiley's) – Capacity from insitu tests (SPT, SCPT) – Negative skin friction – Uplift capacity- Group capacity by different methods (Feld's rule, Converse – Labarre formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift – Codal provision.		**CO4**
UNIT V	**RETAINING WALLS**	**9**
Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesionless and cohesive soil – Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provision.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", CBS Publishers and Distributers Ltd., New Delhi, 2015.
2. Gopal Ranjan and Rao A.S.R. "Basic and Applied soil mechanics", New Age International

	(P) Ltd, New Delhi,2006.
3.	Punmia, B.C., “Soil Mechanics and Foundations”, Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.

REFERENCE BOOKS

1. Arora, K.R., “Soil Mechanics and Foundation Engineering”, Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
2. Das, B.M. “Principles of Foundation Engineering” (Eigth edition), Thompson Asia Pvt. Ltd., Singapore, 2013.
3. Kaniraj, S.R. “Design aids in Soil Mechanics and Foundation Engineering”, Tata McGraw Hill publishing company Ltd., New Delhi, 2002.
4. Varghese, P.C.,”Foundation Engineering”, Prentice Hall of India Private Limited, New Delhi, 2005.
5. Joseph E bowles, “Foundation Analysis and design”, McGraw Hill Education, 5th Edition, 28th August 2015.
6. Relevant IS Codes

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Planning and executing a detailed site investigation to select geotechnical design parameters and type of foundation
CO2	Gaining knowledge on bearing capacity of soil and testing methods for settlement in shallow foundation
CO3	Designing combined footings and raft foundations, its component or process as per the needs and specifications
CO4	Designing deep foundations, determining the load carrying capacity and settlement of pile foundation
CO5	Determining earth pressure on retaining walls and analysis for stability

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	2	1	1	1	1	2	3	2	1	3
CO2	3	3	3	3	1	2	1	1	1	1	2	3	2	1	3
CO3	3	3	3	3	1	2	1	1	1	1	2	3	2	1	3
CO4	3	3	3	3	1	2	1	1	1	1	2	3	2	1	3
CO5	3	3	3	3	1	2	1	1	1	1	2	3	2	1	3

CE1503	RAILWAYS, AIRPORTS AND HARBOUR ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students about planning, design, construction and maintenance and design principles of Railways, Airport and Harbour.

UNIT I	**RAILWAY PLANNING**	**10**
Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings.		**CO1**
UNIT II	**RAILWAY CONSTRUCTION AND MAINTENANCE**	**8**
Earthwork – Stabilization of track on poor soil - Tunneling Methods, drainage and ventilation – Calculation of Materials required for track laying - Construction and maintenance of tracks – Signalling - Railway Station and yards and passenger amenities		**CO2**
UNIT III	**AIRPORT PLANNING**	**9**
Air transport characteristics-airport classification-air port planning: objectives, components, layout characteristics, socio-economic characteristics of the Catchment area, airport site selection-Orientation of Runways and correction factors as ICAO stipulations, typical Airport Layouts, parking and Circulation Area.		**CO3**
UNIT IV	**AIRPORT DESIGN**	**9**
Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design, Configuration and Pavement Design Principles – Elements of Taxiway Design– Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.		**CO4**
UNIT V	**HARBOUR ENGINEERING**	**9**
Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage – Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works – Environmental concern of Port Operations –Coastal Regulation Zone, 2011		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai, 2010
2. C.Venkatramaiah., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
3. Vazirani.V.N and Chandola.S.P, “Transportation Engineering-Vol.II”, Khanna Publishers,New Delhi, 2015.
4. Mundrey J S, Railway Track Engineering, McGraw Hill Education (India) Private Ltd, NewDelhi, 2013.

REFERENCE BOOKS

1. Saxena Subhash, C.and Satyapal Arora, ACourse in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998
2. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee, 1994

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the concepts and elements in Planning, Design and construction of Railways.
CO2	Select appropriate methods for construction and maintenance of Railway tracks and other infrastructures
CO3	Understand the concepts and elements in Planning and selection of site for Airport.
CO4	Design the Runway length and evaluate the orientation of runways
CO5	Understand the terminologies, infrastructures in Harbour Engineering and Coastal regulations.

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	1	3	3	-	-	-	3	2	2
CO2	-	-	3	-	2	2	-	-	-	-	-	2	3	3	3
CO3	-	3	3	2	3	-	-	-	3	2	1	2	3	3	2
CO4	3	3	-	2	2	2	-	3	1	2	-	2	2	2	3
CO5	3	2	3	3	-	-	-	-	-	2	1	-	3	3	3

CE1504	WASTEWATER ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- The objectives of this course is to help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena for successful design, operation and maintenance of sewage treatment plants.

UNIT I	**PLANNING AND DESIGN OF SEWERAGE SYSTEMS**		**9**
Characteristics and composition of sewage - population equivalent -Sanitary sewage flow estimation – Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design – Storm drainage -Storm runoff estimation – sewer appurtenances – corrosion in sewers – prevention and control – sewage pumping-drainage in buildings-plumbing systems for drainage - Rain Water harvesting.		**CO1**	
UNIT II	**PRIMARY TREATMENT OF SEWAGE**		**9**
Objectives – Unit Operations and Processes – Selection of treatment processes – Onsite sanitation - Septic tank- Grey water harvesting – Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks – Construction, Operation and Maintenance aspects.		**CO2**	
UNIT III	**SECONDARY TREATMENT OF SEWAGE**		**9**
Objectives – Selection of Treatment Methods – Principles, Functions, - Activated Sludge Process and Extended aeration systems -Trickling filters– Sequencing Batch Reactor(SBR) – Membrane Bioreactor - UASB – Waste Stabilization Ponds – Other treatment methods - Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction, Operation and Maintenance aspects.		**CO3**	
UNIT IV	**DISPOSAL OF SEWAGE**		**9**
Standards for Disposal - Methods – dilution – Mass balance principle - Self purification of river-Oxygen sag curve – deoxygenation and reaeration - Streeter–Phelps model - Land disposal – Sewage farming – sodium hazards.		**CO4**	
UNIT V	**SLUDGE TREATMENT AND DISPOSAL**		**9**
Objectives - Sludge characterization – Thickening - Design of gravity thickener- Sludge digestion – Standard rate and High rate digester design- Biogas recovery – Sludge Conditioning and Dewatering – Sludge drying beds- ultimate residue disposal – recent advances.		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOKS

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers,New Delhi, 2015.
2. Duggal K.N., “Elements of Environmental Engineering” S.Chand and Co. Ltd., New Delhi, 2014.
3. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010

REFERENCE BOOKS

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill

	Company, New Delhi, 2010.
3.	Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C.,2010
4.	Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand on the characteristics and composition of sewage, ability to estimate sewage generation and design sewer system including sewage pumping stations
CO2	Select type of treatment system and able to perform basic design of the unit operations that are used in sewage treatment. knowledge of septic tank design
CO3	Gain knowledge of selection of treatment process and biological treatment process
CO4	Acquire knowledge of advance treatment technology and reuse of sewage
CO5	Understand the, self-purification of streams and sludge and septage disposal methods.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	-	1	1	3	2	3	3	1	-	3	3
CO2	3	-	3	2	2	3	-	3	2	3	-	2	3	3	3
CO3	3	2	3	2	-	2	-	1	2	3	-	2	3	2	3
CO4	2	-	3	2	3	-	-	1	2	3	2	3	3	2	3
CO5	2	3	3	2	2	-	-	3	3	3	2	3	3	3	3

CE1505	DESIGN OF REINFORCED CONCRETE ELEMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the different types of philosophies related to design of basic structural elements such as slab, beam, column and footing which form part of any structural system with reference to Indian standard code of practice.

UNIT I	DESIGN CONCEPTS AND DESIGN OF BEAMS FOR FLEXURE	9
Design concepts - Concept of elastic method, ultimate load method and limit state method– Advantages of Limit State method over other methods –Design of rectangular beam section by working stress method – Limit state method of design of singly reinforced, doubly reinforced and flanged beams - use of design aids for flexure		**CO1**
UNIT II	**LIMIT STATE DESIGN OF BEAMS FOR SHEAR, TORSION AND SERVICEABILITY**	**9**
Limit state design of RC beams for shear and torsion - Design of RC beams for combined bending, shear and torsion – Use of design aids - Design requirement for bond and anchorage as per IS code – Detailing of reinforcement – Concept of Serviceability - Serviceability requirements for deflection.		**CO2**
UNIT III	**LIMIT STATE DESIGN OF SLABS AND STAIRCASE**	**9**
Behaviour of one way and two way slabs - Design of one way simply supported, cantilever and Continuous slabs - Design of two-way slabs for various edge conditions - Torsion reinforcement at corners - Design of flat slabs - Types of staircases - Design of dog-legged staircase.		**CO3**
UNIT IV	**LIMIT STATE DESIGN OF COLUMNS**	**9**
Types of columns –Axially Loaded columns – Design of short Rectangular, Square and Circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves		**CO4**
UNIT V	**LIMIT STATE DESIGN OF FOOTINGS**	**9**
Concepts of Proportioning footings and foundations based on soil properties-Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular pad and sloped footings – Design of Combined Rectangular footing for two columns only.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. B.C. Punmia. Ashok K. Jain and Arun K. Jain, Limit State design of Reinforced Concrete, Laxmi Publications (P) Ltd., New Delhi, 2016.
2. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2017

REFERENCE BOOKS

1. Unnikrishna Pillai and Devdas Menon, Reinforced Concrete Design (Third Edition), Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 3rd Edition, 2017.
2. N. Subramanian, Design of Reinforced Concrete Structures, Oxford University Press, New Delhi, 2014.
3. P.C. Varghese, Limit State Design of Reinforced Concrete, Prentice Hall of India, Pvt. Ltd., New Delhi, Second Edition, 2008.

4.	S.N. Sinha, Reinforced Concrete Design, Tata McGraw-Hill, New Delhi, 2002

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the various design concepts and design a beam under flexure and draw the reinforcement details.
CO2	Design the beam under shear and torsion, Calculate the anchorage and development length and check the serviceability requirements for RC structural elements.
CO3	Design a RC slab and staircase and draw the reinforcement details.
CO4	Design columns for axial, uniaxial and biaxial eccentric loadings.
CO5	Design of footing by limit state method.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	3	1	1	3	3	3	3	3	3	3
CO2	3	3	2	3	-	3	1	1	3	3	3	3	3	3	3
CO3	3	3	2	3	-	3	1	1	3	3	3	3	3	3	3
CO4	3	3	2	3	-	3	1	1	3	3	3	3	3	3	3
CO5	3	3	2	3	-	3	1	1	3	3	3	3	3	3	3

CE1507	ENVIRONMENTAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- This subject includes the list of experiments to be conducted for characterization of water and municipal sewage. At the end of the course, the student is expected to be aware of the procedure for quantifying quality parameters for water and sewage.

EXERCISES

1. Determination of pH by using pH Meter
2. Determination of Turbidity using Turbidity Meter
3. Determination of Conductivity
4. Determination of Total Hardness
5. Determination of Alkalinity and Acidity
6. Determination of Chlorides
7. Determination of Sulphates
8. Determination of Iron and fluoride
9. Determination of Available Chlorine in bleaching powder
10. Determination of Residual chlorine
11. Determination of MPN index of given water sample
12. Coagulation and Precipitation process for treating wastewater
13. Determination of Phosphates
14. Determination of suspended, Volatile, Fixed and Settleable solids in wastewater
15. Determination of Dissolved Oxygen for the given sample
16. Determination Chemical Oxygen Demand in Wastewater
17. Determination of BOD for the given sample
18. Determination of SVI of Biological sludge and microscopic examination
19. Determination of Concentration of Metal ions using Flame Photometer (Study)
20. Determination of various elements using Atomic Absorption Spectroscopy (Study).

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim “Wastewater Treatment Plants”, CRC Press, Washington D.C.,2010
4. Gray N.F, “Water Technology”, Elsevier India Pvt. Ltd., New Delhi, 2006
5. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers,New Delhi, 2015

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1	Turbidity Meter	1
2	Flame Photometer	1

3	COD Digeter	1
4	Jar Test Apparatus	2
5	Dissolved Oxygen Meter	1
6	Atomic Absorption Spectroscopy	1
7	BOD Analyser	1
8	Ion Selective Electrode-Fluoride, Calcium, Nitrate	1
9	UV-Spectrophotometer	1
10	Gas Chromotography NETEL Model:9100	1

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Quantify the pollutant concentration in water and wastewater
CO2	Suggest the type of treatment required and amount of dosage required for the treatment
CO3	Examine the conditions for the growth of micro-organisms
CO4	Suggest the type of treatment required to reduce e-coli in water
CO5	Compare the analysis of treated water among different treatments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	3	-	3	-	-	1	-	-	1	-	-	3	-	2
CO2	-	1	-	1	-	-	3	-	-	1	-	-	1	-	3
CO3	-	3	-	3	-	-	1	-	-	1	-	-	3	-	3
CO4	-	1	-	1	-	-	3	-	-	1	-	-	1	-	3
CO5	-	1	-	1	-	-	1	-	-	1	-	-	1	-	3

CE1508	SOIL MECHANICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To develop skills for testing the index and engineering properties of soil
- To characterize and classify the soil based on its properties

EXERCISES

1. DETERMINATION OF INDEX PROPERTIES

a. Specific gravity of soil

b. Grain size distribution – Sieve analysis

c. Grain size distribution - Hydrometer analysis

d. Liquid limit and Plastic limit tests

e. Shrinkage limit and Differential free swell tests

2. DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS

a. Field density Test (Sand replacement method and core cutter method)

b. Determination of moisture – density relationship using standard Proctor compaction test.

c. Determination of relative density (Demonstration only)

3. DETERMINATION OF ENGINEERING PROPERTIES

a. Permeability determination (constant head and falling head methods)

b. One dimensional consolidation test (Determination of Co-efficient of consolidation only)

c. Direct shear test in cohesionless soil

d. Unconfined compression test in cohesive soil

e. Laboratory vane shear test in cohesive soil

f. Tri-axial compression test in cohesionless soil (Demonstration only)

g. California Bearing Ratio Test

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Soil Engineering Laboratory Instruction Manual" published by Engineering College Co-operative Society, Anna University, Chennai, 2010.
2. Saibaba Reddy, E. Ramasastri, K. "Measurement of Engineering Properties of Soils", New age International (P) limited publishers, New Delhi, 2008.
3. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.
5. Braja M.Das., "Soil Mechanics: Laboratory Manual", Oxford University Press, eighth edition, 2012.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1	Density Bottles	3
2	Sieves	2 sets
3	Hydrometer	2 sets
4	Liquid and Plastic limit apparatus	2 sets
5	Shrinkage limit apparatus	3 sets
6	Proctor Compaction apparatus	2 sets
7	UTM of minimum of 20kN capacity	1
8	Direct Shear apparatus	1
9	Thermometer	2
10	Sand replacement method accessories	2
11	Core cutter method accessories	2
12	Tri-axial Shear apparatus	1
13	Three Gang Consolidation test device	1
14	Relative Density apparatus	1
15	Vane Shear apparatus	1
16	Weighing machine – 10 kg capacity	1
17	Weighing machine – 1kg capacity	1
18	Constant Head Permeability apparatus accessories	1 set
19	Falling Head Permeability apparatus accessories	1 set
20	California Bearing Ratio Testing Machine & accessories	1 set

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Conducting tests to determine the index properties of soils (coarse and fine)
CO2	Classifying soil based on index properties of soils (coarse and fine)
CO3	Determining the insitu density and compaction characteristics
CO4	Conducting tests to determine the compressibility, permeability and shear strength of soils, and
CO5	Characterizing the soil based on its properties

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	3	1	-	-	-	-	-	1	2	2	-	3
CO2	3	3	1	3	-	1	-	-	-	1	-	3	2	-	3
CO3	3	1	1	3	1	-	-	-	-	-	1	2	2	-	3
CO4	3	1	1	3	1	-	-	-	-	-	1	2	2	-	3
CO5	3	3	1	3	-	1	-	-	-	1	-	3	2	-	3

CE1601	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the needs and mode of irrigation.
- To study about minimizing water losses and on farm development works.
- To learn the concepts involved in elementary hydraulic design of different structures and its maintenance.
- To learn about Irrigation water management.

UNIT I	**PRINCIPLES OF IRRIGATION**	**9**
Need for irrigation – Advantages and ill effects – Development of irrigation – National Water Policy – Tamil Nadu scenario - Physical properties of soil that influence soil moisture characteristics – Concept of soil water potential and its components - Retention of water in soils - Concept of available water – Movement of water into and within the soils – Measurement of soil moisture content.		**CO1**
UNIT II	**CROP WATER REQUIREMENT**	**9**
Necessity and importance– Crop and crop seasons in India –Duty, Delta, Base Period– Factors affecting Duty-Irrigation efficiencies– Consumptive use of water-Irrigation requirements of crops - Standards for irrigation water		**CO2**
UNIT III	**DIVERSION AND IMPOUNDING STRUCTURES**	**9**
Head works –Weirs and Barrages –Types of impounding structures - Factors affecting, location of dams -Forces on a dam -Design of Gravity dams; Earth dams, Arch dams – Spillways - Energy dissipaters		**CO3**
UNIT IV	**CANAL IRRIGATION**	**9**
Classification of canals- Alignment of canals – Design of irrigation canals– Regime theories - Canal Head works – Canal regulators - Canal drops – Cross drainage works – Canal Outlets, Escapes –Lining and maintenance of canals – Other methods of Irrigation: Surface, Subsurface – Merits and Demerits.		**CO4**
UNIT V	**IRRIGATION WATER MANAGEMENT**	**9**
Modernization techniques – Rehabilitation – Command Area Development - Systems of rice intensification - Water delivery systems - Participatory Irrigation Management – Farmers' organization and turn over – Water users' associations - Economic aspects of irrigation.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Sharma, R.K., and Sharma, T.K., "Irrigation Engineering", S. Chand and Company, New Delhi, 2008.
2. Garg, S.K., "Irrigation Engineering," Laxmi Publications, New Delhi, 2008.

REFERENCE BOOKS

1. Arora, K.R., "Irrigation, Water Power and Water Resources Engineering", Standard Publishers Distributors, New Delhi, 2009.
2. Basak, N.N., "Irrigation Engineering", Tata McGraw-Hill Publishing Co, New Delhi, 2008.
3. Punmia, B.C., "Irrigation and Water Power Engineering", Laxmi Publishers, New Delhi, 2008.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe the national water policy structure and soil plant water characteristics
CO2	Describe the basics of requirements and estimation of crop water
CO3	Design the various types of hydraulic structure includes dams, spillways and dissipaters
CO4	Design the components of irrigation canal includes canal drops and cross
CO5	Apply the concepts of Irrigation water management, water user association for participatory irrigation management

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	2		2	-	3	-	3	-	2	3	2	-
CO2	-	1	3	-	2	-	-	3	2	-	2	2	3	3	-
CO3	3	3	-	3		3	-	-	-	-	3	-	3	3	2
CO4	3	3	-	-	-	3	-	-	-	-	3	-	3	3	2
CO5	-	1	-	2	2	3	-	1	3	3	3	-	3	2	2

CE1602	CONSTRUCTION MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to learn about planning of construction projects, scheduling procedures and techniques, cost and quality control projects and use of project information as decision making tool.

UNIT I	CONSTRUCTION PLANNING	9
Basic concepts in the development of construction plans-Choice of Technology and Construction method-Defining Work Tasks- Work breakdown structure- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.		CO1
UNIT II	**SCHEDULING PROCEDURES AND TECHNIQUES**	**9**
Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads, lags and windows-Resource oriented scheduling-Scheduling with resource constraints and precedence's -Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost tradeoffs -Improving the Scheduling process – Introduction to application software.		CO2
UNIT III	**COST CONTROL MONITORING AND ACCOUNTING**	**9**
The cost control problem-The project budget-Forecasting for Activity cost control - financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule.		CO3
UNIT IV	**QUALITY CONTROL AND SAFETY IN CONSTRUCTION**	**9**
Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety in Construction.		CO4
UNIT V	**ORGANIZATION AND PROJECT INFORMATION SYSTEM**	**9**
Types of project information-Accuracy and Use of Information-Computerized organization and use of Information - Organizing information in databases-relational model of Data bases-Other conceptual Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chitkara, K.K. "Construction Project Management Planning", Scheduling and Control, Tata McGraw Hill Publishing Co., New Delhi, 2014
2. Srinath,L.S., "Pert and CPM Principles and Applications", Affiliated East West Press, 2001.
3. Albert Lester, Project Management, Planning and Control, 7th Edition, Butterworth-Heinemann, USA , 2017.

REFERENCE BOOKS

1. Chris Hendrickson and Tung Au, “Project Management for Construction – Fundamentals
2. Concepts for Owners”, Engineers, Architects and Builders, Prentice Hall, Pitsburgh, 2000.
3. Moder.J., Phillips. C. and Davis E, “Project Management with CPM”, PERT and Precedence Diagramming, Van Nostrand Reinhold Co., 3rd Edition, 1985.
4. Willis., E.M., “Scheduling Construction projects”, John Wiley and Sons, 1986.
5. Halpin,D.W., “Financial and Cost Concepts for Construction Management”, John Wiley and Sons, New York, 1985.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire basic concepts of construction planning.
CO2	Schedule the construction activities using critical path method.
CO3	Forecast and control the cost in a construction using various tools.
CO4	Recognize the various quality control tool required in the construction Industry.
CO5	Explain the different databases that can be maintained in a construction industry using computers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	3	1	-	-	-	3	-	3	2	-
CO2	-	3	3	-	3	-	1	-	-	-	3	-	3	2	3
CO3	-	3	-	-	3	-	1	-	-	-	3	-	-	2	-
CO4	3	-	-	-	3	1	1	-	-	-	2	-	-	-	-
CO5	1	2	3	-	3	1	1	-	-	-	2	-	-	3	-

CE1603	DESIGN OF STEEL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students to limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections.
- To provide the students the tools necessary for designing structural systems such as roof trusses and gantry girders as per provisions of current code (IS 800 - 2007) of practice.

UNIT I	INTRODUCTION AND ALLOWABLE STRESS DESIGN	9
Structural steel types – Mechanical Properties of structural steel- Indian structural steel products- Steps involved in the Deign Process -Steel Structural systems and their Elements- -Type of Loads on Structures and Load combinations- Code of practices, Loading standards and Specifications - Concept of Allowable Stress Method, and Limit State Design Methods for Steel structures-Relative advantages and Limitations-Strengths and Serviceability Limit states. Allowable stresses as per IS 800 section 11 -Concepts of Allowable stress design for bending and Shear –Check for Elastic deflection-Calculation of moment carrying capacity –Design of Laterally supported Solid Hot Rolled section beams-Allowable stress deign of Angle Tension and Compression Members and estimation of axial load carrying capacity.		**CO1**
UNIT II	**CONNECTIONS**	**9**
Design of Simple and eccentric Bolted and welded connections - Types of failure and efficiency of joint – prying action - Introduction to HSFG bolts		**CO2**
UNIT III	**TENSION MEMBERS**	**9**
Tension Members - Types of Tension members and sections –Behavior of Tension Members-modes of failure-Slenderness ratio- Net area – Net effective sections for Plates, Angles and Tee in tension –Concepts of Shear Lag- Design of plate and angle tension members-design of built-up tension Members-Connections in tension members – Use of lug angles – Design of tension splice.		**CO3**
UNIT IV	**COMPRESSION MEMBERS**	**9**
Types of compression members and sections–Behavior and types of failures-Short and slender columns- Current code provisions for compression members- Effective Length, Slenderness ratio –Column formula and column curves- Design of single section and compound Angles-Axially Loaded solid section Columns- Design of Built up Laced and Battened type columns – Design of column bases – Plate and Gusseted bases for Axially loaded columns- Splices for columns.		**CO4**
UNIT V	**FLEXURAL MEMBERS**	**9**
Types of steel Beam sections- Behaviour of Beams in flexure- Codal Provisions – Classification of cross sections- Flexural Strength and Lateral stability of Beams –Shear Strength-Web Buckling, Crippling and defection of Beams- Design of laterally supported Beams- Design of solid rolled section Beams- Design of Plated beams with cover plates - Design Strength of Laterally unsupported Beams – Design of laterally unsupported rolled section Beams- Purlin in Roof Trusses-Design of Channel and I section Purlins.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi,

	2010
2.	Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi, 2017.

REFERENCE BOOKS

1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013
2. Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.
3. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014
4. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Familiarize with the aspects of structural behavior of steel structures, Design philosophies
CO2	Understand the design problems in bolted, riveted and welded connections
CO3	Analyze and design most suitable section for tension members and tension splices
CO4	Analyze and design most suitable section for compression members and column bases
CO5	Undertake design problems on beams – laterally supported and unsupported. and to analyze and design roof trusses and industrial trusses

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	1	1	-	-	-	3	3	2
CO2	3	3	3	2	-	-	-	2	1	-	-	-	3	3	2
CO3	3	3	3	2	-	-	-	2	1	-	-	-	3	3	2
CO4	3	3	3	2	-	-	-	2	1	-	-	-	3	3	2
CO5	3	3	3	2	-	-	-	2	1	-	-	-	3	3	2

CE1607	CONSTRUCTION MATERIALS AND HIGHWAY ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To learn the principles and procedures of testing Construction Materials and Highway materials and to get hands on experience by conducting the tests and evolving inferences.

EXERCISES

I.TESTS ON CEMENT AND AGGREGATES

a. Consistency and setting time
b. Specific Gravity
c. Gradation of Aggregate
d. Crushing Strength
e. Abrasion Value
f. Impact Value
g. Water Absorption
h. Flakiness and Elongation Indices

II .TESTS ON FRESH CONCRETE

a. Slump cone test
b. Flow table
c. Compaction factor
d. Vee bee test.

III.TESTS ON HARDENED CONCRETE

a. Compressive strength - Cube & Cylinder
b. Flexure test
c. Modulus of Elasticity

IV .TESTS ON BITUMEN

a. Penetration
b. Softening Point
c. Ductility
d. Flash and fire points.
e. Viscosity
f. Density

V. TESTS ON BITUMINOUS MIXES

a. Determination of Binder Content
b. Marshall Stability and Flow values

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. IS 4031 (Part 1) – 1996 – Indian Standard Method for determination of fineness by drysieving.
2. IS 2386 (Part 1 to Part 6) – 1963 – Indian Standard methods for test for aggregate for concrete

3. IS 383 – 1970 Indian Standard specification for coarse and fine aggregates from natural sources for concrete.
4. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
5. Methods for testing tar and bituminous materials, IS 1201–1978 to IS 1220– 1978, Bureau of Indian Standards
6. Methods of test for aggregates, IS 2386 – 1978, Bureau of Indian Standards
7. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition,1997, Lexington, KY, USA.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
1.	Concrete cube moulds	6
2.	Concrete cylinder moulds	3
3.	Concrete Prism moulds	3
4.	Sieves	2 sets
5.	Concrete Mixer	1
6.	Slump cone	3
7.	Flow table	1
8.	Vibrator	1
9.	Trovels and planers	1 set
10.	UTM – 400 kN capacity	1
11.	Vee Bee Consistometer	1
12.	Aggregate impact testing machine	1
13.	Blains Apparatus	1
14.	Los - Angeles abrasion testing machine	1
15.	Length gauge	2
16.	Thickness gauge	2
17.	Compressometer	1
18.	Marshall Stability Apparatus	1
19.	Penetrometer	1
20.	Tar Viscometer	1
21.	Ring and Ball Apparatus	1
22.	Ductility Testing Machine	1
23.	Centrifuge Extractor - (Motorized)	1
24.	Flash & Fire Point Apparatus	1
25.	Vicat apparatus	3
26.	Mortor cubes	6

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	To do tests on Aggregates and cement as per IS codes of practice
CO2	To do tests on fresh concrete as per IS codes of practice
CO3	To do tests on hardened as per IS codes of practice
CO4	To do tests on bitumen as per IS codes of practice
CO5	To gain knowledge on bituminous design mix

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	2	2	2	1	1	2	2	2	-	2
CO2	3	2	1	1	1	1	3	2	1	1	2	3	3	-	3
CO3	3	2	2	1	1	2	3	2	1	1	2	3	3	-	3
CO4	3	1	1	1	1	2	3	2	1	1	2	2	2	-	2
CO5	2	1	2	1	1	2	2	1	1	1	1	1	3	-	2

CE1608	IRRIGATION AND ENVIRONMENTAL ENGINEERING DRAWING	L	T	P	C
		0	0	4	2

OBJECTIVES

- At the end of the semester, the student shall conceive, design and draw the irrigation and environmental engineering structures in detail showing the plan, elevation and sections.

EXERCISES

PART A: IRRIGATION ENGINEERING

1. TANK COMPONENTS **9**

Fundamentals of design - Tank surplus weir – Tank sluice with tower head - Drawings showing foundation details, plan and elevation.

2. IMPOUNDING STRUCTURES **6**

Design principles - Earth dam – Profile of Gravity Dam

3. CROSS DRAINAGE WORKS **6**

General design principles - Aqueducts – Syphon aqueduct (Type III) – Canal drop (Notch Type) – Drawing showing plan, elevation and foundation details.

4. CANAL REGULATION STRUCTURES **9**

General Principles - Direct Sluice - Canal regulator - Drawing showing detailed plan, elevation and foundation details.

PART B: ENVIRONMENTAL ENGINEERING

1. WATER SUPPLY AND TREATMENT **10**

Design and Drawing of flash mixer, clari-flocculator – Rapid sand filter – Pressure sand filter- Service reservoirs – House service connection for water supply and drainage.

2. SEWAGE TREATMENT & DISPOSAL **20**

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process – Sequencing Batch reactor – Trickling filter – Waste stabilization ponds –Anaerobic sludge digester – Sludge drying beds –- Septic tanks and disposal arrangements.

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Satya Narayana Murthy Challa, “Water Resources Engineering: Principles and Practice”, New Age International Publishers, New Delhi, 2002.
2. Garg, S.K., “Irrigation Engineering and Design of Structures”, New Age International Publishers, New Delhi, 1997.
3. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.

4. Manual on “Sewerage and Sewage Treatment Systems- Part A, B and C” CPHEEO,Ministry of Urban Development, Government of India, New Delhi, 2013.
5. Qasim,S.R., Motley, E.M and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2009.
6. Qasim, S. R. "Wastewater Treatment Plants, Planning, Design & Operation", CRC Press, New York, 2010

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl.No	Description of Equipment	Quantity
	NA	

COURSE OUTCOMES

Upon completion of the course, students will be

CO1	Design and draw tank surplus weir and tank sluice with tower head, earth dam and its profile
CO2	Design and draw -Aqueducts – Syphon aqueduct (Type III) – Canal drop (Notch Type)
CO3	Design and draw - Direct Sluice - Canal regulator
CO4	Design and draw flash mixer, flocculator, clarifier – Rapid sand filter – Service reservoirs – Pumping station – House service connection for water supply and drainage.
CO5	Design and draw screen chamber - Grit channel - Primary clarifier - Activated sludge process – Aeration tank – Trickling filter – Sludge digester – Sludge drying beds – Septic tanks and disposal arrangements.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	3	-	-	-	-	-	-	-	-	3	1	2
CO2	3	1	3	3	-	-	-	-	-	-	-	-	3	1	2
CO3	3	1	3	3	-	-	-	-	-	-	-	-	3	1	2
CO4	3	1	3	3	-	-	-	-	-	-	-	-	3	1	2
CO5	3	1	3	3	-	-	-	-	-	-	-	-	3	1	2

CE1701	ESTIMATION, COSTING AND VALUATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge in estimation, tender practices, contract procedures, and valuation of Civil Engineering works.

UNIT I	**QUANTITY ESTIMATION**	**9**
Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, Septic tank, roads and retaining wall		**CO1**
UNIT II	**RATE ANALYSIS AND COSTING**	**9**
Standard Data – Observed Data – Schedule of rates – Market rates – Assessment of Man Hours and Machineries for common civil works – Rate Analysis – Cost Estimates using Computer softwares.		**CO2**
UNIT III	**SPECIFICATIONS, REPORTS AND TENDERS**	**9**
Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads - TTT Act 2000 – Tender notices – types – tender procedures – Drafting model tenders , E-tendering-Digital signature certificates- Encrypting -Decrypting – Reverse auctions.		**CO3**
UNIT IV	**CONTRACTS**	**9**
Contract – Types of contracts – Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD / MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements		**CO4**
UNIT V	**VALUATION**	**9**
Definitions – Various types of valuations – Valuation methods – Valuation of land – Buildings – Valuation of plant and machineries - Calculation of Standard rent – Mortgage – Lease.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. B.N Dutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2010.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', University Press, 2006

REFERENCE BOOKS

1. Hand Book of Consolidated Data – 8/2000, Vol.1, TNPWD
2. Tamil Nadu Transparencies in Tenders Act, 2000
3. Standard Databook for analysis and rates
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the basic concept of quantity estimation for building, roads, canals and hydraulic structures by manual and software packages

CO2	Acquire the knowledge to calculate rate analysis and man-hours required for the common civil works by manual and software packages
CO3	Develop the specification for the materials used in construction, online and offline tender procedures and tender document preparation and report preparation.
CO4	Acquire the knowledge of construction contracts and contract document preparation.
CO5	Identify the valuation for building, land and plant and machineries, calculation of rent, mortgage and lease.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	2	2	1
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	2	2

CE1702	**STRUCTURAL DESIGN AND DRAWING** (Lab Integrated)	L	T	P	C
		3	0	2	4

Objectives

- To provide the students a solid background on the principles of structural engineering design. They can able to design and detail various special structures like Retaining walls, Flat slabs, water tanks, Plate girder and Gantry girder

Course Outcomes (CO)

CO1	Design and draw retaining walls
CO2	Design and draw flat slabs and solid slab bridge
CO3	Design and draw Rcc and steel water tanks
CO4	Design and draw plate and Gantry girders
CO5	Design and draw steel Truss and Purlins

UNIT - I	RETAINING WALLS	9+6

Reinforced concrete Cantilever and Counter fort Retaining Walls–Horizontal Backfill with Surcharge–Design of Shear Key-Design and Drawing.

UNIT - II	FLAT SLAB and BRIDGES	9+6

Design of Flat Slabs with and without drops by Direct Design Method of IS code- Design and Drawing - IRC Specifications and Loading – RC Solid Slab Bridge – Design and Drawing

UNIT - III	LIQUID STORAGE STRUCTURES	9+6

RCC Water Tanks - On ground, Elevated Circular, underground Rectangular Tanks–Hemispherical Bottomed Steel Water Tank –-Design and Drawing

UNIT - IV	GIRDERS AND CONNECTIONS	9+6

Plate Girders – Behaviour of Components-Deign of Welded Plate Girder-Design of Industrial Gantry Girders – Design of Eccentric Shear and Moment Resisting connections.

UNIT - V	INDUSTRIAL STRUCTURES	9+6

Structural steel Framing - Steel Roof Trusses – Roofing Elements – Codal provisions - Design and Drawing.

Total Periods: 75

DESIGN AND DRAWING EXERCISES FOR PRACTICAL COMPONENT
1. Rectangular Column and Footing
2. Combined footing with Two columns
3. RCC one way &Two way Slab and beam system
4.Underground Rectangular Water Tank
5.Elevated circular water Tank
6.Built up column, column base and Foundation
7.Framed Connections and Detailing

8.Plate Girder – welded

Text Books:

1. Krishnaraju N, Structural Design and Drawing, Universities Press, 2009.

2. Punmia B.C,Ashok Kumar Jain and Arun KumarJain,Comprehensive Design of Steel Structures, Laxmi Publications Pvt. Ltd., 2003.

Reference Books:

1. Krishnamurthy D,Structural Design and Drawing VolI,IIandIII,CBS Publishers, 2010.

2. Shah V L and Veena Gore,Limit State Design of Steel Structures

3. IS 800-2007,Structures Publications, 2009.

4. IS 456(2000) Indian Standard Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi.

5.SP34 Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.

6. IS 800 (2007) Indian Standard General Construction In Steel—Code of Practice, Bureau of Indian Standards, New Delhi.

7.IS 875 Part 1 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Dead Load, Bureau of Indian Standards, New Delhi.

8. IS 875 Part 2 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Imposed Load, Bureau of Indian Standards, New Delhi.

9. IS 875 Part 3 (2003) Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Code of Practice-Wind Load, Bureau of Indian Standards, New Delhi.

10. IS 3370 Part 1 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice–General Requirements, Code of Practice, Bureau of Indian Standards, New Delhi.

11. IS 3370 Part 2 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice-Reinforced Concrete Structures, Code of Practice, Bureau of Indian Standards, New Delhi.

12. IS 3370–Part 4 (2008) Indian Standard Code of Practice for Concrete Structures for The Storage of Liquids-Design Tables, Code of Practice, Bureau of Indian Standards, New Delhi.

13.IS 804 (2008) Indian Standard Specification for Rectangular Pressed Steel Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.

14.IS 805 (2006) Indian Standard Code of Practice for Use of Steel in Gravity Water Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.

15.IRC 112-2011, Code of Practice for Concrete Road Bridges, The Indian Roads Congress,New Delhi.

16.IRC 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II-Loads and Stresses, The Indian Roads Congress, New Delhi.

CE1707	SUMMER INTERNSHIP / INDUSTRIAL TRAINING (2 weeks during 6th Semester - Summer)	L	T	P	C
		0	0	0	1

OBJECTIVES

- To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. To develop skills in facing and solving the field problems.

STRATEGY

- The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To intricacies of implementation textbook knowledge into practice in the chosen fields of engineering.
CO2	To understand the concepts of developments and implementation of new techniques by conducting research.
CO3	To understand the importance of sustainability and cost-effectiveness in design and developments of engineering solution.
CO4	To be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills through continuous professional development and life-long learning.
CO5	To create an awareness of the social, cultural, global and environmental responsibility as an engineer.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	-	-	-	-	3	3	-	3	3	-	2
CO2	-	-	-	3	-	-	-	-	2	3	-	3	3	-	2
CO3	-	-	-	3	-	-	-	-	2	3	-	2	3	-	3
CO4	-	-	-	1	-	-	-	-	3	3	-	3	2	-	3
CO5	-	-	-	2	-	-	-	-	3	3	-	2	1	-	3

Note:

- No End Semester Examination for this Summer Internship / Industrial Training.
- At the end of the semester, the students will be evaluated through a viva-voce examination by a team of internal staff nominated by the Head of the Institution.

CE1708	DESIGN PROJECT	L	T	P	C
		0	0	4	2

OBJECTIVES

- The objective of this course is to impart and improve the design capability of the student. This course conceives purely a design problem in any one of the disciplines of Civil Engineering; e.g., Design of an RC structure, Design of a waste water treatment plant, Design of a foundation system, Design of traffic intersection etc. The design problem can be allotted to either an individual student or a group of students comprising of not more than four. At the end of the course the group should submit a complete report on the design problem consisting of the data given, the design calculations, specifications if any and complete set of drawings which follow the design.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design any of the Civil Engineering structure
CO2	Interpret data, and synthesis the information to provide valid conclusions.
CO3	Apply appropriate techniques, modern Engineering tools to engineering activities.
CO4	Communicate effectively, manage the team or partner
CO5	Apply ethical principles and commit to professional ethics and responsibilities.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	2	1	3	2	2	3	2	2	1	3
CO2	3	3	2	2	3	2	1	3	2	2	3	2	2	1	3
CO3	3	3	2	2	3	2	1	2	2	3	3	2	1	1	3
CO4	3	3	2	2	3	2	1	2	2	3	3	2	1	1	3
CO5	3	3	2	2	3	2	1	2	2	3	3	2	1	1	3

CE1709	SURVEY TRAINING	L	T	P	C
		0	0	2	1

OBJECTIVES

- To train the students in field work so as to have a firsthand knowledge in carrying out Surveying.
- To develop skills in facing and solving the field problems in Surveying.

STRATEGY

- The training must involve work on a large area of not less than 40 acres continuously for a period of one week.
- Groups of not more than six members will carry out each exercise in the training.
- At the end of the training, each student shall have mapped and contoured the area.
- The training report shall include all original field observations, calculations and plots.

EXERCISES

1. Boundary Survey using Total Station
2. Layout Survey using Total Station
3. Road Survey using Total Station
4. Topographical Survey using Total Station
5. Contour Survey using Total Station
6. Pile and Column marking using Total Station

Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

TOTAL : 30 PERIODS

Note:

- No End Semester Examination for this Survey Training.
- At the end of the training, the students will be evaluated through a viva-voce examination by a team of internal staff nominated by the Head of the Institution.

CE1807	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

STRATEGY:

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Take up any challenging practical problems in Civil Engineering
CO2	Solve the problem from its identification and through literature reviews
CO3	Apply appropriate techniques, modern Engineering tools to solve the problems
CO4	Solve the problem in context with societal and environmental need
CO5	Prepare project reports, presentations and to face interviews

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	3	2	2	3	2	2	2	3
CO2	3	3	2	2	2	2	1	3	2	2	3	2	2	2	3
CO3	3	3	2	2	2	2	1	3	2	3	3	2	2	2	3
CO4	3	3	2	2	2	2	1	3	2	3	3	2	2	2	3
CO5	3	3	2	2	2	2	1	3	2	3	3	2	2	2	3

CE1001	REMOTE SENSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to understand the concepts, components and source of remote Sensing.
- To gain knowledge about different types of remote sensing platforms and sensors
- To explain the concept of satellite image interpretation
- To understand the applications of remote sensing in Civil Engineering

UNIT I	**REMOTE SENSING AND ELECTROMAGNETIC RADIATION**	**9**
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities		**CO1**
UNIT II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL**	**9**
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.		**CO2**
UNIT III	**ORBITS AND PLATFORMS**	**9**
Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit.		**CO3**
UNIT IV	**SENSING TECHNIQUES**	**9**
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV –Orbital and sensor characteristics of live Indian earth observation satellites		**CO4**
UNIT V	**DATA INTERPRETATION AND CIVIL ENGINEERING APPLICATIONS**	**9**
Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys – Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification – Civil Engineering applications: highway and railway alignments, site selection for dams, town and regional planning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2009.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Universities Press (India) Private limited, Hyderabad, 2018

REFERENCE BOOKS

3. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002.
4. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
5. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.
6. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and Jacob Van Zyl, 2006 Edition II, Wiley Publication.
7. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts and laws related to remote sensing
CO2	Understand the interaction of electromagnetic radiation with atmosphere and earth material
CO3	Acquire knowledge about satellite orbits and different types of satellites
CO4	Understand the different types of remote sensors
CO5	Gain knowledge about the concepts of interpretation of satellite imagery and civil engineering applications

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	1	-	-	1	2	2
CO2	-	-	-	-	-	-	-	-	-	3	-	-	2	3	2
CO3	2	-	-	-	-	3	3	-	-	-	-	-	2	1	2
CO4	2	-	2	-	-	-	-	-	-	-	1	2	2	2	1
CO5	2	3	2	3	3	2	3	3	1	-	-	-	3	2	2

CE1002	GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

UNIT I	**FUNDAMENTALS OF GIS**	**9**
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		**CO1**
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – Entities – ER diagram - data models - conceptual, logical and physical models - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.		**CO2**
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input –Digitiser- – Datum Projection and reprojection -Coordinate Transformation – Topology - Adjacency, connectivity and containment – Topological Consistency – Non topological file formats - Attribute Data linking – Linking External Databases – GPS Data Integration		**CO3**
UNIT IV	**DATA QUALITY AND STANDARDS**	**9**
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure		**CO4**
UNIT V	**DATA MANAGEMENT AND OUTPUT**	**9**
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS distributed GIS.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.

CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	1	-	-	-	-	-	-	1	2	2
CO2	2	1	2	2	3	1	-	-	-	-	-	-	2	3	2
CO3	2	1	2	2	3	1	-	-	-	-	-	-	2	1	2
CO4	2	1	2	-	3	1	-	-	-	-	-	-	2	2	1
CO5	2	-	2	-	3	1	-	-	-	-	-	-	3	2	2

CE1003	GEOINFORMATICS APPLICATIONS FOR CIVIL ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To solve the Civil Engineering problems with the help of Geoinformatics technique.

UNIT I	MAP PRODUCTION CONCEPTS	9
Maps - uses — Types of Maps – Map Scales – Map projections — Map co-ordinate systems – Elements of a map - Map Layout principles – Map Design fundamentals – symbols and conventional signs - colours and patterns in symbolization – map lettering - map production – map printing– colours and visualization – map reproduction - Map generalization – geometric transformations – bilinear and affine transformations.		CO1
UNIT II	**GIS AND SPATIAL DATA**	**9**
Data – Information – Primary and Secondary data sources – GIS - Components of a GIS – Hardware, Software, Data, People, Methods - Types of data – Spatial, Attribute data – scales/ levels of measurements - spatial data models - Raster vs Vector Models - Raster Data Structures - TIN and GRID data models.		CO2
UNIT III	**RASTER AND VECTOR DATA ANALYSIS**	**9**
Raster Data analysis: Query Analysis – Local, Focal and Zonal Operations – Cost-Distance Analysis - Least Cost Path – Vector data analysis – attribute data analysis - query, calculations – Integrated data analysis - Reclassification, Aggregation, Overlay analysis: Point-in-polygon, Line1in-Polygon, Polygon-on-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering		CO3
UNIT IV	**NETWORK ANALYSIS**	**9**
Network – Introduction - Network Data Model – Elements of Network - Building a Network database - Geocoding – Address Matching - Shortest Path in a Network – Time and Distance Based shortest path analysis – Driving Directions – Closest Facility Analysis – Catchment / Service Area Analysis-Location-Allocation Analysis.		CO4
UNIT V	**MODELLING AND APPLICATIONS**	**9**
Land Information studies - Building information system – Digital Infrastructure management - Watershed modelling for sustainable development - modelling of reservoir siltation – soil degradation assessment - Highway alignment studies – Intelligent transportation systems – Solid Waste management - Air quality monitoring - Disaster management.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. C.P. Lo Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Second edition, PHI Learning Private Limited, Delhi, 2014.
2. Jonathan E. Campbell, Michael Shin, Essential of Geographic Information System, Saylor Foundation, 2011.

REFERENCE BOOKS

1. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
2. Michael N. DeMers, Fundamentals of geographic information systems, Wiley,2009
3. John Peter Wilson, The handbook of geographic information science, Blackwell Pub.,2008
4. Harvey J.Miller, Shih-Lung Shaw, Geographic Information System for Transportation-

Principle and Applications, Oxford University Press,2001.

5. Kang-Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, 2nd Edition, 2011.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts of map making process.
CO2	Gain knowledge on spatial data and Geographic Information System
CO3	Impart the required skills for analyzing the spatial data useful modelling the real world problems
CO4	Impart the required skills for analyzing the spatial data useful modelling transportation networks and resource transport.
CO5	Gain knowledge on the applicability of Geoinfomatics technology on diverse Civil Engineering Problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	2	2	1
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	2	2

CE1004	ADVANCED SURVEYING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the working of Total Station and GPS and solve the surveying problems.

UNIT I	**FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES**	**9**
Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Classification-applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies		**CO1**
UNIT II	**DISTANCE AND ATMOSPHERIC CORRECTION**	**9**
Refractive index (RI) - factors affecting RI-Computation of group for light and near infrared waves at standard and ambient conditions-Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction - Total atmospheric correction- Use of temperature and pressure transducers.		**CO2**
UNIT III	**ELECTRO OPTICAL AND MICRO WAVE SYSTEM**	**9**
Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments – Traversing and Trilateration-COGO functions, offsets and stake out-land survey applications.		**CO3**
UNIT IV	**GPS SATELLITE SYSTEM**	**9**
Basic concepts of GPS - Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion - Keplerian motion – Kepler‘s Law - Perturbing forces – Geodetic satellite - Doppler effect - Positioning concept –GNSS, IRNSS and GAGAN - Different segments - space, control and user segments - satellite configuration – GPS signal structure – Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - GPS receivers.		**CO4**
UNIT V	**GPS DATA PROCESSING**	**9**
GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data RINEX Format – Differential data processing – software modules -solutions of cycle slips, ambiguities, Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -satellite geometry & accuracy measures - applications- long baseline processing- use of different softwares.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. Satheesh Gopi, rasathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. isbn: 978-81317 00679

REFERENCE BOOKS

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983.
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin,3rd

Edition,2016.

4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.
5. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin,2nd Edition,2003.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Learn the fundamentals of Total station.
CO2	Provides knowledge about electromagnetic waves and its usage in Total station and GPS.
CO3	Understand the measuring and working principle of electro optical and Microwave Total station and GPS
CO4	Learn the basic concepts of GPS
CO5	Gains knowledge about Total station and GPS data downloading and processing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	1	2	2	2	1	3	2	1	2	1	2	1
CO2	1	2	2	2	1	2	2	1	2	2	2	1	2	3	2
CO3	1	2	1	1	2	1	2	1	2	1	1	2	2	1	2
CO4	1	1	1	1	3	1	1	1	1	1	1	3	2	2	2
CO5	1	3	1	1	3	1	2	1	3	1	1	3	3	2	3

CE1005	AIR POLLUTION AND CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

UNIT I	**AIR QUALITY**	**9**
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.		**CO1**
UNIT II	**ATMOSPHERIC DISPERSION OF AIR POLLUTANT**	**9**
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise		**CO2**
UNIT III	**CONTROL OF PARTICULATE POLLUTANTS**	**9**
Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.		**CO3**
UNIT IV	**CONTROL OF GASEOUS POLLUTANTS**	**9**
Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing.		**CO4**
UNIT V	**INDOOR AIR QUALITY**	**9**
Sources types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution – Measurement – Standards–Control and Preventive measures.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies‟ , Allied Publishers (P) Ltd., India 2002

REFERENCE BOOKS

1. David H.F. Liu, Bela G. Liptak „Air Pollution‟ , Lweis Publishers, 2000.
2. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)‟ , Academic Press, 2006.
3. Wayne T.Davis, „Air Pollution Engineering Manual‟ , John Wiley & Sons, Inc.,2000

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the chemistry of atmosphere, characterize the air pollutants ,know

	the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics ,science and engineering fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise ,and select suitable method for measuring and control of noise pollution

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	2	3
CO2	2	1	-	-	-	-	-	-	-	-	-	-	1	2	3
CO3	3	2	-	-	-	1	-	-	-	-	-	-	2	3	3
CO4	3	2	-	-	-	1	-	-	-	-	-	-	2	3	3
CO5	3	2	-	-	-	1	-	-	-	-	-	-	2	3	3

CE1006	ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

UNIT I	**INTRODUCTION**	**9**
Impacts of Development on Environment – Rio Principles of Sustainable Development-Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework.		**CO1**
UNIT II	**ENVIRONMENTAL ASSESSMENT**	**9**
Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.		**CO2**
UNIT III	**ENVIRONMENTAL MANAGEMENT PLAN**	**9**
Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Public Hearing-Environmental Clearance		**CO3**
UNIT IV	**SOCIO ECONOMIC ASSESSMENT**	**9**
Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis		**CO4**
UNIT V	**CASE STUDIES**	**9**
EIA case studies pertaining to Infrastructure Projects – Roads and Bridges – Mass Rapid Transport Systems - Airports - Dams and Irrigation projects - Power plants.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Canter, R.L, “Environmental impact Assessment “, 2nd Edition, McGraw Hill Inc, New Delhi,1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, “Environmental Impact Assessment for Developing Countries in Asia”, Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel “Methods of Environmental Impact Assessment”, Routledge Publishers,2009.

REFERENCE BOOKS

1. Becker H. A., Frank Vanclay,“The International handbook of social impact assessment” conceptual and methodological advances, Edward Elgar Publishing,2003.
2. Barry Sadler and Mary McCabe, “Environmental Impact Assessment Training Resource Manual”, United Nations Environment Programme,2002.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol. I and II”, Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Carry out scoping and screening of developmental projects for environmental and social

	assessments
CO2	Explain different methodologies for environmental impact prediction and assessment
CO3	Plan environmental impact assessments and environmental management plans
CO4	Evaluate environmental impact assessment reports
CO5	Mitigate the environmental and social impacts of developmental projects

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	2	2	1	3	2	1	2	1	2	2
CO2	3	2	-	-	-	2	2	1	2	2	2	1	2	3	2
CO3	3	2	-	-	-	1	2	1	2	1	1	2	2	1	2
CO4	3	2	-	-	-	1	1	1	1	1	1	3	2	2	1
CO5	3	2	-	-	-	1	2	1	3	1	1	3	3	2	2

CE1007	INDUSTRIAL WASTEWATER TREATMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on composition treatment and effective disposal of industrial effluents

UNIT I	**SOURCES OF POLLUTANTS**	**9**
Sources of Pollution - Physical, Chemical, Organic & Biological properties of Industrial Wastes - Difference between industrial & municipal waste waters - Effects of industrial effluents on sewers and Natural water Bodies.		**CO1**
UNIT II	**PRIMARY TREATMENT OF POLLUTANTS**	**9**
Pre & Primary Treatment - Equalization, Proportioning, Neutralization, Oil separation by Floating-Waste Reduction-Volume Reduction-Strength Reduction.		**CO2**
UNIT III	**WASTE TREATMENT METHODS**	**9**
Waste Treatment Methods - Nitrification and De-nitrification-Phosphorous removal -Heavy metal removal - Membrane Separation Process - Air Stripping and Absorption Processes - Special Treatment Methods - Disposal of Treated Waste Water.		**CO3**
UNIT IV	**CHARACTERISTICS AND COMPOSITION OF INDUSTRIAL WASTEWATER**	**9**
Characteristics and Composition of waste water and Manufacturing Processes of Industries like Sugar, Characteristics and Composition of Industries like Food processing Industries, Tanneries - Joint Treatment of Raw Industries waste water and Domestic Sewage.		**CO4**
UNIT V	**OIL REFINERS, PHARMACEUTICAL PLANTS**	**9**
Characteristics and Composition of Industries like Textiles, and other Mineral Processing Industries – Steel, and Petroleum Refineries – Common Effluent Treatment Plants(CETP) – Location, Design, Operation and Maintenance Problems – Economical aspects.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Handbook of Industrial Waste Disposal by Richard A. Conway Richard Ross– Van Nostrand publisher (1980)
2. Eckenfelder, W.W., “Industrial Water Pollution Control”, McGraw-Hill
3. Metcalf & Eddy, “Wastewater engineering Treatment disposal reuse”, Tata McGraw Hill

REFERENCE BOOKS

1. Industrial Waste Treatment: Contemporary Practice and Vision for the Future by Nelson Leonard Nemerow, Nemerow – Butterworth Weinemann publisher (2006)
2. Wastewater Treatment by M. N. Rao and A. K. Datta–Oxford I. B. H publishers
3. C.G. Gurnham –Principles of Industrial Waste Engineering.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Distinguish between the quality of domestic and industrial water requirements and Wastewater quantity generation
CO2	Understand the industrial process, water utilization and waste water generation
CO3	Impart knowledge on selection of treatment methods for industrial wastewater
CO4	Acquire the knowledge on operational problems of common effluent treatment plants.

CO5	Gain knowledge on different techniques and approaches for minimizing the generation and application of Physio chemical and biological treatment methods for recovery, reuse and disposal of industrial wastewater.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	3	3	-	2	-	3	2	1	2	-	2	2
CO2	3	1	-	3	3	-	2	-	3	2	1	2	-	2	2
CO3	3	1	-	3	3	-	2	-	3	2	1	2	-	2	2
CO4	3	1	-	3	3	-	2	-	3	2	1	2	-	2	2
CO5	3	1	-	3	3	-	2	-	3	2	1	2	-	2	2

CE1008	MUNICIPAL SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste

UNIT I	**SOURCES AND CHARACTERISTICS**	**9**
Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management –Social and Financial aspects – I solid waste (M&H) rules – integrated solidwaste management-Public awareness; Role of NGO‟ s- Public Private participation.		**CO1**
UNIT II	**ON-SITE STORAGE AND PROCESSING**	**9**
On-site storage methods – Effect of storage, materials used for containers – segregation of solid wastes – Public health and environmental aspects of open storage – waste segregation and storage – case studies under Indian conditions – source reduction of waste – Reduction, Reuse and Recycling of plastic waste –Construction and Demolishing waste.		**CO2**
UNIT III	**COLLECTION AND TRANSFER**	**9**
Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems- solving		**CO3**
UNIT IV	**OFF-SITE PROCESSING**	**9**
Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options – case studies under Indian conditions.		**CO4**
UNIT V	**DISPOSAL**	**9**
Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills – Landfill liners – Management of leachate and landfill gas- Landfill bioreactor – Dumpsite capping –Biomining.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Cherry P M, Solid and Hazardous Waste Management, CBS publishers and distributors Pvt Ltd, 2018
2. Rao M.N, Razia Sultana, Sri Harsha Kota, solid and hazardous waste management – Science and Engineering , Butterworth-Heinemann, 2016

REFERENCE BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015.
2. CPHEEO, “Manual on Municipal Solid waste management,Vol I, II and III, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2016.
3. William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
5. John Pitchtel,Waste Management Practices, CRC Press,Taylor and Francis Group,2014.

6.	Gary C. Young, Municipal Solid Waste to Energy.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	2	2	1
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	2	2

CE1009	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- ❖ Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements.
- ❖ Further, the student will be in a position to assess quality and evaluate the serviceability conditions of pavements

UNIT I	PAVEMENT TYPES AND STRESS DISTRIBUTION	9
Introduction – Pavement as layered structure – Pavement types rigid and flexible. Resilient modulus - Stress and deflections in pavements under repeated loading.		CO1
UNIT II	**DESIGN OF FLEXIBLE PAVEMENTS**	**9**
Flexible pavement design Factors influencing design of flexible pavement, Empirical Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.		CO2
UNIT III	**DESIGN OF RIGID PAVEMENTS**	**9**
Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.		CO3
UNIT IV	**PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE**	**9**
Construction of pavements – Construction Equipments-Methods of construction. Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).		CO4
UNIT V	**STABILIZATION OF PAVEMENTS**	**9**
Stabilization with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilization for rural roads in India – Use of Geosynthetics in roads.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition, 2014.
2. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley 2000.
3. R.Srinivasa Kumar., “Pavement Engineering” Universities Press (India) Private Limited, Hyderabad, 2013.
4. Prithvi Singh Kandhal,” Bituminous Road Construction in India”, PHI Learning Private Limited, New Delhi, 2016.

REFERENCE BOOKS

1. Rajib B.Mallick and Tahar El-Korchi, “Pavement Engineering Principles and Practice:, CRC Press, 2009
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khanna tech. Publications, New Delhi, 2005
3. Guidelines for the Design of Flexible Pavements, IRC-37–2012, The Indian roads Congress,

	New Delhi.
4.	Guideline for the Design of Rigid Pavements for Highways, IRC 58-1998, The Indian Road Congress, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain concepts and standards adopted in Planning, Design and construction of Pavements.
CO2	Apply the knowledge of science and engineering fundamentals in designing flexible pavement. by adopting various design standards
CO3	Apply the standards adopted in designing rigid pavement.
CO4	Select appropriate methods for construction and evaluation of Pavements
CO5	Address the problem statement in construction of pavement and to impart knowledge in stabilization techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	2	1	2	3	2	1	3	2	1	2	1	2	1
CO2	1	2	2	2	1	2	2	1	2	2	2	1	2	3	2
CO3	1	2	1	1	2	2	1	1	2	1	1	2	2	1	1
CO4	1	1	1	1	3	1	1	1	1	1	1	3	2	2	1
CO5	1	3	1	1	3	3	1	1	3	1	1	3	3	2	1

CE1010	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give an overview of Traffic engineering, various surveys to be conducted, traffic Regulation, management and traffic safety.

UNIT I	**TRAFFIC CHARACTERISTICS**	**10**
Road Characteristics – Classification – Functions and standards – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India.		**CO1**
UNIT II	**TRAFFIC SURVEYS**	**7**
Traffic Surveys – Speed, journey time and delay surveys – Vehicle Volume Survey – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – level of service – Concept, application and significance.		**CO2**
UNIT III	**TRAFFIC ENGINEERING REGULATION AND CONTROL**	**8**
Capacity of Rotary intersection and Design – Capacity of signalized intersections – Traffic signals, warrants, type – Design and coordination – Intersection channelization – Grade separation – Traffic signs and road markings.		**CO3**
UNIT IV	**TRAFFIC SAFETY AND ENVIRONMENT**	**10**
Road accidents – Causes, effect, prevention, and cost – street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, health effects and abatement measures.		**CO4**
UNIT V	**TRAFFIC MANAGEMENT**	**10**
Area Traffic Management System – One way street system, exclusive traffic lanes, tidal flow operation, staggering of work hours and road pricing – Non road pricing options _ Parking charges, Public transport, Subsidies, Vehicle License fees, Road Building, Permit system, Physical Traffic Management Transport System Management (TSM) and Transport Demand Management (TDM)- - Introduction to Intelligent Transportation Systems (ITS)- ITS Applications in Traffic Management.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kadiyali. L.R. Traffic Engineering and Transport Planning, Khanna Publishers, Delhi,2008.
2. Khanna .K and Justo C.E.G. and Veeraragavan, A Highway Engineering, Nem Chand Bros., Roorkee, Revised 10th Edition, 2014.
3. Srinivasa Kumar, “Introduction to Traffic Engineering”, Universities Press, 2018
4. Partha Chakroborty and Animesh Das Principles of Transportation Engineering, PHI Learning Pvt. Ltd., 2011

REFERENCE BOOKS

1. Indian Roads Congress (IRC) Specifications: Guidelines and special publications on Traffic Planning and Management.
2. C. Jotin Khisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998
3. Hobbs. F.D. Traffic Planning and Engineering, University of Brimingham, Peragamon Press Ltd, 1994.
4. Taylor MAP and Young W, Traffic Analysis – New Technology and New Solutions, Hargreen

Publishing Company , 1998.
5. Jason C.Yu Transportation Engineering, Introduction to Planning, Design and Operations, Elsevier, 1992.
6. Salter. R.I and Hounsell N.B, Highway Traffic Analysis and design, Macmillan Press Ltd.1996.
7. Roger P.Roess, William R.Mcshane and Elena S.Prassas, Traffic Engineering-Second Edition, Prentice Hall Publishers,, Upper Saddle River, New Jersey 1998.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the principles and standards adopted in Planning and Design of Traffic system.
CO2	Apply the knowledge of science and engineering fundamentals in conducting traffic surveys and analyze the problems.
CO3	Designing various types of control and regulatory measures to meet an efficient traffic network.
CO4	Select appropriate methods to ensure the safety of the road users and analyze the environmental issues related to traffic network.
CO5	Understand various traffic management measures in addressing the demand, pricing and ITS applications.

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	3	-	1	-	-	3	2	-
CO2	3	-	3	3	2	2	-	-	-	1	-	2	3	3	1
CO3	-	3	3	2	3	-	-	-	3	2	2	3	3	3	1
CO4	2	3	2	1	3	-	-	3	3	3	2	3	3	3	2
CO5	-	2	1	1	2	-	1	3	3	1	1	3	2	1	1

CE1011	TRANSPORTATION PLANNING AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give an exposure on overview of the principles of the bus and rail transportation planning and evaluation of the transportation projects.

UNIT I	STUDY AREA AND SURVEYS	9
Importance of planning and integrated transport facilities in urban areas – Delineation of study area and zoning – Conducting various surveys – Travel patterns, transport facilities and planning parameters.		CO1
UNIT II	**MODES**	**9**
Basics of trip generation – Trip distribution – Trip assignment and modal split models – Validation of the model.		CO2
UNIT III	**PLAN PREPARATION AND EVALUATION**	**9**
Preparation of alternative plans – Evaluation techniques – Economic and financial evaluation – Environment Impact Assessment (EIA) – Case Studies.		CO3
UNIT IV	**BUS TRANSPORTATION**	**9**
Characteristics and bus transportation in urban areas – Fare policy – Route planning – Planning of terminals – Break even point and its relevance.		CO4
UNIT V	**RAIL TRANSPORTATION**	**9**
Characteristics of suburban, IRT and RRT systems – Planning of rail terminals – Fare policy – Unified traffic and transport authority.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael J.Bruton, Introduction to Transportation Planning, Hutchinson, London, 1995.
2. Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2008.

REFERENCE BOOKS

1. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.
2. C. Jotin Khisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998
3. Juan de Dios Ort zar and Luis G. Willumsen, Modelling Transport, John Wiley & Sons 2001
4. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concepts and surveys adopted in Transportation planning
CO2	Knowledge on modelling of trip generation assigning and distribution techniques in transportation system.
CO3	Planning and evaluating transportation projects through various case studies.
CO4	Knowledge on planning of bus transportation system in urban areas.
CO5	Planning of various rail transportation and fare policies adopted.

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)	PROGRAM SPECIFIC OUTCOMES (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2	-	3	-	1	-	-	3	2	-
CO2	3	-	3	3	2	2	-	-	-	1	-	2	3	3	1
CO3	-	3	3	2	3	-	-	-	3	2	2	3	3	3	1
CO4	2	3	2	1	3	-	-	3	3	3	2	3	3	3	2
CO5	-	2	1	1	2	-	1	3	3	1	1	3	2	1	1

CE1012	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.

UNIT I	**BASIC ISSUES**	**9**
Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Classification of urban areas – Trend of Urbanisation at International, National, Regional and State level.		**CO1**
UNIT II	**PLANNING PROCESS**	**9**
Principles of Planning – Types and Level of Plan, Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design.		**CO2**
UNIT III	**DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION**	**9**
Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights , Special Economic Zones- Development of small town and smart cities-case studies,		**CO3**
UNIT IV	**PLANNING AND DESIGN OF URBAN DEVELOPMENT PROJECT**	**9**
Site Analysis, Layout Design, Planning Standards, Project Formulation – Evaluation, Plan Implementation, Constraints and Implementation, Financing of Urban Development Projects.		**CO4**
UNIT V	**LEGISLATION, DEVELOPMENT AND MANAGEMENT OF URBAN SYSTEM**	**9**
Town and Country Planning Act, Land Acquisition and Resettlement Act etc., Urban Planning Standards and Regulations, Involvement of Public, Private, NGO, CBO and Beneficiaries.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

REFERENCE BOOKS

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai
2. Goel S.L., Urban Development and Management, Deep and Deep Publications, New Delhi,2002
3. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005
4. CMDA, Second Master Plan for Chennai, Chennai 2008

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basic concepts in urban planning and development.
CO2	Knowledge on principles of planning, surveys and analysis. in developing an urban area.

CO3	Knowledge on development of regional, master plan and norms for development of smart cities.
CO4	Planning of standards, implanting and financing of Urban projects.
CO5	Understand the norms, legal aspects and stakeholders role in planning an urban area.

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	2	-	-	3	-	3	-	-	3	3	-
CO2	3	3	3	3	2	-	-	-	3	-	-	-	3	-	2
CO3	3	1	2	-	-	2	-	3	-	2	-	3	3	-	2
CO4	-	1	2	3	-	2	-	3	3	2	3	3	2	2	3
CO5	-	-	-	-	-	-	1	3	3	3	-	-	-	3	2

CE1013	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the student to the concept of hydrological aspects of water availability and requirements and should be able to quantify, control and regulate the water resources.

UNIT I	PRECIPITATION AND ABSTRACTIONS	9
Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges -Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception - Evaporation. Horton's equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton's equation - double ring infiltrometer, infiltration indices.		CO1
UNIT II	RUNOFF	9
Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical – Strange's table and SCS methods – Stage discharge relationships- flow measurements- Hydrograph – Unit Hydrograph – IUH		CO2
UNIT III	FLOOD AND DROUGHT	9
Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve		CO3
UNIT IV	RESERVOIRS	9
Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security		CO4
UNIT V	GROUNDWATER AND MANAGEMENT	9
Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge – Rain Water Harvesting in rural and urban areas		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Subramanya. K. "Engineering Hydrology"- Tata McGraw Hill, 2010.
2. Jayarami Reddy. P. "Hydrology", Tata McGraw Hill, 2008.
3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.

REFERENCE BOOKS

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007.
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath. H.M., "Hydrology", Wiley Eastern Ltd., 1998.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Define the key drivers on water resources, hydrological processes and their integrated behaviour in catchments
CO2	Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and Hydrograph
CO3	Explain the concept of hydrological extremes such as Flood and Drought and management

	strategies
CO4	Describe the importance of spatial analysis of rainfall and design water storage reservoirs
CO5	Apply the concepts of groundwater for water resources management

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	1	2	2	-	-	-	2	2	2	2
CO2	3	2	3	3	3	2	-	3	-	2	2	2	2	3	2
CO3	3	3	3	2	3	2	2	2	-	2	3	2	1	2	3
CO4	3	3	3	3	3	3	-	3	-	2	2	3	3	3	3
CO5	2	3	3	2	3	2	-	3	2	3	3	3	2	2	3

CE1014	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the students to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- To develop a knowledge-base on capacity building on IWRM.

UNIT I	IWRM FRAMEWORK	9
Definition, classification, and characteristics of systems - Scope and steps in systems engineering - Need for systems approach to water resources and irrigation. Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management – Paradigm shift : Processes and prospective outcomes		**CO1**
UNIT II	**CONTEXTUALIZING IWRM**	**9**
IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development		**CO2**
UNIT III	**EMERGING ISSUES IN WATER MANAGEMENT**	**9**
Bellman's optimality criteria, problem formulation and solutions - Application to design and operation of reservoirs, Single and multipurpose reservoir development plans - Case studies. Emerging Issues -– Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought– Linkages between water, health and poverty		**CO3**
UNIT IV	**IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA**	**9**
Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security		**CO4**
UNIT V	**ASPECTS OF INTEGRATED DEVELOPMENT**	**9**
Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mollinga P. et al. “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., “Ecosystem Principles and Sustainable Agriculture”, Scitech Publications (India) Pvt.Lt, Chennai, 1999.

REFERENCE BOOKS

1. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
2. Murthy, J.V.S., “Watershed Management in India”, Wiley Eastern Ltd., New York, 1995.
3. Dalte, S.J.C., “Soil Conservation and Land Management”, International Book Distribution, India, 1986.
4. Wagner H.M., "Principles of Operations Research with Application to Management Decisions", Prentice Hall, India, New Delhi, 1993.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand objectives, principles and evolution of integrated water resources management.

CO2	Get an exposure towards well design and practical problems Have an idea of contextualizing IWRM
CO3	Gain knowledge in emerging issues in water management, flood, drought, pollution and poverty.
CO4	Understand the water resources development in India and wastewater reuse.
CO5	Gain knowledge on integrated development of water management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	1	1	-	-	2	-	3	1	-	3	2	2
CO2	2	3	2	2	1	2	2	2	2	3	1	2	2	2	2
CO3	2	2	2	-	2	2	2	3	3	3	1	2	2	2	2
CO4	2	2	2	-	1	-	-	2	2	3	-	2	2	2	2
CO5	2	2	2	1	1	-	-	3	2	3	1	3	3	3	3

CE1015	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers,
- To understand the techniques of development and management of groundwater.

UNIT I	**HYDROGEOLOGICAL PARAMETERS**	**9**
Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – GECnorms - Steady state flow - Darcy's Law - Groundwater Velocity –- Dupuit Forchheimer assumption – Steady Radial Flow into a Well		**CO1**
UNIT II	**WELL HYDRAULICS**	**9**
Unsteady state flow - Theis method - Jacob method – Chow's method – Law of Times – Theis Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells – Well losses – Specific Capacity and Safe yield - Collector well and Infiltration gallery		**CO2**
UNIT III	**GROUNDWATER QUALITY**	**9**
Ground water chemistry - Origin, movement and quality - Water quality standards – Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements		**CO3**
UNIT IV	**GROUNDWATER MANAGEMENT**	**9**
Need for Management Model – Database for Groundwater Management – Groundwater balance study – Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition – Calibration – Validation – Future Prediction – Sensitivity Analysis – Uncertainty – Development of a model		**CO4**
UNIT V	**GROUNDWATER CONSERVATION**	**9**
Artificial recharge techniques – Reclaimed wastewater recharge – Soil aquifer treatment (SAT) – Aquifer Storage and Recovery (ASR)Seawater Intrusion and Remediation – Ground water Basin management and Conjunctive use – Protection zone delineation, Contamination source inventory and remediation schemes		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.

REFERENCE BOOKS

1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand aquifer properties and its dynamics
CO2	Get an exposure towards well design and practical problems
CO3	Students will be able to understand the importance of artificial recharge and groundwater quality concepts.

CO4	Develop a model for groundwater management.
CO5	Gain knowledge on conservation of groundwater.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	1	1	2	3	-	-	1	2	2	2	2
CO2	3	3	3	-	2	2	2	1	-	-	2	2	2	3	2
CO3	2	2	2	-	3	3	2	3	-	-	2	3	3	3	3
CO4	2	2	3	-	3	2	2	2	-	-	3	2	3	3	3
CO5	2	2	2	3	3	3	2	3	3	3	2	2	3	3	3

CE1016	WATER RESOURCES SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge and skills relevant to application of systems concept to water resources planning and management. Optimization technique for modeling water resources systems and advanced optimization techniques to cover the socio-technical aspects will be taught.

UNIT I	**SYSTEM CONCEPTS**	**9**
Definition, classification, and characteristics of systems - Scope and steps in systems engineering - Need for systems approach to water resources and irrigation.		**CO1**
UNIT II	**LINEAR PROGRAMMING**	**9**
Introduction to operations research - Linear programming, problem formulation, graphical solution, solution by simplex method - Sensitivity analysis, application to design and operation of reservoir, single and multipurpose development plans - Case studies.		**CO2**
UNIT III	**DYNAMIC PROGRAMMING**	**9**
Bellman's optimality criteria, problem formulation and solutions - Application to design and operation of reservoirs, Single and multipurpose reservoir development plans - Case studies.		**CO3**
UNIT IV	**SIMULATION**	**9**
Basic principles and concepts - Random variant and random process - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models – Case studies.		**CO4**
UNIT V	**ADVANCED OPTIMIZATION TECHNIQUES**	**9**
Integer and parametric linear programming - Goal programming models with applications Discrete differential dynamic programming and incremental dynamic programming - Linear decision rule models with application - Stochastic dynamic programming models.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chaturvedi. M.C., "Water Resources Systems Planning and Management". Tata McGraw Hill, New Delhi, 1997.
2. Mays L.W., and Tung YK, "Hydro systems Engineering and Management". McGraw Hill Inc., New York, 1992.

REFERENCE BOOKS

1. Gupta P.K and Man Mohan, "Problems in Operations Research (Methods and solutions)". Sultan Chand and sons, New Delhi, 1995
2. Hiller F.S and Liebermann G.J., "Operations Research CBS Publications and distributions". New Delhi, 1992.
3. Goodman Alvin S., "Principles of Water Resources Planning", Prentice Hall Inc., Englewood Cliffs, New Jersey, 1995.
4. Course material, "Micro Computer Application to Systems Analysis in Irrigation Water Management", CWR, Anna University, 1992.
5. Wagner H.M., "Principles of Operations Research with Application to Management Decisions", Prentice Hall, India, New Delhi, 1993.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Define the system concept and steps in systems approach for the water resources engineering.
CO2	Apply the knowledge of optimisation techniques such as Linear programming and simplex method for reservoir operation.
CO3	Explain single and multipurpose reservoir optimisation using dynamic programming
CO4	Develop the simulation model based on deterministic and stochastic simulation for reservoir operating policy
CO5	Apply the creative and advance optimisation techniques like goal programming, heuristic algorithm in the field of water planning and management.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	-	-	-	-	-	2	-	-	-	-	3	2	2	2
CO2	3	2	-	-	-	3	-	3	-	-	2	2	2	3	2
CO3	3	3	2	-	2	2	-	2	-	-	3	2	1	3	3
CO4	3	3	3	-	3	3	-	3	-	2	2	3	3	3	3
CO5	3	3	3	3	3	3	-	3	2	-	3	3	3	3	3

CE1017	DESIGN OF PLATE AND SHELL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the design of plate and shell and spatial structures

UNIT I	**THIN PLATES WITH SMALL DEFLECTION**	**9**
Laterally loaded thin plates - Governing differential equation, various boundary conditions.		**CO1**
UNIT II	**RECTANGULAR PLATES**	**9**
Simply supported rectangular plates - Navier solution and Levy's method – Loading.		**CO2**
UNIT III	**ANALYSIS OF THIN SHELLS**	**9**
Shells of revolution – Spherical dome, Conical shell and ellipsoid of revolution – Shells of translation – Cylindrical shell and hyperbolic paraboloid - Classification of shells - Types of shells - Structural action		**CO3**
UNIT IV	**DESIGN OF SHELLS**	**9**
Spherical dome, conical shell and Cylindrical shell.		**CO4**
UNIT V	**SPACE FRAMES**	**9**
Space Frames – Configuration – Node connector- Types – General principles of design philosophy– Behaviour		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Varghese, Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Private Limited, New Delhi, 2010.
2. R.Szilard, Theory and Analysis of Plates, Prentice Hall Inc., 1995.

REFERENCE BOOKS

1. Billington D.P. Thin Shell Concrete Structures, McGraw Hill, 1995.
2. Chatterjee B.K. Theory and design of Concrete Shells, Oxford and IBH Publishing Co., New Delhi 1998.
3. N.Subramanian, Principles of Space Structures, Wheeler Publishing Co. 1999.
4. Maan Jawad, Theory and Design of Plate and Shell Structures, 1994.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Assess the strength of thin plates under different types of loads.
CO2	Analyze thin plates using Navier's method and Levy's method.
CO3	Analyze circular plates under axis - symmetric deflection.
CO4	Classify different types of shells and study their behavior.
CO5	Analyze space frame.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	1	1	1	1	1	2	1	1	1	2	1	2
CO2	3	2	3	1	1	1	1	1	1	1	1	1	2	1	2
CO3	3	2	3	1	1	1	1	1	1	1	1	1	2	1	2
CO4	2	2	3	1	1	1	1	1	1	1	1	1	2	1	2
CO5	2	2	3	1	1	1	1	1	1	1	1	1	2	1	2

CE1018	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the behaviour and performance of prestressed concrete structures.
- To Compare the behaviour of prestressed concrete members with that of the normal reinforced concrete structures.
- To Understand the performance of composite members.
- To learn the design of prestressed concrete structures.

UNIT I	INTRODUCTION	9
Basic concepts–Advantages–Materials required–Systems and methods of prestressing–Analysis of sections– Stress concept–Strength concept–Load balancing concept–Effect of loading on the tensile stresses in tendons –Effect of tendon profile on deflections– Factors influencing deflections–Calculation of deflections –Short term and long-term deflections-Losses of prestress –Estimation of crack width.		**CO1**
UNIT II	**DESIGN FOR FLEXURE AND SHEAR**	**9**
Basic assumptions for calculating flexural stresses–Permissible stresses in steel and concrete as perI.S.1343Code–Design of sections of Type I and Type II post-tensioned and pre-tensioned beams–Check for strength limit based on I.S. 1343 Code –Layout of cables in post-tensioned beams–Location of wires in pre-tensioned beams –Design for shear based onI.S.1343Code.		**CO2**
UNIT III	**DEFLECTION AND DESIGN OF ANCHORAGE ZONE**	**9**
Factors influencing deflections–Short term deflections of uncracked members–Prediction of long-term deflections due to creep and shrinkage–Check for serviceability limit state of deflection. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and IS1343code–design of anchorage zone reinforcement– Check for transfer bond length in pre-tensioned beams.		**CO3**
UNIT IV	**COMPOSITE BEAMS AND CONTINUOUS BEAMS**	**9**
Analysis and design of composite beams – Methods of achieving continuity in continuous beams– Analysis for secondary moments–Concordant cable and linear transformation–Calculation of stresses– Principles of design.		**CO4**
UNIT V	**MISCELLANEOUS STRUCTURES**	**9**
Design of tension and compression members– Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. KrishnaRaju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2012.

REFERENCE BOOKS

1. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2002.
2. Dayaratnam.P., SarahP, Prestressed Concrete Structures, Seventh Edition, Oxford and IBH,

2017.

3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., NewDelhi,2013.
4. Sinha.N.C. And Roy.S.K. Fundamentals of Prestressed Concrete, S.Chand and Co. Ltd.,2011.
5. IS 1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design a prestressed concrete beam accounting for losses.
CO2	Design for flexure and shear.
CO3	Design the anchorage zone for post tensioned members and deflection in beams.
CO4	Design composite members and continuous beams.
CO5	Design water tanks, pipes and poles.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	2	-	-	1	1	-	1	3	-	3
CO2	3	2	3	-	-	1	-	-	1	1	-	1	3	-	3
CO3	3	2	3	-	-	1	-	-	1	1	-	1	3	-	3
CO4	2	2	3	-	-	1	-	-	1	1	-	1	3	-	3
CO5	2	2	3	-	-	1	-	-	1	1	-	1	3	-	3

CE1019	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

To learn the planning, layout, functional aspects of industries and design of major steel and R.C structures needed for industries.

UNIT I	**PLANNING**	**9**
Classification of industries and industrial structures – Site Planning and Selection – Exterior and interior Layout for Industries and buildings - Guidelines from factories act.		**CO1**
UNIT II	**FUNCTIONAL REQUIREMENTS**	**9**
Lighting – Ventilation – Noise and Vibration control – Fire safety		**CO2**
UNIT III	**DESIGN OF STEEL STRUCTURES**	**9**
Pre-engineered and Mill buildings – Transmission Lines Towers – plate girders. Bunkers and Silos – pipe/cable racks- Chimney.		**CO3**
UNIT IV	**DESIGN OF R.C. STRUCTURES**	**9**
Corbels, Brackets and Nibs - Silos and bunkers –Chimney –Cooling Towers (Principles only)		**CO4**
UNIT V	**PREFABRICATION**	**9**
Principles of prefabrication and pre cast construction – Prestressed precast roof trusses – Floor slabs - Wall panels- Handling and erection stresses –joints in precast structures.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ramamrutham.S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2007.
2. Varghese.P.C., Advanced Reinforced Concrete Design, PHI, Eastern Economy Editions, Second Edition, 2005.
3. Subramanian, N., Design of Steel Structures, Oxford University Press, 2008.

REFERENCE BOOKS

1. Henn W. Buildings for Industry, Vol.I and II, London Hill Books, 1995
2. Handbook on Functional Requirements of Industrial buildings, SP32–1986, Bureau of Indian Standards, 1990.
3. Handbook of Industrial Lighting, Stanley L.Lyons, Butterworths, London.1981
4. Koncz, J., Manual of Precast Construction Vol. I and II, Bauverlay GMBH, 1971.
5. Ramachandra and Virendra Gehlot, Design of steel structures –Vol. 2, Scientific Publishers, 2012.
6. Handbook on Precast Construction, An Indian Concrete Institute Publication, 2016.9. IS Code 15284 (Part 1): 2003 "Design and Construction for Ground Improvement – Guidelines" (Stone Column), Bureau of Indian Standards, New Delhi.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know the requirements of various industries and get an idea about the materials used and planning of various industrial components.

CO2	Acquire the functional requirements for industrial structures.
CO3	Design special steel structures like bunkers, silos, crane girders, chimneys and pre-engineered buildings.
CO4	Design special RC structures like corbels, silos, bunkers, chimneys, plates and shells.
CO5	Understand the principles of prefabrication and prestressing

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	2	1	1	-	-	-	2	3	-	2
CO2	3	2	3	-	-	2	1	1	-	-	-	1	3	-	2
CO3	3	2	3	-	-	2	1	1	-	-	-	2	3	-	2
CO4	2	2	3	-	-	2	1	1	-	-	-	2	3	-	2
CO5	2	2	3	-	-	2	1	1	-	-	-	1	3	-	2

CE1020	MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquire the knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures

UNIT I	MAINTENANCE AND REPAIR STRATIGES	9
Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.		CO1
UNIT II	**STRENGTH AND DURABILITY OF CONCRETE**	**9**
Quality assurance for concrete – Strength, Durability, of concrete - Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated, Corrosion - Effects of cover thickness.		CO2
UNIT III	**SPECIAL CONCRETES**	**9**
Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete - High performance concrete - Vacuum concrete - Self compacting concrete – Geopolymer concrete - Reactive powder concrete - Concrete made with industrial wastes.		CO3
UNIT IV	**TECHNIQUES FOR REPAIR AND PROTECTION METHODS**	**9**
Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.		CO4
UNIT V	**REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES**	**9**
Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Demolition techniques - Engineered demolition methods - Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1st edition 2009.

REFERENCE BOOKS

1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
2. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD ,Govt of India , New Delhi – 2002
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.
4. R. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier,New Delhi 2012

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know the importance of inspection and maintenance.
CO2	Study the Impacts of cracks, corrosion and climate on structures.

CO3	Know about High Performance concrete.
CO4	Understand the materials and techniques needed for repairs.
CO5	Know the failures of the structures and demolition techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	1	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	3	2
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	1	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	2	2	1
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	2	2

CE1021	POWERPLANT STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge about principles, planning, layout, structural requirements and analysis of power plants.

UNIT I	**FUNDAMENTALS OF POWER PLANTS**	**9**
Introduction – Classification of Power Plants – Principles of Power Plant – Lay out of Power Plant Building – Selection of type of generation – Resources for power generation – Machine foundation.		**CO1**
UNIT II	**HYDRO ELECTRIC POWER PLANTS**	**9**
Elements of hydro-electric power plants – Advantages and disadvantages of water power - General and essential elements of Hydro electric Power Plant – Structural requirements – Selection of site for hydroelectric plant – Penstocks and surge Tanks in Power Station.		**CO2**
UNIT III	**THERMAL POWER PLANTS**	**9**
Planning, Analysis of thermal power plants – Layout – Ash handling – Dust collection – Induced draught and natural cooling towers – Air/water pollution by thermal power plants.		**CO3**
UNIT IV	**NUCLEAR POWER PLANTS**	**9**
General characteristics of Nuclear Power Plants – Classification of reactors – Pressurized Water Reactor, Boiling Water Reactor, Fusion Power Reactor, Heavy Water Reactor - Selection criteria of materials for different systems – Containment structures – Nuclear power plant safety measures –Safety systems and support systems.		**CO4**
UNIT V	**NON CONVENTIONAL POWER PLANTS**	**9**
Types – Wind power plants – Selection of wind mill – Tidal power plants – Solar thermal power plants – Geothermal power plants – Principles and essential features.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. S.C. Sharma and G.R. Nagpal, Power Plant Engineering, Khanna Publishers, 2013.
2. Raja A.K, Amit Prakash Srivastava and Manish Dwivedi, Power Plant Engineering, New Age International Publishers, 2013.

REFERENCE BOOKS

1. R.K Rajput, Power Plant Engineering, Fifth Edition, 2016.
2. P.C Sharma, power Plant Engineering, S.K. Kataria & Sons; 2013.
3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press / Computational Mechanics, First edition, 2010.
4. Dipak k Sarkar,Thermal Power plant: Design and Operation,Elsevier Publisher 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the principles, layout and functional aspects of a power plant structure.
CO2	Analyze and design the layout and components of hydroelectric power plant.
CO3	Explain, analyze and design the layout and components of Thermal power plant.
CO4	Explain the functioning of a nuclear power plant and design its components.

CO5	Develop an understanding of the various non-conventional sources of energy and design the layout and components.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	-	1	1	2	-	-	1	3	-	2
CO2	3	2	3	-	-	-	1	1	1	-	-	1	3	-	2
CO3	3	2	3	-	-	-	1	1	1	-	-	1	3	-	2
CO4	2	2	3	-	-	-	1	1	1	-	-	1	3	-	2
CO5	2	2	3	-	-	-	1	1	1	-	-	1	3	-	2

CE1022	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the principles of prefabrication, behaviour and design of prefabricated components and structural connections.
- To appreciate modular construction and industrialised construction

UNIT I	**INTRODUCTION**	**9**
Need for prefabrication - Principles- Materials - Modular co-ordination – Standardization – Systems Production – Transportation – Erection - Disuniting of Structures.		**CO1**
UNIT II	**PREFABRICATED COMPONENTS**	**9**
Behavior of structural components–Large panel constructions–Construction of roof, floor slabs and Wall panels–Columns–Shear walls.		**CO2**
UNIT III	**DESIGN PRINCIPLES**	**9**
Design of Structural components–Beam, Column and Corbel-Stress limitations–Handling without cracking, handling with controlled cracking–Design for stripping forces.		**CO3**
UNIT IV	**JOINTS IN STRUCTURAL MEMBERS**	**9**
Joints for different structural connections–Beam to Column, Beam to Beam, Column to Column, Column to Foundation, Connections between wall panels, Connections between floor panels-Dimensions and detailing–Design of expansion joints-Jointing Materials.		**CO4**
UNIT V	**DESIGN FOR EARTHQUAKES AND CYCLONES**	**9**
Progressive collapse–Codal provisions–Equivalent design loads for considering abnormal effects such as earthquakes, cyclones etc.-Importance of avoidance of progressive collapse.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, Akademiai Kiado, Budapest, 1964.

REFERENCE BOOKS

1. PCI Design Hand Book, 6th Edition, 2004.
2. Handbook on Precast Concrete for Buildings, ICI Bulletin 02, First Edition, 2016.
3. A.S.G. Bruggeling and G.F.Huyghe, Prefabrication with concrete, Netherlands: A.A.Balkema Publishers, 1991.
4. Glover C.W, Structural Precast Concrete, Asia Publishing House, 1965.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the principles of modular coordination
CO2	Know the construction of roof and floors
CO3	Design for stripping forces
CO4	Identify the different types of connections between structural members
CO5	Understand the concept of progressivecollapse

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	-	-	2	-	-	1	1	-	1	3	-	2
CO2	3	2	3	-	-	1	-	-	1	1	-	1	3	-	2
CO3	3	2	3	-	-	1	-	-	1	1	-	1	3	-	2
CO4	2	2	3	-	-	1	-	-	1	1	-	1	3	-	2
CO5	2	2	3	-	-	1	-	-	1	1	-	1	3	-	2

CE1023	TALL STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the design philosophy of tall buildings, the loading and behaviour of structural systems.

UNIT I	DESIGN CRITERIA AND MATERIALS	9
Design Philosophy - Modern concepts – Materials used - High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self-Compacting Concrete, High strength steel, Composites.		**CO1**
UNIT II	**LOADING**	**9**
Gravity Loading – Dead load, Live load – Live load reduction techniques, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Dynamic Analysis, Combination of Loads.		**CO2**
UNIT III	**BEHAVIOUR OF STRUCTURAL SYSTEMS**	**9**
Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, in filled frames, Shear walls, Coupled Shear walls, Wall – Frames, Tubular and Outrigger – Hybrid systems		**CO3**
UNIT IV	**ANALYSIS**	**9**
Modeling for approximate analysis, accurate analysis and reduction techniques, Analysis of structures as an integral unit, Analysis for drift and twist. Computerized 3D analysis.		**CO4**
UNIT V	**DESIGN PARAMETERS**	**9**
Design for differential movement, Creep and Shrinkage effects, Temperature Effects and Fire Resistance, Stability of Tall Structures - PΔ Effects, Buckling analysis of Tall Buildings.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bryan Stafford Smith and Alex Coull, Tall Building Structures, Analysis and Design, John Wiley and Sons, Inc., 2011.
2. Taranath B.S, Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, McGraw Hill, 2011.

REFERENCE BOOKS

1. Lin T.Y. and Burry D.Stotes, Structural Concepts and Systems for Architects and Engineers, John Wiley, 1994.
2. Lynn S.Beedle, Advances in Tall Buildings, CBS Publishers and Distributors, Delhi, 1996.
3. Wolfgang Schuler, High Rise Building Structures, John Wiley & Sons, New York, 1986.
4. Kolousek V, Pimer M, Fischer O and Naprstek J, Wind effects on Civil Engineering Structures. Elsevier Publications.1984.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the design aspects and the various innovative materials which can be used for the construction of tall buildings
CO2	Apply the knowledge of engineering fundamentals to characterize various types of loading

	which could be considered for the analysis of tall building.
CO3	Identify various structural systems, their behavior and performance under different loading conditions.
CO4	Analyze the structures as an integral unit for drift and twist.
CO5	Design tall structures under different conditions like stability considerations, creep, shrinkage, and temperature and fire resistance.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	2
CO2	3	3	3	3	3	3	1	3	1	1	1	1	2	2	2
CO3	1	2	2	1	2	1	1	1	1	1	1	1	3	1	3
CO4	1	3	2	1	3	2	1	1	2	1	1	1	3	3	2
CO5	1	3	3	2	2	2	1	1	2	2	1	1	3	2	2

CE1024	ASEISMIC DESIGN OF STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the behaviour of structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions.

UNIT I	**SINGLE DEGREE OF FREEDOM SYSTEM**	**9**
Definition of degree of freedom – Idealization of structure as Single Degree of Freedom (SDOF) system – Formulation of equation of motion for various SDOF system – D'Alemberts Principles - Effect of damping – Free and forced vibration of damped and undamped structures – Response to harmonic forces and periodic loading.		**CO1**
UNIT II	**MULTI DEGREE OF FREEDOM SYSTEM**	**9**
Formulation of equation of motion for multidegree of freedom (MDOF) system – Evaluation of natural frequencies and modes – Eigen values and Eigen vectors – Orthogonality and normality principles – Response to free and forced vibration of undamped and damped MDOF systems – Modal superposition methods		**CO2**
UNIT III	**INTRODUCTION TO EARTHQUAKE ENGINEERING**	**9**
Elements of Engineering Seismology – Definitions, Introduction to Seismic hazard, Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction.		**CO3**
UNIT IV	**EARTHQUAKE EFFECTS ON STRUCTURES**	**9**
Effect of earthquake on different types of structures – Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading – Pinching Effect – Bouchinger Effects – Liquefaction of soil – Response Spectra – Causes of damage – Lessons learnt from past earthquakes.		**CO4**
UNIT V	**CONCEPTS OF EARTHQUAKE RESISTANT DESIGN**	**9**
Planning considerations and Architectural concepts – Evaluation of Earthquake forces – Static load method, Response spectrum method – Guidelines for Earthquake resistant design – Earthquake resistant design of masonry and RCC buildings - Design considerations – Guidelines– Design and detailing		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.

REFERENCE BOOKS

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.138
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.

3. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering,Prentice Hall Inc., 2007.
4. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002.
5. IS 4326: 2013 Earthquake Resistant Design And Construction Of Buildings – Code Of Practice
6. IS 1893: 2016 Criteria For Earthquake Resistant Design Of Structures – Part 1 General Provision And Buildings.
7. IS 13920:2016 Ductile Design And Detailing Of Reinforced Concrete Structures Subjected To Seismic Forces – Code Of Practice.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply the knowledge of science and engineering fundamentals to idealize and formulate the equations of motion for SDOF system
CO2	Develop the equations of motion for MDOF system and to evaluate the natural frequencies and mode shapes.
CO3	Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation.
CO4	To identify the various causes and effects of earthquakes on structures due to past earthquakes.
CO5	To analyse the structures subjected to dynamic loading and to design for seismic loading as per codal provisions.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	3	2	1	3	1	-	1	3	2	1
CO2	3	3	3	2	2	3	2	1	3	1	-	1	3	2	1
CO3	3	1	1	1	-	3	1	2	1	-	-	1	3	2	1
CO4	3	2	3	2	2	3	2	3	3	3	2	1	3	2	1
CO5	3	3	3	3	3	3	2	3	3	3	2	1	3	2	1

CE1025	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I	**INTRODUCTION TO DISASTERS**	**9**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc – Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don‘ts during various types of Disasters.		**CO1**
UNIT II	**APPROACHES TO DISASTER RISK REDUCTION**	**9**
Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.		**CO2**
UNIT III	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India – Relevance of indigenous knowledge, appropriate technology and local resources.		**CO3**
UNIT IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9**
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy – Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.		**CO4**
UNIT V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS**	**9**
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS
1. Singhal J.P. Disaster Management, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423 2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361] 3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011 4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
REFERENCE BOOKS
1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005 2. Government of India, National Disaster Management Policy,2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Differentiate the types of disasters, causes and their impact on environment and society
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation
CO3	enhance awareness of institutional processes in the country
CO4	develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity
CO5	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	0	0	0	2	2	1	3	0	1	2	0	0	2
CO2	3	2	0	0	0	2	2	1	2	0	2	1	0	0	2
CO3	3	2	0	0	0	1	2	1	2	0	1	2	0	0	2
CO4	3	2	0	0	0	1	1	1	1	0	1	3	0	0	1
CO5	3	2	0	0	0	1	2	1	3	0	1	3	0	0	2

CE1026	GEO-ENVIRONMENTAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

UNIT I	**GENERATION OF WASTES AND CONSQUENCES OF SOIL POLLUTION**	**9**
Introduction to Geo environmental engineering – Environmental cycle – Sources, production and classification of waste – Causes of soil pollution – Factors governing soil pollution interaction clay minerals - Failures of foundation due to waste movement.		**CO1**
UNIT II	**SITE SELECTION AND SAFE DISPOSAL OF WASTE**	**9**
Safe disposal of waste – Site selection for landfills – Characterization of land fill sites and waste – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system – Application of geosynthetics in solid waste management – Rigid or flexible liners.		**CO2**
UNIT III	**TRANSPORT OF CONTAMINANTS**	**9**
Contaminant transport in sub surface – Advection, Diffusion, Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Hydrological consideration in land fill design – Ground water pollution.		**CO3**
UNIT IV	**WASTE STABILIZATION**	**9**
Stabilization - Solidification of wastes – Micro and macro encapsulation – Absorption, Adsorption, Precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement.		**CO4**
UNIT V	**REMEDIATION OF CONTAMINATED SOILS**	**9**
Exsitu and insitu remediation-Solidification, bio-remediation, incineration, soil washing, electro kinetics, soil heating, vetrification, bio-venting.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Manoj Datta,” Waste Disposal in Engineered landfills”, Narosa Publishing House, 1997.
2. Manoj Datta, B.P. Parida, B.K. Guha, “Industrial Solid Waste Management and Landfilling Practice”, Narosa Publishing House, 1999.

REFERENCE BOOKS

1. Hari D. Sharma and Krishna R. Reddy, “Geo-Environmental Engineering” –John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., “Geotechnical Practice for waste disposal”, Chapman & Hall, London 1993.
3. Westlake, K, “Landfill Waste pollution and Control”, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., “Hazardous Waste Management”, McGraw Hill, Singapore, 1989.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand basic knowledge of concepts and principles of Geo-environmental Engineering.
CO2	Select site for safe disposal of waste.

CO3	Aware of soil stabilization by utilizing solid waste.
CO4	Assess the contamination in the soil and to select suitable remediation methods based on contamination.
CO5	Prepare the suitable disposal system for particular waste.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	1	3	1	3	1	2	3	3	3	2
CO2	3	1	3	3	2	3	3	1	3	1	1	3	2	2	3
CO3	3	2	2	3	2	3	3	1	3	1	1	3	2	2	3
CO4	2	1	3	3	3	3	3	1	3	1	1	3	2	2	3
CO5	3	1	3	2	3	3	3	1	3	1	1	3	2	3	2

CE1027	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

UNIT I	**PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES**	**9**
Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.		**CO1**
UNIT II	**DEWATERING**	**9**
Dewatering Techniques - Well points – Vacuum and electroosmotic methods – Seepage analysis for two dimensional flow for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.		**CO2**
UNIT III	**INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS**	**9**
In-situ densification of cohesionless soils – Shallow as deep compaction – Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils -Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.		**CO3**
UNIT IV	**EARTH REINFORCEMENT**	**9**
Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.		**CO4**
UNIT V	**GROUTING TECHNIQUES**	**9**
Types of grouts – Grouting equipment's and machinery – Injection methods – Grout monitoring –Stabilization with cement, lime and chemicals – Stabilization of expansive soil.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Purushothama Raj. P, "Ground Improvement Techniques", Lakshmi Publications, 2nd Edition, 2016.
2. Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering",McGraw Hill, 1994.
3. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House, First Edition, 2012.
4. Mittal.S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, First Edition, 2013.

REFERENCE BOOKS

1. Moseley, M.P., "Ground Improvement" Blockie Academic and Professional, 1992.
2. Moseley, M.P and Kirsch. K., 'Ground Improvement", Spon Press, Taylor and Francis Group, London, 2nd Edition, 2004.

3. Jones C.J.F.P. “Earth Reinforcement and Soil Structure”, Thomas Telford Publishing,1996.
4. Winterkorn, H.F. and Fang, H.Y. “Foundation Engineering Hand Book”. Van Nostrand Reinhold, 1994.
5. Das, B.M., “Principles of Foundation Engineering” (seventh edition), Cengage learning, 2010.
6. Coduto, D.P., “Geotechnical Engineering – Principles and Practices”, Prentice Hall of India Pvt.Ltd. New Delhi, 2011.
7. Koerner, R.M., “Designing with Geosynthetics” (Sixth Edition), Xlibris Corporation, U.S.A, 2012.
8. Relevant IS Codes.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on methods and selection of ground improvement techniques.
CO2	Acquire dewatering techniques and design for simple cases.
CO3	Get knowledge on in-situ treatment of cohesionless and cohesive soils.
CO4	Get knowledge on in-situ treatment of cohesionless and cohesive soils.
CO5	Get to know types of grouts and grouting technique.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	-	3	1	2	-	-	-	3	3	-	2
CO2	3	3	2	2	-	3	1	2	-	-	-	3	3	-	2
CO3	2	3	3	2	-	3	1	2	-	-	-	3	3	-	2
CO4	3	2	3	3	-	3	1	2	-	-	-	3	3	-	2
CO5	3	3	2	2	-	3	1	2	-	-	-	3	3	-	2

CE1028	SOIL DYNAMICS AND MACHINE FOUNDATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods.

UNIT I	**THEORY OF VIBRATION**	**9**
Nature dynamic loads – Vibrations of single degree freedom system – Free vibrations of spring – mass systems – Forced vibrations – Viscous damping - Transmissibility – Principles of vibration measuring instruments – Effect of Transient and Pulsating loads		**CO1**
UNIT II	**WAVE PROPAGATION**	**9**
Elastic waves in rods of infinite length – Longitudinal and Torsional – Effect of end conditions – Longitudinal and torsional vibrations of rods of finite length – Wave Propagation in infinite, homogeneous isotropic and elastic medium - Wave propagation in elastic half space – Typical values of compression wave and shear wave velocity – Wave propagation due to Machine foundation – Surface wave – Typical values – Particle movements and velocity.		**CO2**
UNIT III	**DYNAMIC PROPERTIES OF SOILS**	**9**
Dynamic stress – Strain characteristics – Principles of measuring dynamic properties – Laboratory Techniques – Field tests – Factors affecting dynamic properties – Typical values – Dynamic bearing capacity – Dynamic earth pressure.		**CO3**
UNIT IV	**FOUNDATION FOR DIFFERENT TYPES OF MACHINES**	**9**
Types of machines and foundation – General requirements – Modes of vibration of a rigid foundation – Method of analysis – Linear elastic weightless spring method – Elastic half space method – Analog Method – Design of block foundation – Special consideration for rotary, Impact type of machines – Codal Provisions.		**CO4**
UNIT V	**INFLUENCE OF VIBRATION AND REMEDIATION**	**9**
Mechanism of Liquefaction – Influencing factors – Evaluation of Liquefaction potential based on SPT-Force Isolation – Motion Isolation – Use of spring and damping materials – Vibration control of existing machine foundation – Screening of vibration – Open trenches – Pile Barriers – Salient construction aspects of machine Foundations.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Swamisaran, “Soil Dynamics and Machine Foundations”, Galgotia Publications Pvt.Ltd. (Second Edition) 2006, (Reprint 2010), New Delhi-110002
2. Srinivasulu. P, and Vaidyanathan. C. V, “Handbook of Machine Foundations”, Tata McGraw-Hill, 2007

REFERENCE BOOKS

1. Kamaswara Rao., “Vibration Analysis and Foundation Dynamics”, Wheeler Publishing, New Delhi, 1998.
2. Kameswara Rao., “Dynamics Soil Tests and Applications”, Wheeler Publishing, New Delhi, 2003.
3. Moore, P.J., “Analysis and Design of Foundation for Vibration”, Oxford and IBH, 2005
4. Steven L. Kramer, “Geotechnical Earthquake Engineering”, Prentice Hall, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to	
CO1	Have the basic knowledge about the theory of vibration.
CO2	Understand the different types of waves and its behaviour.
CO3	Have enough knowledge about various laboratory and field tests to determine
CO4	Assess the contamination in the soil and to select suitable remediation methods based on contamination.
CO5	Assess the influence of vibrations and selection of remediation methods based on the nature of vibration, properties and behaviour of soil.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	1	1	1	3	1	3	1	1	2	1	2	2
CO2	3	3	1	1	1	1	3	1	3	1	1	1	2	3	2
CO3	3	2	3	2	3	1	3	1	3	1	1	2	2	1	2
CO4	3	3	3	1	1	1	3	1	3	1	1	3	2	2	1
CO5	3	1	2	1	1	2	2	1	3	1	1	3	3	2	2

CE1029	ROCK MECHANICS				L	T	P	C
					3	0	0	3

OBJECTIVES

- To impart knowledge on fundamentals of rock mechanics and its application in solving simple problems associated with rock slopes and underground openings.
- Student gains the knowledge on the mechanics of rock and its applications in underground structures and rock slope stability analysis.

UNIT I	**CLASSIFICATION AND INDEX PROPERTIES OF ROCKS**	**9**
Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose – Rock Mass Rating and Q System.		**CO1**
UNIT II	**ROCK STRENGTH AND FAILURE CRITERIA**	**9**
Modes of rock failure – Strength of rock – Laboratory measurement of shear, tensile and compressive strength. Stress - strain behaviour of rock under compression – Mohr -Coulomb failure criteria and empirical criteria.		**CO2**
UNIT III	**INITIAL STRESSES AND THEIR MEASUREMENTS**	**9**
Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – measurements of in-situ stresses – Hydraulic fracturing – Flat jack method – Over coring method.		**CO3**
UNIT IV	**APPLICATION OF ROCK MECHANICS IN ENGINEERING**	**9**
Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence.		**CO4**
UNIT V	**ROCK STABILISATION**	**9**
Introduction – Rock support and Rock reinforcement – Principles – Support reaction curves – Shotcreting.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Goodman, P.E. “Introduction to Rock Mechanics”, John Wiley and Sons, 1999.
2. Ramamurthy. T., “Engineering in Rocks for Slopes, Foundation and Tunnels: (Third Edition), PHI Learning Private Limited, New Delhi, 2014.

REFERENCE BOOKS

1. Brown, E.T. “Rock Characterization Testing and Monitoring”. Pergaman Press 1991.
2. Arogyaswamy, R.N.P., Geotechnical Application in Civil Engineering”, Oxford and IBH, 1991.
3. Hook E.and Bray J., Rock slope Engineering, Institute of Mining and Metallurgy”, U.K.2004.
4. Brady, B.H.G. and Brown, E.T., Rock mechanics for underground mining (Third Edition), Kluwer Academic Publishers, Dordrecht, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have the knowledge in characterizing and rating the rock mass.
CO2	Arrive at the behaviour of rock for the given project.
CO3	Calculate the insitu stresses of rock.
CO4	Design underground excavation, open excavation and sub-structures.

CO5	Design suitable support system under unstable condition.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO2	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO3	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO4	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3
CO5	3	3	2	2	2	1	1	1	2	1	2	3	2	1	3

CE1030	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- The main purpose of coastal engineering is to protect harbors and improve navigation.
- The students to the diverse topics as wave mechanics, wave climate, shoreline protection methods and laboratory investigations using model studies.

UNIT I	**INTRODUCTION TO COASTAL ENGINEERING**	**9**
Indian Scenario - Classification of Harbours. Introduction - wind and waves - Sea and Swell - Introduction to small amplitude wave theory - use of wave tables- Mechanics of water waves - Linear (Airy) wave theory, Introduction to Tsunami		**CO1**
UNIT II	**WAVE PROPERTIES AND ANALYSIS**	**9**
Behaviour of waves in shallow waters, Introduction to non-linear waves and their properties - Waves in shallow waters - Wave Refraction, Diffraction and Shoaling -Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves. Short term wave analysis - wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.		**CO2**
UNIT III	**TYPES AND WAVE TRANSFORMATION**	**9**
Tide analysis and prediction, storm surge, seiches and seasonal fluctuations - Long term water level fluctuations – Wave shoaling; wave refraction; wave breaking; wave diffraction		**CO3**
UNIT IV	**COASTAL DEFENSE**	**9**
Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures -Case studies.		**CO4**
UNIT V	**MODELING IN COASTAL ENGINEERING**	**9**
Physical modeling in Coastal Engineering - Limitations and advantages - Role of physical modeling in coastal engineering - Numerical modeling - Modeling aspects - limitations - Case studies using public domain models, Tsunami mitigation measures – Introduction to DPSIR Approach		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Mani J.S., Coastal Hydrodynamics. PHI Pvt.Ltd. New Delhi - 2012.
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994

REFERENCE BOOKS

1. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill, Inc., New York, 1978.
2. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Pub. New York, 1978.
3. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe the problems associated with Indian coast. Apply Linear wave theory and use wave tables for solving the dispersion equation.
CO2	Distinguish between linear and non-linear wave theories. Solve problems on wave transformations. Apply probability theory for wave analysis.
CO3	Types of waves, wave shoaling, diffraction, refraction

CO4	Model and design shore defense structures and describe the problems from reliability and risk perspective.
CO5	Compare and contrast physical and mathematical coastal models and critique the advantages and disadvantages between them.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	2	-	-	-	-	3	3	1	1
CO2	3	2	-	-	-	3	-	3	-	-	-	2	3	3	1
CO3	3	3	2	-	2	2	2	2	2	2	2	2	2	3	3
CO4	3	3	3	-	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3

CE1031	COASTAL ZONE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To be able to "see" the features and components of the natural, engineering and human aspects of the coast, the function of component and relationship between them.
- To be able to interpretation and analysis of coastal issues to determine appropriate approaches in coastal management.
- To be able to understand the need for coastal zone management and to develop an ICM plan.

UNIT I	COASTAL ZONE	9
Coastal Zone – Beach Profile – Surf Zone – Off Shore – Coastal Waters – Coastal sediments- Estuaries – Wet Lands And Lagoons – Coastal dunes-Coastal Geomorphology.		**CO1**
UNIT II	**COASTAL RESOURCES**	**9**
Types and functions of coastal and marine resources- Renewable and Non- Renewable resources – living marine resources and Nonliving marine resources-Marine minerals-placer deposits-hydrocarbon deposits-polymetallic nodules.		**CO2**
UNIT III	**COASTAL ECOSYSTEM**	**9**
Marine ecosystem: Mangroves- Sea grass -seaweeds - coral reef- Large marine ecosystem- Climate effects on living marine resources- Biological monitoring of marine ecosystem- Human impacts on marine ecosystem.		**CO3**
UNIT IV	**COASTAL PROCESSES**	**9**
Erosion And Depositional Shore Features – Methods Of Protection – Littoral Currents – Coastal Aquifers – Sea Water Intrusion – Impact Of Sewage Disposal In Seas.		**CO4**
UNIT V	**COASTAL REGULATIONS**	**9**
Introduction- What is ICM- Developing an ICM framework- Principles-Goals-defining boundaries- Coastal regulations for main land India – coastal regulations for Islands-introduction to Environmental Law and policy.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. NCSCM straigies and guideline for National implementation of Integrated Coastal zone management, 2013
2. Ramesh R and Purvaja R , E- learning moduleon ICZM for UNESCO-IHE, The Netherlands, 2006

REFERENCE BOOKS

1. Richard Sylvester, "Coastal Engineering, Volume I And II", Elseiner Scientific Publishing Co., 1999
2. Dwivedi, S.N., Natarajan, R And Ramachandran, S.,"Coastal Zone Management In Tamilnadu", Madras, 1991

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe The Coastal Zone Regulations, Coastal Processes And to identify natural, engineering and human components on the coast
CO2	Able to interpretation and analysis of coastal issues to determine appropriate

	approaches in coastal management and able to communicate effectively in speech and writings
CO3	Able to learn about different ecosystem available in coastal zones and their Importance
CO4	Able to learn about coastal erosion and accretions, impacts of sewage disposal
CO5	Able to understand about coastal regulations, its laws and policies

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	3	-	2	-	3	2	-	3	3	3
CO3	2	3	3	2	3	3	3	2	-	3	-	2	3	-	3
CO4	-	3	-	2	3	3	2	2	-	3	1	3	3	3	3
CO5	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-

CE1032	GLOBAL CLIMATE CHANGE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give students the various perspectives on climatic change and the actions societies have taken to address its potential and actual impacts
- To highlight that natural processes and human activities alter the composition of the ocean and atmosphere, both globally and regionally, that trigger climate change at different temporal and spatial scales
- To provide a basic conceptual understanding of the complexity of the climate system; and the observed and potential effects of anthropogenic-induced climate change on human and natural systems based on IPCC recommendations
- To enable understanding of the international and national responses to climate change and consider individual responsibility and future challenges

UNIT I	INTRODUCTION	9
Historical Overview of Climate Change Science- Changes in Atmospheric Constituents and Radiative Forcing - The Ice Ages: An Introduction - Determining Past Climates - Reconstructing Past Climate Change -- Interannual to decadal variability- Observations: Atmospheric Surface and Climate Change		**CO1**
UNIT II	**OCEAN-ATMOSPHERE INTERACTIONS**	**9**
Role of the oceans in climate -Introduction to ocean-atmosphere interactions - Global radiation balance -Ocean currents - Thermohaline circulation and deep water masses - Ocean heat budgets a nd water mass mixing - the cryosphere		**CO2**
UNIT III	**IMPACTS OF CLIMATE CHANGE**	**9**
Global warming - greenhouse effect - green house gases - impacts on physical systems - impacts on ecological systems - vulnerability of coast - climate change and biodiversity - sectoral impacts - ocean acidification - carbon sequestration by ecological systems		**CO3**
UNIT IV	**ASSESSMENT OF CLIMATE CHANGE**	**9**
The IPCC Assessments -UNFCCC - global convention on climate change - protocols - international negotiations - Indian assessments - India's plan of action for climate change		**CO4**
UNIT V	**ADAPTATION AND MITIGATION**	**9**
Mitigating climate change - blue carbon- geoengineering - renewable energy and other alternate systems - adaptation indigenous knowledge - sectoral adaptations - coastal ecosystems - coastal communities - mainstreaming climate change into development practices		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Climate Change – The Science, Impacts and Solutions (2nd Edition) – A. Barrie Pittock, CSIRO Publishing, 2009.
2. Fundamentals of weather and climate (2nd Edition) – Robin Mcllveen, Oxford University Press, 2009

REFERENCE BOOKS

1. Climate change – Mitigation of Climate, IPCC, 2013.
2. Atmosphere Weather and Climate – K Siddartha, Kisalaya Publications Pvt. Ltd, 2013
3. W. Neil Adger, Irene Lorenzoni and Karen L. O, Adapting to Climate Change: Thresholds, Values, Governance, Cambridge, 2009.

4. Vineet Kumar, Arjuna Srinidhi, Chandra Bhushan, Geetika Singh, Rising to the Call: Good Practices of Climate Change Adaptation in India, Centre For Science And Environment publisher, 2014.
5. Dan Gafta and John Akeroyd, Nature Conservation Concepts and Practice, Springer, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the science and basic of weather and climate
CO2	Student will attain the knowledge on natural and anthropogenic activities, which accelerate the climate change
CO3	Acquire knowledge on various protocols and agreement that help to control and reduce climate change impacts
CO4	Know the adaptive techniques to build the climate resilience society.
CO5	Gain awareness about the stress on natural based resources and to conserve it from natural calamities

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	3	-	-	2	-	-	-	-	-	2	2	2	-	-
CO4	-	-	3	2	2	3	3	-	-	-	2	-	2	2	3
CO5	-	-	-	-	-	-	-	2	3	3	-	3	-	3	3

CE1033	CLIMATE CHANGE AND VULNERABILITY ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the methodologies of climate impacts and vulnerability assessment on Natural resources

UNIT I	**INTRODUCTION**	**9**
Global, Regional and Local climates, Ocean Circulation, weather parameters. Tropical climate, Monsoons and their role in global climate change.		**CO1**
UNIT II	**NATIONAL ACTION PLAN ON CLIMATE CHANGE**	**9**
National and State Action Plan on Climate Change, Significance on Sustainable development of Natural resources – National Water Mission, Sustainable Agriculture Mission, Green India Mission, Coastal Conservation.		**CO2**
UNIT III	**CLIMATE SCENARIOS**	**9**
Global and Regional Climate Scenarios – Representative Concentration Pathways (RCP 2.6, 4.5,6.0 and 8.5), Global Circulation Model (GCM) - Statistical and Dynamical Downscaling of GCM – Regional Climate Model (RCM).		**CO3**
UNIT IV	**IMPACTS AND VULNERABILITY ASSESSMENT – METHODOGLOGY**	**9**
Definitions of Risk, Hazards, Exposure, Sensitivity and Vulnerability. Climate Risk Assessment, IPCC Methodology – Vulnerability indices.		**CO4**
UNIT V	**VALIDATION AND APPLICATION OF MODELS**	**9**
Climate Projections and Validation– Uncertainty analysis – Bias Correction – Sectoral wise Case Studies in India.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1.IPCC Fifth Assessment Report - Impacts, Adaptation and Vulnerability, Cambridge University Press, 2014.

2.Neelin David J, “Climate Change and Climate Modelling”, Cambridge University Press, 2011.

REFERENCE BOOKS

1. Thomas Stocker, “Introduction to Climate Modelling”, Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication, 2011.
2. India's National Action Plan on Climate Change (NAPCC), Government of India, 2018
3. Michele Companion and Miriam S. Chaiken, Responses to Disasters and Climate Change: Understanding Vulnerability and Fostering Resilience, CRC Press, 2017.
4. Climate Change – The Science, Impacts and Solutions (2nd Edition) – A. Barrie Pittock, CSIRO Publishing, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basic and concept behind the climate change
CO2	Know the global and national policies to combat the climate change impacts
CO3	Understand the basics of climate modelling and envisage the climate change impact based on different emission scenario

CO4	Able to assess the risk and vulnerability on different sectors due to climate change
CO5	Know the validation of climate models and correlate the climate related case studies

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	2	-	-	-	-	-	2	3	-	2	2	3
CO3	2	-	-	2	3	-	-	-	-	-	-	3	-	-	-
CO4	2	3	3	3	3	3	3	3	2	3	-	2	-	-	2
CO5	2	2	2	-	3	-	2	2	-	2	2	-	-	2	-

OME103	ENERGY CONSERVATION IN THERMAL AND ELECTRICAL UTILITIES	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings and
- Utilize the available resources in optimal ways

UNIT I	INTRODUCTION	9
Energy & Power scenario of the World; Present National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.		**CO1**
UNIT II	**THERMAL SYSTEMS**	**9**
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories		**CO2**
UNIT III	**ELECTRICAL SYSTEMS**	**9**
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.		**CO3**
UNIT IV	**ENERGY CONSERVATION IN MAJOR UTILITIES**	**9**
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets		**CO4**
UNIT V	**ECONOMICS**	**9**
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCE BOOKS

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

COURSE OUTCOMES	
Upon completion of this course, the students can able to analyse the energy data of industries. ● Can carryout energy accounting and balancing ● Can suggest methodologies for energy savings	
CO1	Ability to learn the concept of energy scenario, energy consumption and instruments for energy auditing.
CO2	Ability to carry out energy accounting and balancing in electrical system
CO3	Ability to carry out energy accounting and balancing in thermal system system
CO4	Ability to suggest methodologies for energy savings in major utilities
CO5	To understand the economics in energy saving

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	1	1	1	2	2	3	1	3
CO2	3	3	3	3	2	3	3	1	1	1	3	2	3	1	3
CO3	3	3	3	3	3	2	3	1	1	1	3	2	3	1	3
CO4	3	3	3	3	3	2	3	1	1	1	2	2	3	1	3
CO5	3	3	3	3	2	3	3	1	1	1	3	2	3	1	3

OCH103	ENVIRONMENT AND AGRICULTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it

UNIT I	**ENVIRONMENTAL CONCERNS**	**9**
Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.		**CO1**
UNIT II	**ENVIRONMENTAL IMPACTS**	**9**
Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts		**CO2**
UNIT III	**CLIMATE CHANGE**	**9**
Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.		**CO3**
UNIT IV	**ECOLOGICAL DIVERSITY AND AGRICULTURE**	**9**
Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.		**CO4**
UNIT V	**EMERGING ISSUES**	**9**
Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005

REFERENCE BOOKS

1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To gain knowledge on the issues of environmental concerns
CO2	To understand the environmental impacts on agriculture and watershed.
CO3	To gain knowledge on the basic concepts of Climate Change, Water scarcity and water

	knowledge
CO4	To understand the ecosystem, ecological diversity
CO5	To understand the global and local emerging issues on agriculture and biotechnology

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO2	2	1	2	1	2	2	2	1	-	-	1	2	2	2	2
CO3	3	3	3	1	-	3	3	1	-	-	1	3	3	3	3
CO4	2	1	2	1	-	2	2	1	-	-	1	2	2	2	2
CO5	3	1	2	1	-	2	2	1	-	-	1	2	2	2	3

OEE102	RENEWABLE ENERGY SOURCES	L	T	P	C
	(Common to MECH, ECE &CIVIL)	3	0	0	3

OBJECTIVES

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources

UNIT I	BASICS OF SOLAR RADIATION	9
Environmental aspects of energy utilization- importance of renewable energy sources - physics of the sun-the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface. Instruments for measuring solar radiation and sun shine - solar radiation data.		**CO1**
UNIT II	**SOLAR ENERGY COLLECTORS**	**9**
Non-Concentrating and concentrating collectors-classification of concentrating and non-concentrating collectors- orientation and thermal analysis- advanced collectors.		**CO2**
UNIT III	**SOLAR ENERGY STORAGE AND APPLICATIONS**	**9**
Storage methods- Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying. photovoltaic energy conversion.		**CO3**
UNIT IV	**WIND ENERGY AND BIOMASS**	**9**
Sources and potentials- horizontal and vertical axis windmills- performance characteristics- Types of wind Turbine generators- Betz criteria. BIO-MASS: Principles of Bio-Conversion- Anaerobic/aerobic digestion- types of Bio-gas digesters- gas yield- combustion characteristics of bio-gas- utilization for cooking.		**CO4**
UNIT V	**GEOTHERMAL AND OCEAN ENERGY**	**9**
Geothermal Resources- types of wells- methods of harnessing the energy- potential in India. OCEAN ENERGY: OTEC- Principles utilization- setting of OTEC plants- thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques- mini-hydel power plants and their economics.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rai G.D, “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Twidell&Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011

REFERENCE BOOKS

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004.
3. Mittal K M , “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Ability to understand the physics of solar radiation and possible energy conversion.
CO2	Ability to understand the operation of various solar energy collectors.
CO3	Ability to learn the methodologies of storing solar energy.
CO4	Acquire Knowledge in wind and biomass energy conversion techniques.
CO5	Acquire Knowledge in geothermal and ocean energy conversion techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI101	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

UNIT I	**INTRODUCTION TO SENSOR-BASED MEASUREMENT SYSTEMS**		**9**
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types		**CO1**	
UNIT II	**MOTION, PROXIMITY AND RANGING SENSORS**		**9**
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).		**CO2**	
UNIT III	**FORCE, MAGNETIC AND HEADING SENSORS**		**9**
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.		**CO3**	
UNIT IV	**OPTICAL, PRESSURE AND TEMPERATURE SENSORS**		**9**
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC Sensor, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors – Introduction to Smart Sensors – Film (Thin and thick film) sensor, MEMS & Nano mechanical Sensors, LASER sensors, Environmental (Air and water quality) monitoring sensors		**CO4**	
UNIT V	**SIGNAL CONDITIONING and DAQ SYSTEMS**		**9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances ,Manufacturing , Structural health monitoring		**CO5**	
			TOTAL : 45 PERIODS

TEXT BOOKS

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawhney A K and Puneet Sawhney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Expertise in various calibration techniques and signal types for sensors.
CO2	Apply the proximity and ranging sensors in the automotive and mechatronics applications.
CO3	Understand the principles of various magnetic and heading sensors.
CO4	Understand the functioning of optical, pressure, temperature and smart sensors.
CO5	Implement the DAQ systems with different sensors for real time applications.

MAPPING OF COs WITH POs AND PSOs

Cos	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO2	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO3	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO4	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO5	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1

OME107	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the basics, sources and its control techniques of vibration
- To study the basics, sources and its control techniques of noise
- To study the sources of vibration and noise in automobiles
- To reduce vibration and noise in automotive components

UNIT I	**BASICS OF VIBRATION**	**9**
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.		**CO1**
UNIT II	**BASICS OF NOISE**	**9**
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.		**CO2**
UNIT III	**AUTOMOTIVE NOISE SOURCES**	**9**
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.		**CO3**
UNIT IV	**CONTROL TECHNIQUES**	**9**
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.		**CO4**
UNIT V	**SOURCE OF NOISE AND CONTROL**	**9**
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1.Singiresu S.Rao, “Mechanical Vibrations”, 5th Edition, Pearson Education, 2010

2. David Bies and Colin Hansen, “Engineering Noise Control – Theory and Practice”,4th Edition, E and FN Spon, Taylore & Francise e-Library,2009

REFERENCE BOOKS

1. Benson H. Tongue, “Principles of Vibrations”, 2nd Edition, Oxford University,2007
2. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, “Theory of Vibration with Application”, 5th Edition Pearson Education,2011
3. Grover. G.T., “Mechanical Vibrations”, Nem Chand and Bros., 1996
4. Bernard Challen and Rodica Baranescu - “Diesel Engine Reference Book”, Second Edition, SAE International,1999.
5. Julian Happian-Smith - “An Introduction to Modern Vehicle Design”- Butterworth-Heinemann, 2004
6. Rao, J.S and Gupta, K., “Introductory course on Theory and Practice of Mechanical Vibration”, 2nd Edition, New Age International Publications,2010
7. Shabana. A.A., “Theory of vibrations – An introduction”, 2nd Edition, Springer,2010
8. Balakumar Balachandran and Edward B. Magrab, “Fundamentals of Vibrations”, 1st Editon, Cengage Learning, 2009

9. John Fenton, “Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing,1998

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basics, different types and source of vibration
CO2	To understand the basics, different types and source of noise
CO3	To understand and analyze the various sources of automotive noise
CO4	To understand the various control techniques of vibration
CO5	To understand the sources and control techniques of automotive noise

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2
CO4	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO5	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3

OCH104	TEXTILE EFFLUENT TREATMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	**CHARACTERISTICS OF EFFLUENTS**	**9**
Constituents of water and their effect on textile wet processing, Effluent discharge standards for inland surface water public sewers, on land for irrigation, marine coastal areas and drinking water parameters, Quality requirements of water for cotton and synthetic Textile processing.		**CO1**
UNIT II	**PRIMARY TREATMENT**	**9**
Characteristics and treatment of cotton, synthetics and wool processing effluents, Reduction of pollution load, Primary treatment methods - screening, sedimentatation, equalisation, neutralisation, coagulation and flocculation		**CO2**
UNIT III	**SECONDARY TREATMENT**	**9**
Secondary treatment methods – Trickling filtration, Activated sludge process, aerated lagoons, secondary sedimentation, oxidation ponds, Anaerobic Digestion, sludge disposal.		**CO3**
UNIT IV	**TERTIARY TREATMENT**	**9**
Tertiary treatment – Evaporation (solar and steam), Advanced oxidation system, Membrane technologies (MF, UF, NF & RO) ,Reverse osmosis, ion exchange and activated carbon treatment. Quality parameters at entry and exit of RO.		**CO4**
UNIT V	**AIR QUALITY MANAGEMENT**	**9**
Air Pollution - Properties of air pollutants, control of air pollutants – Air pollution control equipment, Ambient air quality standards. Noise pollution – Types of noise – Noise measurement and – Control of noise pollution.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Rao,C.S., "Environment Pollution control Engineering", New age International Ltd. and Publishers, N.Delhi, 2004.
2. Reife, A., and Freeman, H.S., (Ed)., "Environmental chemistry of dyes and pigment", Wiley., London, 2000, ISBN: 047158276.

REFERENCE BOOKS

1. Horrockks, A.R (Ed)., "Ecotextiles'98: Sustainable development", The Text.Inst., Manchester 1999, ISBN: 1855732426.
2. Modak.P., "The textile industry and the environment", UNEP:HMSO, Blackwells, Leeds, 2003, ISBN: 9280713671

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the characteristics of water and effluent discharge standards
CO2	Understand the primary treatment process involved in textile industry

CO3	Understand the different treatment processes involved in waste water treatment
CO4	Perform the research and development to produce zero discharge effluents
CO5	Understand the textile processing related causes for pollution

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	0	3	3	0	2	0	3	2	1	2	2	2	2
CO2	3	1	0	3	3	0	2	0	3	2	1	2	2	2	2
CO3	3	1	0	3	3	0	2	0	3	2	1	2	3	3	3
CO4	3	1	0	3	3	0	2	0	3	2	1	2	2	2	2
CO5	3	1	0	3	3	0	2	0	3	2	1	2	2	2	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart awareness about the pollution created by different stages of wet processing
- To familiarize the students about the importance of water and its analysis
- To enable the students to understand about the waste water treatment plants and various treatments carried out

UNIT I	FUNDAMENTALS OF ROBOT	9
Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.		**CO1**
UNIT II	**ROBOT DRIVE SYSTEMS AND END EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		**CO2**
UNIT III	**SENSORS AND MACHINE VISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors-Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		**CO3**
UNIT IV	**ROBOT KINEMATICS AND ROBOT PROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		**CO4**
UNIT V	**IMPLEMENTATION AND ROBOT ECONOMICS**	**9**
RGV (Rail Guided Vehicle), AGV (Automatic Guided Vehicle); Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations, Hazards of robot, Economic Analysis of Robots- Payback, EUAC, ROI Method.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.

2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

REFERENCE BOOKS

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To learn concepts of Robotic system, its components and instrumentation and control related to robotics.
CO2	To improve skills on hardware drives and interfacing aspects.
CO3	To enhance basics of different sensors and machine vision interaction.
CO4	To develop student's skills in performing kinematics analysis of robot systems.
CO5	To provide the student with some knowledge and skills associated with robot economics control.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO2	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO3	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO4	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1
CO5	3	2	1	2	2	0	0	0	0	0	0	2	3	2	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

❖ · To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I	INTRODUCTION	9
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.		CO1
UNIT II	CHEMICAL HAZARDS	9
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.		CO2
UNIT III	ENVIRONMENTAL CONTROL	9
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.		CO3
UNIT IV	HAZARD ANALYSIS	9
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment		CO4
UNIT V	SAFETY REGULATIONS	9
Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCE BOOKS

1. Safety Manual, “EDEL Engineering Consultancy”, 2000.
2. David L.Goetsch, “Occupational Safety and Health for Technologists”, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	understand the basic safety concepts in Industrial boilers, pressure vessels
CO2	understand the hazardous effects caused and prevention methods of chemicals used in industry
CO3	understand the environmental measures and controls towards safety
CO4	understand the analysis of safety preventions and hazards in industry
CO5	understand the safety regulations and safety management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

CO2	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

<table>
<tr><td>OCS101</td><td colspan="2">INTRODUCTION TO C PROGRAMMING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">OBJECTIVES
❖ To understand the basic concepts in C Programming Language.
❖ To understand Input and Output Statements.
❖ To enhance analyzing and problem solving skills and use the same for writing programs in C.
❖ To familiarize the basic syntax in arrays and pointers
❖ To provide exposure to problem-solving through programming</td></tr>
<tr><td>UNIT I</td><td>INTRODUCTORY CONCEPTS & C FUNDAMENTALS</td><td colspan="5">9</td></tr>
<tr><td colspan="2">Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants.</td><td colspan="5">CO1</td></tr>
<tr><td>UNIT II</td><td>OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS</td><td colspan="5">9</td></tr>
<tr><td colspan="2">Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement</td><td colspan="5">CO2</td></tr>
<tr><td>UNIT III</td><td>FUNCTIONS & PROGRAM STRUCTURE</td><td colspan="5">9</td></tr>
<tr><td colspan="2">Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions</td><td colspan="5">CO3</td></tr>
<tr><td>UNIT IV</td><td>ARRAYS & POINTERS</td><td colspan="5">9</td></tr>
<tr><td colspan="2">Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions</td><td colspan="5">CO4</td></tr>
<tr><td>UNIT V</td><td>STRUCTURES, UNIONS & DATA FILES</td><td colspan="5">9</td></tr>
<tr><td colspan="2">Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files</td><td colspan="5">CO5</td></tr>
<tr><td colspan="7">TOTAL : 45 PERIODS</td></tr>
<tr><td colspan="7">TEXT BOOKS</td></tr>
<tr><td colspan="7">1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.</td></tr>
<tr><td colspan="7">REFERENCE BOOKS</td></tr>
<tr><td colspan="7">1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition.
2. Let Us C Yashavant kanetkar, BPB</td></tr>
<tr><td colspan="7">COURSE OUTCOMES</td></tr>
</table>

Upon completion of the course, students will be able to	
CO1	Identify situations where computational methods and computers would be useful.
CO2	Demonstrate the use of operators, input and output statements and control statements
CO3	Identify solution to a problem and apply control structures and user defined functions for solving the problem
CO4	Demonstrate the use of numeric arrays and pointers
CO5	Demonstrate the ability to design creative solutions to real life problems faced by the industry.

OME106	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various material testing methods and standards.
- To study the various mechanical testing and material characterization
- To study the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT I	INTRODUCTION TO MATERIALS TESTING	9
Overview of materials: Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.		CO1
UNIT II	MECHANICAL TESTING	9
Introduction to mechanical testing: Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.		CO2
UNIT III	NON DESTRUCTIVE TESTING	9
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.		CO3
UNIT IV	MATERIAL CHARACTERIZATION TESTING	9
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction Techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.		CO4
UNIT V	OTHER TESTING	9
Thermal Testing: Differential Scanning Calorimetry, Differential Thermal Analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007.
4. Suryanarayana A. V. K., “Testing of metallic materials”, 2nd Edition, BS publications, 2018

REFERENCE BOOKS

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.

2. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA. 3. Brandon D.G., “Modern Techniques in Metallography”, Von Nostrand Inc. NJ, USA, 1986. Publishing, 1998.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify various materials, different types of material testing, material testing standards and organizations, characterization and techniques
CO2	Identify various mechanical testing and its procedure with application for industrial use.
CO3	understand the various non-destructive testing techniques with application for industrial use.
CO4	analyze the surface and elemental behavior of various materials using different material characterization techniques.
CO5	understand the thermal and chemical behavior of various materials by special testing techniques.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1
CO2	3	2	2	1	2	1	2	1	1	1	2	3	2	2	2
CO3	3	2	1	2	2	1	2	1	1	1	2	3	2	1	1
CO4	3	1	2	2	2	1	2	1	1	1	1	3	2	2	2
CO5	3	2	2	2	2	1	2	1	1	1	1	3	2	1	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I:	INTRODUCTION	9
	History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features	**CO1**
UNIT II:	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**9**
	Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties	**CO2**
UNIT III:	**ORGANS OF GOVERNANCE**	**9**
	Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	**CO3**
UNIT IV:	**EMERGENCY PROVISIONS**	**9**
	Emergency Provisions - National Emergency, President Rule, Financial Emergency	**CO4**
UNIT V:	**LOCAL ADMINISTRATION**	**9**
	District’s Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy	**CO5**
	TOTAL PERIODS: 45	

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

COURSE OUTCOMES	
Upon completion of the course, the students will be	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRA M OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I:	**INTRODUCTION TO VALUE EDUCATION**		**9**
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		**CO1**	
UNIT II:	**IMPORTANCE OF VALUES**		**9**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		**CO2**	
UNIT III:	**INFLUENCE OF VALUE EDUCATION**		**9**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.		**CO3**	
UNIT IV:	**REINCARNATION THROUGH VALUE EDUCATION**		**9**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		**CO4**	
UNIT V:	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**		**9**
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		**CO5**	
			TOTAL PERIODS: 45

REFERENCE:

Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	Gain knowledge of self-development

CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self-destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I:	INTRODUCTION AND METHODOLOGY	9
	Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.	**CO1**
UNIT II:	**THEMATIC OVERVIEW**	**9**
	Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.	**CO2**
UNIT III:	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**9**
	Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.	**CO3**
UNIT IV:	**PROFESSIONAL DEVELOPMENT**	**9**
	Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes	**CO4**
UNIT V:	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**9**
	Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.	**CO5**
	TOTAL PERIODS:	**45**

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES	
Upon completion of the course, the students will be able to	
CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I:	**INTRODUCTION TO YOGA**		**9**
Definitions of Eight parts of yog.(Ashtanga)		**CO1**	
UNIT II:	**YAM**		**9**
Do`s and Don't's in life. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		**CO2**	
UNIT III:	**NIYAM**		**9**
Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		**CO3**	
UNIT IV:	**ASAN**		**9**
Various yog poses and their benefits for mind & body		**CO4**	
UNIT V:	**PRANAYAM**		**9**
Regularization of breathing techniques and its effects-Types of pranayam		**CO5**	
		TOTAL PERIODS:	**45**

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES	
Upon completion of the course, the students will be able to	
CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do's and Don't's in life through Yam
CO3	Learn Do's and Don't's in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind

UNIT I:	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I**	**9**
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		**CO1**
UNIT II:	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**9**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		**CO2**
UNIT III:	**ORGANS OF GOVERNANCE**	**9**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		**CO3**
UNIT IV:	**EMERGENCY PROVISIONS**	**9**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		**CO4**
UNIT V:	**LOCAL ADMINISTRATION**	**9**
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 –Verses 37,38,63		**CO5**
		TOTAL PERIODS:45

REFERENCES:

1. Gopinath, Rashtriya Sanskrit Sansthanam P,Bhartrihari's Three Satakam ,Nitisringar vairagya, Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, the students will be

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**											**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	9

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of “Soul of India lies in villages” – (Gandhi Ji), Rural infrastructure, problems in rural area.

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

CO1

UNIT - II	RURAL ECONOMY AND LIVELIHOOD	9

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market .

Assignment: Describe your analysis of rural household economy, it’s challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

CO2

UNIT - III	RURAL INSTITUTIONS	9

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3-Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles.

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

CO3

UNIT - IV	RURAL DEVELOPMENT PROGRAMMES	9

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.

CO4

<table>
<tr><td>UNIT - V</td><td>FIELD WORK</td><td>9</td></tr>
<tr><td colspan="2">Each student selects one programme for field visit Field based practical activities:

• Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities

• Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site

• Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures

• Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)

• Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization

• Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps

• Participate in Gram Sabha meetings, and study community participation

• Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries

• Attend Parent Teacher Association meetings, and interview school drop outs

• Visit local Anganwadi Centre and observe the services being provided

• Visit local NGOs, civil society organisations and interact with their staff and beneficiaries.

• Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys

• Raise understanding of people's impacts of climate change, building up community's disaster preparedness

• Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants

• Formation of committees for common property resource management, village pond maintenance and fishing.</td><td>CO5</td></tr>
<tr><td colspan="2" align="right">Total Periods:</td><td>45</td></tr>
<tr><td colspan="3">Text Books:</td></tr>
<tr><td colspan="3">1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs</td></tr>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td colspan="3">1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in</td></tr>
</table>

COURSE OUTCOMES	
Upon completion of the course, the students will be able to	
CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community
CO6	Understand of rural life, culture and social realities

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The course will introduce the students to

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I:	INTRODUCTION TO CULTURE	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		**CO1**
UNIT II:	**INDIAN LANGUAGES AND LITERATURE**	**9**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languagesand Literature – II: Northern Indian Languages & Literature		**CO2**
UNIT III:	**RELIGION AND PHILOSOPHY**	**9**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		**CO3**
UNIT IV:	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		**CO4**
UNIT V:	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Scienceand Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		**CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES	
Upon completion of the course, the students will be able to	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Know the contribution of scientists of different eras.
CO6	Understand education systems in India

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO6	-	-	-	-	-	-	-	-	1	1		1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

The main learning objective of this course is to make the students an appreciation for:

1. Introduction to Sanga Tamil Literature.
2. 'Agathinai' and 'Purathinai' in SangaTamil Literature.
3. 'Attruppadai' in SangaTamil Literature.
4. 'Puranaanuru' in SangaTamil Literature.
5. 'Pathitrupaththu' in SangaTamil Literature.

UNIT I:	SANGA TAMIL LITERATURE – AN INTRODUCTION		9
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables.		CO1	
UNIT II:	**'AGATHINAI'AND'PURATHINAI'**		**9**
Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History of Culture from Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		CO2	
UNIT III:	**'ATTRUPPADAI'.**		**9**
AttruppadaiLiterature–Attruppadaiin'Puranaanuru'-Attruppadaiin'Pathitrupaththu'-Attruppadaiin 'Paththupaattu'.		CO3	
UNIT IV:	**'PURANAANURU'**		**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		CO4	
UNIT V:	**'PATHITRUPATHTHU'**		**9**
Pathitrupaththuin 'Ettuthogai'– Pathitrupaththu's Parables–Tamildynasty:Valor, Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.		CO5	

TOTAL PERIODS: 45

REFERENCES:

1. Sivaraja Pillai, The Chronology of the Early Tamils, SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES

Upon completion of the course, the students will be able to	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	1	-	1	-	-	-

OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
	(COMMON TO BIOTECH, EEE, EIE, MECH)	3	0	0	3

OBJECTIVES

- To impart knowledge on the principle and design of particulate/ gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT I	**AIR QUALITY MONITORING**	**9**
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Composition of Particulate and Gaseous Pollutants.		**CO1**
UNIT II	**EFFECT OF ATMOSPHERIC DISPERSION**	**9**
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise		**CO2**
UNIT III	**PARTICULATE CONTAMINANTS**	**9**
Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.		**CO3**
UNIT IV	**GASEOUS CONTAMINANTS**	**9**
Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing.		**CO4**
UNIT V	**INDOOR AIR QUALITY MONITORING**	**9**
Sources, types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution– Standards–Control and Preventive measures.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies‟ , Allied Publishers (P) Ltd., India 2002

REFERENCE BOOKS

1. David H.F. Liu, Bela G. Liptak „Air Pollution‟ , Lweis Publishers, 2000.

2. Arthur C.Stern, „Air Pollution (Vol.I – Vol.VIII)" , Academic Press, 2006.
3. Wayne T.Davis, „Air Pollution Engineering Manual" , John Wiley & Sons, Inc.,2000

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	0	0	0	0	0	0	0	0	0	0	1	2	3
CO2	2	1	0	0	0	0	0	0	0	0	0	0	1	2	3
CO3	3	2	0	0	0	1	0	0	0	0	0	0	2	3	3
CO4	3	2	0	0	0	1	0	0	0	0	0	0	2	3	3
CO5	3	2	0	0	0	1	0	0	0	0	0	0	2	3	3

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
	(COMMON TO AIDS, AIML, CSE, ECE, IT)	3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output
- processes.

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		**CO1**
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.		**CO2**
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.		**CO3**
UNIT IV	**DATA ANALYSIS**	**9**
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation		**CO4**
UNIT V	**APPLICATIONS**	**9**
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	1	-	2	1	-	-	-	-	-	-	1	2	2
CO2	2	1	2	2	3	1	-	-	-	-	-	-	2	3	2
CO3	2	1	2	2	3	1	-	-	-	-	-	-	2	1	2
CO4	2	1	2	-	3	1	-	-	-	-	-	-	2	2	1
CO5	2	-	2	-	3	1	-	-	-	-	-	-	3	2	2

OCE103	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
	(COMMON CHEMICAL, MECHANICAL)	3	0	0	3

OBJECTIVES

- To impart knowledge on Environmental management and Environmental Impact Assessment.

UNIT I	INTRODUCTION	9
Impact of development projects–EIA Notifications-Urbanization–Meaning– Activities involved–Effects on environment-Environmental Impact Assessment(EIA)-Environmental Impact Statement(EIS).		CO1
UNIT II	METHODOLOGIES	9
Methods of EIA–Checklists–Matrices–Networks–Cost-benefit analysis–Analysis of alternatives – Uncertainty in EIA.		CO2
UNIT III	PREDICTION AND ASSESSMENT	9
Assessment of Impact on land, water, air, social & cultural activities and on flora& Fauna-Mathematical models-Public participation–SIA Judgment authorities-Rapid EIA.		CO3
UNIT IV	ENVIRONMENTAL MANAGEMENT PLAN	9
Plan for mitigation of adverse impact on environment–Options for mitigation of impact on water, air, land and on flora& fauna- Addressing the issues related to the Project Affected People		CO4
UNIT V	CASE STUDIES	9
EIA for infrastructure projects–Dams–Highways–Multi-storey Buildings–Water Supply and Drainage Projects–Waste water treatment plants, STP.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Canter,R.L., “Environmental Impact Assessment”, McGraw-Hill Inc., New Delhi,1996.
2. Richard K. Morgan., “Environmental Impact Assessment” Kluwer Academic Publications, London, 2002

REFERENCE BOOKS

1. John G. Rauand David C Hooten (Ed).,“Environmental Impact Analysis Handbook”, McGraw-Hill BookCompany,1990.
2. “Environmental Assessment Sourcebook”, Vol.I, II &III. The World Bank, Washington, D.C., 1991.
3. Judith Petts, “Handbook of Environmental Impact Assessment Vol.I & II”, Blackwell Science, 1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	carry out scoping and screening of developmental projects for environmental and social assessments
CO2	explain different methodologies for environmental impact prediction and assessment
CO3	plan environmental impact assessments and environmental management plans
CO4	evaluate environmental impact assessment reports
CO5	understand the Membrane Applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	-
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	-
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	-
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	-
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	-

OCE104	GREEN BUILDING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- The course aims to develop skills of the students in the area of Civil Engineering with emphasis in environmental implications of buildings and comforts in building
- This will enable the students to perform calculations pertaining to processes and operations.

UNIT I	**ENVIRONMENTAL IMPLICATIONS OF BUILDINGS**	**9**
Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.		**CO1**
UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	**9**
Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.		**CO2**
UNIT III	**COMFORTS IN BUILDING**	**9**
Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations		**CO3**
UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	**9**
Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.		**CO4**
UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	**9**
Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Low Energy Cooling for Sustainable Buildings. John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOKS

1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	understand core building science fundamentals
CO2	perform some building sustainability concepts
CO3	understand energy efficiency in relation to cost performance, ROI, etc
CO4	understand and perform some building performance testing and be exposed to different

	agencies involved in the testing.
CO5	understand and perform some weatherization fundamentals.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO2	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO3	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO4	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3
CO5	3	3	-	3	3	3	3	-	-	-	3	2	1	-	3