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.

B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

B.TECH ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

REGULATION - 2021

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTERS CURRICULAM AND COMPARISION

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 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 (PSO)

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 PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

AbroadrelationbetweenthePrammeobjectiveandtheoutcomesisgiveninthefollowingtable

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	A	B	C	D	E	F	G	H	I	J	K	L
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 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		2	3			1						
3	1		2	1	2		1		1	1	1	

Contribution 1: Reasonable **2: Significant** **3: Strong**

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 Practice 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 to 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 Systems	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓
		Nature Inspired Computing Techniques	✓	✓	✓	✓								✓	✓	✓	✓
		Web programming(Lab Integrated)	✓	✓	✓		✓				✓		✓	✓	✓	✓	✓
		Applied Reinforcement Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
		Advanced Artificial Intelligence Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	VI	Deep Learning	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓
		Autonomous Mobile Robot		✓								✓	✓	✓	✓	✓	✓
		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	✓	✓	✓	✓								✓	✓	✓	✓
		Machine Intelligence for Network Sciences	✓	✓	✓	✓	✓							✓	✓	✓	✓
		Natural Language Processing Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
		Capstone Project-Phase1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	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	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓
		Application Of Machine Learning In Industries	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓
	VI	Green Computing	✓	✓	✓						✓			✓	✓	✓	✓
		Game Programming	✓	✓	✓	✓								✓	✓	✓	✓
		Game Theory	✓	✓	✓	✓								✓	✓	✓	✓
		Parallel And Distributed Computing	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Case Based Reasoning	✓	✓	✓	✓							✓	✓	✓	✓	✓
IV	VII	AI for Clinical Information System	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		AI In Healthcare	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Data Mining And Predictive Modelling	✓	✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
		Virtualization Techniques	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Augmented & Virtual Reality	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓
		Genetic Algorithm	✓	✓	✓	✓	✓			✓		✓	✓	✓	✓	✓	✓
		Speech Processing	✓	✓	✓					✓	✓	✓			✓	✓	✓
		Advanced Optimization Techniques		✓	✓	✓									✓	✓	✓
		Intelligent Transport Systems	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓	✓
		Advanced Bio-Inspired Artificial Intelligence Techniques	✓	✓	✓	✓									✓	✓	✓
	VIII	Video Analytics	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
		Block chain Architecture Design	✓	✓	✓	✓					✓	✓			✓	✓	✓
		Microsoft Bots Framework	✓	✓	✓	✓								✓	✓	✓	✓
		Business Intelligence	✓	✓	✓	✓						✓	✓	✓	✓	✓	✓
		Supply Chain Management		✓	✓	✓									✓	✓	✓
		Internet of Everything	✓	✓	✓	✓	✓					✓	✓	✓	✓	✓	✓
		Human Robot Interaction	✓	✓	✓	✓	✓			✓				✓	✓	✓	✓
		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	4	0	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	4	3	1	0	3
6	GE1106	Engineering Graphics **(Common for all branches of B.E. /B. Tech Programmes)**	ESC	5	1	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	4	0	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 C **(Common to CSE, AI-DS & IT)**	PCC	4	3	1	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				**28**	**19**	**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	4	0	0	4
2	CS1302	Data Structures **(Common to CSE, AI-DS & IT)**	PCC	4	3	1	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				**32**	**19**	**1**	**12**	**25**

SEMESTER – IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1454	Discrete Mathematics and Graph Theory	BSC	4	4	0	0	4
2	CS1401	Design and Analysis of Algorithm **(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
PRACTICAL								
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**	**19**	**0**	**10**	**24**

SEMESTER – V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1501	Reinforcement Learning	PCC	4	3	1	0	3
2	DS1502	Advanced Artificial Intelligence Systems **(Common to AI-DS)**	PCC	4	3	1	0	3
3	ML1502	Nature Inspired Computing Techniques	PCC	4	3	1	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
PRACTICAL								
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				**31**	**18**	**3**	**10**	**23**
10		Value Added Course	Audit Course	Two Weeks				1

SEMESTER – VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1601	Deep Learning	PCC	4	3	1	0	3
2	ML1602	Autonomous Mobile Robot	PCC	4	3	1	0	3
3	ML1603	Probabilistic Graphical Models	PCC	4	3	1	0	3
4	ML1604	Big Data Analytics	PCC	4	3	1	0	3
5		Open Elective-II	OEC	3	3	0	0	3
6		Professional Elective-II	PEC	3	3	0	0	3
PRACTICAL								
7	ML1607	Deep Learning Laboratory	PCC	4	0	0	4	2
8	ML1608	Socially relevant Project	EEC	4	0	0	4	2
Total				**31**	**18**	**3**	**10**	**22**
9		Audit Course (Optional)	AC					

SEMESTER – VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	ML1701	Statistical Natural Language Processing	PCC	4	3	1	0	3
2	ML1702	Formal Languages and Automata Theory	PCC	4	4	0	0	4
3	ML1703	Image Processing and Vision Techniques	PCC	4	3	1	0	3
4	ML1704	Machine Intelligence for Network Sciences	PCC	4	3	1	0	3
5		Professional Elective-III	PEC	3	3	0	0	3
6		Professional Elective-IV	PEC	3	3	0	0	3
PRACTICALS								
7	ML1707	Natural Language Processing Laboratory	PCC	4	0	0	4	2
8	ML1708	Capstone Project-Phase1	EEC	4	0	0	4	2
Total				**30**	**18**	**4**	**8**	**23**

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	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	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	MA1251	Linear Algebra	BSC	4	4	0	0	4
6	PH1252	Physics for Information Science	BSC	3	3	0	0	3
7	MA1354	Probability and Bayesian Inference	BSC	4	4	0	0	4
8	MA1454	Discrete Mathematics and Graph Theory	BSC	4	4	0	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	4	3	1	0	3
2	GE1106	Engineering Graphics	ESC	5	1	0	4	4
3	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4	BE1205	Basic Electrical and Electronics Engineering	ESC	3	3	0	0	3
5	GE1207	Engineering Practice Lab	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	4	3	1	0	3
2	CS1208	Programming in C Lab	PCC	4	0	0	4	2
3	CS1302	Data Structures	PCC	4	3	1	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 to 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	DS1408	Machine Learning Laboratory	PCC	4	0	0	4	2
17	ML1501	Reinforcement Learning	PCC	4	3	1	0	3
18	DS1502	Advanced Artificial Intelligence Systems	PCC	4	3	1	0	3
19	ML1502	Nature Inspired Computing Techniques	PCC	4	3	1	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	1	0	3
24	ML1602	Autonomous Mobile Robot	PCC	4	3	1	0	3
25	ML1603	Probabilistic Graphical Models	PCC	4	3	1	0	3
26	ML1604	Big Data Analytics	PCC	4	3	1	0	3
27	ML1607	Deep Learning Laboratory	PCC	4	0	0	4	2
28	IT1701	Statistical Natural Language Processing	PCC	4	3	1	0	3
29	ML1701	Formal Languages and Automata Theory	PCC	4	4	0	0	4
30	ML1702	Content Based Image And Video Retrieval	PCC	4	3	1	0	3
31	ML1703	Machine Intelligence for Network Sciences	PCC	4	3	1	0	3
32	ML1707	Natural Language Processing Laboratory	PCC	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSES (PEC)
PROFESSIONAL ELECTIVE – I (V)

Sl. 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	Application 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	Game Theory	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)

Sl. 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	AI In Healthcare	PEC	3	3	0	0	3
3	ML1713	Data Mining And Predictive Modelling	PEC	3	3	0	0	3
4	CS1712	Virtualization Techniques	PEC	3	3	0	0	3
5	IT1715	Augmented & Virtual Reality	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	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	ML1724	Intelligent Transport Systems	PEC	3	3	0	0	3
5	ML1725	Advanced Bio-Inspired Artificial Intelligence 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	Human Robot Interaction	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

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 EnlightenmentSkills	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					27	15.00
ESC	9	5							14	7.77
PCC		5	20	20	17	14	15		91	50.55
PEC					3	3	6	6	18	10.00
OEC					3	3			6	3.33
EEC						2	2	10	14	7.78
Total	**24**	**23**	**25**	**24**	**23**	**22**	**23**	**16**	**180**	**100**

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–criticalreading–findingkey 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 ofspeech. 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-longtexts-TEDtalks-extensivespeechoncurrentaffairsand discussionsSpeaking–describingasimpleprocess–askingandanswering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context –useofsequencewords.		CO2

UNIT III	GRAMMAR AND LANGUAGE DEVELOPMENT	9
Reading- short texts and longer passages (close reading)&makinga criticalanalysisofthegiventextWriting–typesofparagraphandwriting essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- roleplays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause&effectexpressions, 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 -Speakingabout		CO4

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&debatesLanguage 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)	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 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	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	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: 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	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		**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	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	1	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)		1	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**	**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 : 45 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 ofMatter
- The Optical properties , Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties ofMaterials
- Enable the students to enhance accuracy in experimentalmeasurements.
- 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

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)	4	0	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 : 45 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	P	T	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	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 –		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', 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, 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	1	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 fileprocessing.

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

GE 1207	ENGINEERING PRACTICES LAB	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)

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

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
		4	0	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	**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 forEngineers", 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 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	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	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 – Cut vertex – Euler circuits – Applications of graphs.		**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 Cll, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using Cll, 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 AIproblems
- 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), Jonesand 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 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

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 GovernanceData 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

ML1302	OBJECT ORIENTED SOFTWARE ENGINEERING Lab Integrated	L	T	P	C
		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-OBJECTS, CLASSES AND INTERFACES	9+6

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 - ArrayList - Strings and StringBuffer - 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.

CO1

UNIT II	EXCEPTION, IO STREAMS AND CONCURRENT PROGRAMMING	9+6

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.

CO2

UNIT III	PLANNING & SCHEDULING	9+6

Introduction to Software Engineering - Software Development process models – Agile **CO3**

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		
UNIT IV	**ANALYSIS AND DESIGN**	**9+6**
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		**CO4**
UNIT V	**IMPLEMENTATION, TESTING AND MAINTENANCE**	**9+6**
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)		**CO5**
		PRACTICALS: 30 PERIODS
		THEORY: 45 PERIODS
		TOTAL : 75 PERIODS

TEXT BOOKS

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.

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 STRUCTURE 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

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) 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

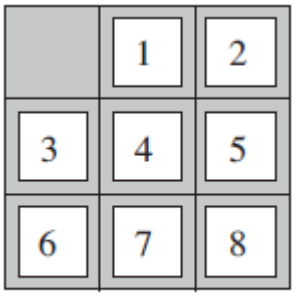
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

DS1308	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common 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.	**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

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 SKILLSLAB	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 & GRAPH THEORY	L	T	P	C
		4	0	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 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, 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	P	T	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: Elsevier Science,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

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 Conceptsll, 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.	
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

ML1501	REINFORCEMENT LEARNING	L	P	T	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. 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. [Draft copies available now]
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 SYSTEMS	L	T	P	C
	(Common to AI-DS)	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. 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	P	T	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 ,AdaptationFeedback-Self-Organization-Complexity, Emergence and ,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

ML1503	WEB PROGRAMMING (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

OBJECTIVES

- To understand and explore HTML, CSS and Javascript
- 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

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 – 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**

Lab Component

- Design a Webpage using all HTML elements
- Create a web page with all types of Cascading style sheets and CSS Selectors

UNIT II	Client-Side Scripting and HTML DOM	9

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 **CO2**

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

UNIT III	WEB APPLICATIONS AND ANGULAR.JS	9

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 **CO3**

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

UNIT IV	INTRODUCTION TO NODE.JS	9

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 **CO4**

Lab Component

- Design an online super market using Express JS and MongoDB database a)

	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**
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**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. BradDayley,Node.js,MongoDB,andAngularJSWebDevelopment;2edition,AddisonWesley,2017
2. JonDuckett,JavaScriptandJQuery:InteractiveFront-EndWebDevelopment,Wiley,2014Zammetti,Frank,ModernFull-StackDevelopment,Apress,2020

REFERENCE BOOKS

. 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. AmolNayak, “MongoDB Cookbook Paperback”, November 2014

4. KrasimirTsonev, “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	
3. Implement Thomson sampling algorithm with python	
4. Implement Policy iteration algorithm with python	
5. Implement Value Iteration code algorithm with python	CO2
6. Implement Monte Carlo control & MC Policy Evaluvation algorithm with python	
7. Implement TD(0) Prediction algorithm with python	
8. Implement SARSA algorithm with python	CO3
9. Implement Q Learning algorithm with python	

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

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(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).	
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

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	1	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.
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

ML1602	AUTONOMOUS MOBILE ROBOT	L	P	T	C
		3	1	0	3

OBJECTIVES

- To understand the fundamental concepts of Autonomous mobile robotics.
- To know about robot sensory perception algorithms, sensor suites and robot control through sensory feedback.
- To understand the basic concepts and algorithms required for locomotion and mobile robot Kinematics.
- To get deep knowledge about mapping and localization.
- To understand the basic concepts and algorithm required for mobile robot planning and navigating.

UNIT I	FUNDAMENTAL CONCEPTS OF AUTONOMOUS MOBILE ROBOTICS	9
Introduction to Robotics- Robot features, sensors, manipulators- Application areas-State of Robotics research and adoption.-Robotic hardware systems- Intelligence and embodiment-Ratslife- Challenges of Mobile Autonomous Robots- Challenges of Autonomous Manipulation.		**CO1**
UNIT II	**ROBOTICSENSORS AND VISION**	**9**
Robotic Sensors- Proprioception of robot kinematics and internal Forces- Sensors using light-Sensors using sound- Inertia-based sensors- Beacon-based sensors-Vision- Images as two-dimensional signals- From signals to information- Basic image operations- Feature extraction-Uncertainty and Error Propagation.		**CO2**
UNIT III	**LOCOMOTION AND MOBILE ROBOT KINEMATICS**	**9**
Locomotion: Introduction- Legged Mobile Robots- Wheeled Mobile Robots- Aerial Mobile Robots. Mobile Robot Kinematics: Introduction-Kinematic Models and Constraints- Mobile Robot Maneuverability- Mobile Robot Workspace- Beyond Basic Kinematics- Motion Control (Kinematic Control).		**CO3**
UNIT IV	**LOCALIZATION AND MAPPING**	**9**
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.		**CO4**
UNIT V	**PLANNING AND NAVIGATION**	**9**
Introduction- Planning and Reacting- Path Planning- Obstacle avoidance- 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 Architectures.		**CO5**
		TOTAL : 45 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	Understand the fundamental concepts of Autonomous mobile robotics
CO2	Discuss the essential of Robotic Sensors and Vision
CO3	Understand the concepts and algorithms for mobile robot locomotion and mobile robot Kinematics
CO4	Get firm grasp of the algorithms for mapping and localization
CO5	Describe the concepts and algorithm required for mobile robot planning and navigating

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

ML1603	PROBABILISTIC GRAPHICAL MODELS	L	P	T	C
		3	1	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	P	T	C
		3	1	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

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.

.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	1	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
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.		**CO5**

Unit IV Machine Learning for NLP

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

Unit V Applications in NLP

Question Answering with SQUAD **–** Dependency Parsing – Machine Translation – Conference Resolution – Text Summarization

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. DeeptiChopra,NisheethJoshiItiMathur, “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. AtefehFarzindar,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 apply NLG and machine translation

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 automata 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 type checking procedure during the compilation
- To understand the storage structure of the running program

UNIT I	AUTOMATA	9
Introduction to formal proof – Additional forms of proof – Inductive proofs –Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon transitions- Equivalence and minimization of Automata.		**CO1**
UNIT II	**CONTEXT FREE GRAMMARS AND LANGUAGES**	**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 – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.		**CO2**
UNIT III	**BASICS OF COMPILATION**	**9**
Compilers – 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 – Top down parser : Table implementation of Predictive Parser – Bottom up Parser : SLR(1) Parser – Parser generators.		**CO3**
UNIT IV	**TYPE CHECKING AND RUNTIME ENVIRONMENTS**	**9**
Syntax directed definitions – Construction of syntax trees – Type systems – Specification of a simple type checker- Equivalence of type expressions – Type conversions – Attribute grammar for a simple type checking system – Runtime Environments: Source language issues – Storage organization – Storage allocation strategies – Parameter passing		**CO4**
UNIT V	**CODE GENERATION AND OPTIMIZATION**	**9**
Issues in the design of a code generator - The target machine - Run-time storage management - Basic blocks and flow graphs - Next-use information - A simple code generator - Register allocation and assignment - The dag representation of basic blocks - Generating code from DAG – Dynamic programming code generation algorithm – Code generator generators - Code optimization		**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 a Turing machine.
CO3	Select appropriate grammar for the implementation of compiler phases and Design a lexical analyzer and simple parser
CO4	Design and implement techniques used for optimization by a compiler.
CO5	Write a very 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-Image Processing Operations– Basic Image filtering operations: Noise Suppression by Gaussian Smoothing- Median Filters- Mode Filters- Rank Order Filters- The Role of Filters in Industrial Applications of VisionThresholding- Adaptive Thresholding-Edge detection techniques – corner and interest point detection – mathematical morphology – Some Basic Approaches to Texture Analysis.		**CO1**

UNIT II	IMAGE ENHANCEMENT IN THE SPATIAL AND FREQUENCY DOMAIN	9
Image enhancement by point processing-Image enhancement by neighbourhood processing-Basic Gray Level 20% Transformations-Histogram Processing-Enhancement Using Arithmetic and Logic Operations-Zooming- Basics of Spatial Filters- Smoothening and Sharpening Spatial Filters-Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain-Smoothing and Sharpening Frequency Domain Filters- Homomorphic Filtering		**CO2**

UNIT III	IMAGE RESTORATION AND IMAGE COMPRESSION	9
Model of The Image Degradation / Restoration Process-Noise Models- Restoration in the presence of Noise Only Spatial Filtering- Periodic Noise Reduction by Frequency Domain Filtering-Linear Position-Invariant DegradationsEstimation of Degradation Function- Inverse Filtering-Wiener filtering- Constrained Least Square Filtering-Geometric Mean Filter-Geometric Transformations. Data Redundancies-Image Compression Models-Elements of Information Theory- Lossless and Lossy compression-Huffman Coding-Shanon-Fano Coding- Arithmetic Coding-GolombCodingLZW Coding-Run Length Coding-Loss less predictive Coding- Bit Plane Coding- Image compression standards		**CO3**

UNIT IV	3D VISION	9
3-D Vision - Methods for 3D vision – projection schemes – shape from shading – photometric stereo – Surface Smoothness– shape from texture – use of structured lighting- three-dimensional object recognition schemes- Image Transformations and Camera Calibration.		**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- Surveillance-foreground-background separation – particle filtres – Chamfer matching- tracking- and occlusion – combining views from multiple cameras – human gait analysis Application- In-vehicle vision system: locating roadway – road markings – road signs – locating pedestrians		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
2 Rafael C. Gonzalez & Richard E. Woods, “Digital Image Processing”, 2nd edition, Pearson Education

REFERENCE BOOKS

1. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
2. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012
3. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition,Academic Press, 2012.
4. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
5. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'ReillyMedia, 2012.
6. A.K. Jain, “Fundamental of Digital Image Processing”, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement fundamental image processing techniques required for computer vision
CO2	Understand the image enhancement in the Spatial and Frequency Domain.
CO3	Apply Image Restoration and Image Compression.
CO4	Apply 3D vision 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	2	-	3	-	-	-	-	-	-	-	3	-	-	3
CO2	-	3	3	2	-	-	-	-	-	-	-	3	3	-	3
CO3	-	3	3	3	-	-	-	-	-	-	-	3	3	-	3
CO4	-	3	2	3	-	-	-	-	-	-	-	3	3	-	-
CO5	-	2	3	3	-	-	-	-	-	-	3	3	-	3	-

ML1704	MACHINE INTELLIGENCE FOR NETWORK SCIENCES	L	T	P	C
		3	1	0	3

OBJECTIVES

- .To understand human behaviour in social web and related communities.
- To learn visualization of social networks.
- Learn to predict human behaviour in social web and related communities

UNIT I	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.		CO1
UNIT II	**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 & 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		CO2
UNIT III	**MACHINE LEARNING FOR GRAPHS - I**	**9**
Machine Learning for Graphs; Traditional Methods for ML in Graphs – Node Level Tasks, Node Level prediction, Link level prediction, Graph -level prediction; Node Embeddings. Label Propagation for Node Classification		CO3
UNIT IV	**MACHINE LEARNING FOR GRAPHS – II**	**9**
Graph Neural Networks – Model, Design Space; Applications of GNN; Knowledge Graph Embeddings; Reasoning over Knowledge Graphs; Subgraph mining with GNNs.		CO4
UNIT V	**GENERATIVE MODELLING AND CASE STUDY**	**9**
Traditional Generative Models for Graphs ; Deep Generative Models for Graphs; Graph neural networks in computational biology (GNN), Graph Embeddings in fraud detection, Networks recommended systems, Machine learning and Drug Discovery		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	Use statistical software to visualize networks and analyze their properties, connecting these to network concepts and theories
CO2	Know basic notation and terminology used in network science
CO3	Graph Machine Learning uses the network structure of the underlying data to improve predictive outcome
CO4	provide an easy way to do node-level, edge-level, and graph-level prediction tasks.
CO5	To understand human behaviour in social web and related communities

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

ML1707	NATURAL LANGUAGE PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- able to explain and apply fundamental algorithms and techniques in the area of natural language processing (NLP)
- Understand language modeling.
- to manipulate and analyze language data using Python

LIST OF EXPERIMENTS

1. Word Generation- generate word forms from root and suffix information	**CO1**
2. Morphology- Understanding the morphology of a word by the use of Add-Delete table	
3. N-Grams- to calculate bigrams from a given corpus and calculate probability of a sentence.	
4. N-Grams Smoothing- to apply add-one smoothing on sparse bigram table.	
5. POS Tagging: Hidden Markov Model- to calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	**CO2**
6. POS Tagging: Viterbi Decoding- to find POS tags of words in a sentence using Viterbi decoding.	
7. Building POS Tagger- to know the importance of context and size of training corpus in learning Parts of Speech	
8. Chunking- to understand the concept of chunking and get familiar with the basic chunk tagset.	**CO3**
9. Building Chunker- selecting proper features for training a model and size of training corpus in learning how to do cunking.	
10. Parsing: parsing specific kinds of data, focusing primarily on dates, times, and HTML	

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Python 3 Interpreter for Windows/Linux 30 Nos

PYTHON PACKAGES

Students are expected to know/ learn the following Python NLP packages

• NLTK (www.nltk.org/ (http://www.nltk.org/))

• Spacy (https://spacy.io/)

• TextBlob (http://textblob.readthedocs.io/en/dev/

• Gensim (https://pypi.python.org/pypi/gensim)

• Pattern (https://pypi.python.org/pypi/Pattern)

DATASETS

NLTK includes a small selection of texts from the Project Gutenberg electronic text

archive, which contains some 25,000 free electronic books, hosted at

http://www.gutenberg.org/.

2. The Brown Corpus contains text from 500 sources, and the sources have been

categorized by genre, such as news, editorial, and so on (http://icame.uib.no/brown/bcmlos.html).

3. Wikipedia Articles

Or any other dataset of your choice

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Tag a given text with basic language features.
CO2	To implement a rule based system to tackle morphology/syntax of a language
CO3	To design a tag set to be used for statistical processing for real-time 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	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

ML1708	CAPSTONE PROJECT- PHASE I	L	P	T	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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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

ML1807	CAPSTONE PROJECT- PHASE II	L	P	T	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	P	T	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 :	8
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 Protoc ols – Conc urrency Control in Distributed Databases –Distributed Query Processing.		CO1
UNIT II	**OBJECTAND OBJECT RELATIONAL DATABASES**	**8**
Object-Based Databases: Complex Data Types–Structured Types and Inheritance in SQL –Table Inheritance –Arra y 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**	**8**
XML: Motivation –Structure of XML Data –XML Document Schema –Querying and Transformation – Appl ication Program Interfaces to XML –Storage of XML Data –XML Applications.		CO3
UNIT IV	**SPATIAL AND TEMPORAL DATABASES**	**8**
Spatial and Temporal Data and Mobility: Time in Databases –Spatial and Geographic Data Mobility a nd Personal Databases.		CO4
UNIT V	**MULTIMEDIA DATABASES**	**8**
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	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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	PO 10	PO 11	PO 12	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	P	T	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 Btrees – 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 Reducability – 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	PO 10	PO 11	PO 12	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 GeneticProgramming		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", IEEETrans. 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	PO 10	PO 11	PO 12	PSO 1	PSO 2	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	APPLICATION 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	MACHINES LEARNING IN BANKING AND SECURITIES	9
Why machine learning in banking sector, Use of AI in banking and finance, Fraud detection, Tough competition in banking industry, Risk modelling and investment banks, Customer data management, Decreased customer experience and loyalty, Personalized marketing, Role of machine learning: Challenges of banking sector and securities, Widely used machine learning algorithms in banking and security, Fraud prevention and detection systems, Rule based and machine learning based approach in fraud detection, Anomaly detection: Ways to expose suspicious transactions in banks, Advanced fraud detection systems, Risk management systems, Case study: Application of machine learning for financial risk management, Credit risk analysis using machine learning classifier, Investment prediction systems, Portfolio management systems, Objectives of portfolio management, Algorithmic trading, Deep learning for customer services, Chatbot: Deep learning approach, AI powered marketing systems, Deep learning in cyber security, Types of cyber-attacks in banks, Deep learning methods used in cyber security, Deep learning v/s restricted Boltzmann machines, Convolution Neural Networks (CNNs), Recurrent neural networks, Machine learning techniques: Loan underwriting & sentiment/news analysis, Sentiment or news analysis, Current challenges and opportunities: Banking and security domain.		**CO1**

UNIT II	MACHINE LEARNING IN COMMUNICATION, MEDIA, HEALTHCARE AND LIFE SCIENCE	9
Machine learning in communication, media and entertainment, Usage of machine learning in media and entertainment industry, Machine learning techniques for customer sentiment analysis, World embedding's, Sentiment analysis with long short term memory networks, Real-time analytics in communication, media and entertainment industries, Real time analytics and social media, Deep learning for social media analytics, Recommendations engines, Collaborative filtering, Memory based collaborative filtering, Model based collaborative filtering, Content based filtering, Hybrid recommendation systems, Summary of recommendation systems, Deep learning techniques on recommender systems. Applications of machine learning in health and life sciences, The most important applications of machine learning in healthcare, Role of machine learning in drug discovery, Medical image analysis, Why deep learning for medical image analysis, Neural network and deep learning architecture, Comparisons between architecture of different types of deep learning models, Machine learning in genetics and genomics, Genomics and AI background, Two category of genomics, How to use deep learning effectively, Interpreting deep learning models, Predictive medicine: Prognosis and diagnostics accuracy, Predictive medicine: Examples, ML applications in breast cancer diagnosis and prognosis.		**CO2**

UNIT III	MACHINE LEARNING IN EDUCATION, MANUFACTURING AND PETROLEUM INDUSTRIES	9
Advantages of machine learning in education, learning analytics, Academic analytics, Action research, Educational data mining, Recommender system, Personalized adaptive learning, Learning analytics process, Data environment:		**CO3**

What? Stakeholders: Who? Methods: How? Case study: Sentimental analysis for student's feedback using ML, Recommender systems in education, Domain model, Learner model, Students classification algorithm, Recommendation model, Case study: Application of ML in predicting students' performance, Proposed methodology, Data description, Sample data sets, Visualization, Selection of machine learning technique. Introduction, Applications of machine learning in manufacturing industry, Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, Case study, Construction of CNN, Experimental results, Efficiency of CNN for defect detection, Comparative experiments, Machine learning for fault assessment, Time frequency methods, Spectrograms: Short-Time Fourier Transform (STFT), Scalograms: Wavelet transform, Hilbert-Huang transform, Proposed CNN architecture for fault classification based on vibration signals, Case study 1, Machinery failure prevention technology.		
UNIT IV	**MACHINE LEARNING IN GOVERNMENT ADMINISTRATION AND INSURANCE INDUSTRIES**	**9**
Introduction, 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 between citizen and government, Media richness theory, Chatbots in the public sector, Case study, Data management services, Knowledge processing services, Application services, An application scenario, Classifications of citizen complaints using ML, Case study, Step 1: Document collection, Step 2: Prepossessing, Step 3: Feature extraction, Term frequency- Inverse document frequency, Step 4: Feature selection, Step 5: Classification, How to implement, Result. Importance of machine learning in insurance, Potential use cases of machine leaning in insurance industry, Case study on insurance climb analysis using machine learning algorithms, Case study on using machine learning for insurance pricing optimization, Personalized marketing in insurance industry, Predictive model for insurance underwriting, Case study: Risk prediction in life insurance industry		**CO4**
UNIT V	**MACHINE LEARNING IN RETAIL AND SUPPLY CHAIN, TRANSPORTATION AND LOGISTICS, ENERGY AND UTILITIES**	**9**
Introduction, Inventory management, Few use case examples, Benefits of predictive analytics to retailers, Robots-seeing to customer satisfaction, IoT: Prevention first, Predictive analytics: Weathering demand, Analysing buying patterns, Analysing traffic patterns, Assortment planning, Eliminate guess work, Feed the right stores, Get better information, Assortment planning to drive supply chain, Retail analytics, Domestic forecasting, Case study: Forecasting seasonal footwear demand using ML, Demand forecasting methods, Predictor variables in demand forecasting, Traditional techniques v/s machine learning techniques, Methodology, Machine learning techniques used, List of attributes from the aggregated data by month at the style level, Feature selection and engineering, List of attributes for feature selection, Dataset partitioning, Model building, Three step model, K-means clustering, Three steps followed in classification, Three sub-steps in prediction, Performance measurement, Results, Three step model, Machine learning for supply chain management, Recommended architecture for machine learning models, Machine learning models use case. Introduction, Applications of ML and artificial intelligence in transportation, Applications of machine learning in transport, Incident detection, Predictive models, Application of AI in aviation and public transportation, Aviation, Shared mobility, Buses, Intelligent urban mobility, Autonomous vehicles, Autonomous transportation, Artificial intelligence use cases in logistics, Back office AI, Cognitive customs, Predictive logistics, Predictive risk management, Seeing thinking and speaking logistics operations, ML powered customer experience, Limitations of AI techniques in transportation, Computation complexity of AI algorithms. Introduction, Smart grid, Smart grid technologies, Key characteristics of smart grid, Machine learning applications in smart grid, Machine learning techniques for renewable energy generation, Forecasting		**CO5**
TOTAL : 45 PERIODS		

TEXT BOOKS	
Data Mining & Predictive Modeling (IBM ICE Publications).	
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	P	T	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, and 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	P	T	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	8
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.		CO 1
UNIT II	**GAME ENGINE DESIGN**	**8**
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.		CO 2
UNIT III	**GAME PROGRAMMING**	**8**
Application Layer, Game Logic, Game Views, Managing Memory, Controlling The Main Loop, Loading And Caching Game Data, User Interface Management, Game Event Management.		CO 3
UNIT IV	**GAMING PLATFORMS AND FRAMEWORKS**	**8**
2D And 3D Game Development Using Flash, DirectX, Java, Python, Game Engines – DX Studio, Unity		CO 4
UNIT V	**GAME DEVELOPMENT**	**8**
Developing 2D And 3D Interactive Games Using DirectX Or Python – Isometric And Tile Based Games, Puzzle Games, Single Player Games, Multi Player Games.		CO 5

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 To Real-Time Computer Graphics” 2nd Editions, Morgan Kaufmann, 2006.
4. Ernest Adams And Andrew Rollings, “Fundamentals Of Game Design”, 2nd Edition Prentice Hall / New Riders, 2009.

5. Eric Lengyel, “Mathematics For 3D Game Programming And Computer Graphics”, 3rd Edition, Course Technology PTR, 2011.

6. Jesse Schell, The Art Of Game Design: A Book Of Lenses, 1st Edition, CRC Press, 2008.

.

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	GAME THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- 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 assumptionsthe 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 Maxminimization: Maxminimization-Maxminimization and Nash Equilibrium-Strictly Competitive Games -Maxminimization and Nash Equilibrium in Strictly Competitive Games-Maxminimization: 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		CO5

Auction Design -Bargaining: Nash Bargaining Solution, Ultimatum game, Alternating-offers game, Threat Points, Bargaining Shares	

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 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

ML1614	PARALLEL AND DISTRIBUTED COMPUTING	L	P	T	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**:	8
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**	**8**
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**	**8**
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**	**8**
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**	**8**
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 caseretrieval, 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 AttributesSimilarity 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 AcquisitionPrototypes and Evaluation The Knowledge Containers - Systematic Development of CBR SystemsImplementation 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 ManagementCase-Based Reasoning and Knowledge Management- CBR Implementing KM 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-Interscience, 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	PO10	PO11	PO12	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. 3.

REFERENCE BOOKS

1. Arnold, M. (2016). Digital health news update: Machine learning meets health search. Decision Resources Group
2. Blenner, S. R., Köllmer, 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	AI IN HEALTHCARE	L	P	T	C
		3	0	0	3

OBJECTIVES

- To discuss the role of data analytics in quality and performance improvement efforts.
- To describe the tools and techniques used for data analytics in health care organizations.
- To Identify techniques for summarization and visualization of data
- To understand various data analysis tools and Techniques
- To apply regression and non-regression techniques for predictive analysis.

UNIT I	INTRODUCTION TO QUALITY IMPROVEMENT AND DATA ANALYTICS	9
Health care data analytics – Definition - How analytics can help transform health care-The drivers for health care transformation -Business value of data to an organization eg healthcare institution- Health care quality and value- The background and evolution of quality and performance improvement - The quality improvement frameworks that utilize analytics -Types of data analytics techniques and their strengths and weaknesses.		**CO1**
UNIT II	**DATA PROCESSING AND REPORTING TECHNIQUES**	**9**
The Data Life Cycle- Data sources and data structures – examples from healthcare- Measuring quality and safety of care- Various measures, metrics, and indicators -Defining and Developing Key Performance Indicators- The purpose and use of Key Performance Indicators (KPI's) -Data information, knowledge and wisdom hierarchy- Organizational approach for effective use of data analytics- The role of data governance-The DMAIC problem-solving model and the tools and techniques used in each step of the process - Apply the DMAIC methodology to a health care issue.		**CO2**
UNIT III	**DATA SUMMARY AND VISUALIZATION TECHNIQUES**	**9**
Common data types -The information value chain - The importance of data context and relevance to business processes - Basic statistical terms - Recognize common patterns or distributions in statistics -Distributions using numerical measures such as mean, median and standard deviation - Graphical representations of data including histograms, bar charts and scatterplots- Data summary techniques (for measurement and categorical data)- Visualization techniques (for measurement and categorical data)- Interactive visualization techniques- Common misuses of data visualization.		**CO3**
UNIT IV	**DATA ANALYTICS TOOLS AND TECHNIQUES**	**9**
Data analytics terms - The process steps of data analytics and the tools used in each step - The role of the data analyst - Tools and techniques used to analyse and interpret healthcare data effectively - Various types of databases and how they are structured -Data warehouse concepts - Enterprise data architecture in health care organizations.		**CO4**
UNIT V	**PREDICTIVE ANALYTICS INVOLVING REGRESSION AND NON-REGRESSION TECHNIQUES**	**9**
Principles of predictive analytics-Predicting one outcome variable from a predictor variable – Simple linear regression-Predicting one measurement outcome variable from several predictor variables – Multiple linear regression-Predicting one binary outcome variable from several predictor variables – Multiple logistic regression- Misuses of regression techniques in predictive analytics- Bayesian techniques in predictive analytics- Application of Bayesian techniques in predicting health screening outcomes- Principles of Survival Analysis- Support Vector Machines for cluster analysis- Strategic applications of Sentiment Analysis in Healthcare.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Albert Zomaya, Ajith Abraham, Patrick Siarry, Mengjie Zhang, FazleBaki, Anand J. Kulkarni, Pramod Kumar Singh," Big Data Analytics in Healthcare", 2019
2. Editors: Chandan K. Reddy, Charu C. Aggarwal," Healthcare Data Analytics", 2015.
3. Chandan K. Reddy and Charu C. Aggarwal," Healthcare Data Analytics", First Edition, Chapman & Hall /CRC Press 2015.

REFERENCE BOOKS

1. Ross M. Mullner Edward M. Rafalski, "Healthcare Analytics – Foundations and Frontiers" First Edition, T&F/Routledge, 2020.
2. El Morr, Christo, Ali-Hassan, Hossam ," Analytics in Healthcare",springer 2019

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand role of data analytics in quality and performance improvement efforts in healthcare institutions.
CO2	Understand the tools and techniques used for data analytics in health care organizations.
CO3	Summarize and Visualize Data.
CO4	Apply Data Analytics Tools and Techniques.
CO5	Predict health screening outcomes, Survival Analysis and sentiment analysis in Healthcare.

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	-	-	-	-	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

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)**		
	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	-	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

CS1712	VIRTUALIZATION TECHNIQUES	L	T	P	C
		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

IT1715	AUGMENTED & 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	**8**
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	**8**
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	**8**
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	**8**
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		**8**
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

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 known 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, A simple genetic algorithm, Applications of genetic algorithms **Genetic Algorithms in Scientific models:** Evolving computer programs, data analysis and prediction, 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, multiobjective 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	P	T	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	P	T	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

ML1724	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. ITSHand 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

ML1725	ADVANCED BIO-INSPIRED ARTIFICIAL INTELLIGENCE TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

To impart knowledge on

- To appreciate the use of biological aspects in building intelligent systems
- To understand the algorithms, programming and applications of Evolutionary and genetic algorithms and neural and fuzzy systems
- To appreciate the adaptation of cellular and developmental systems
- To focus on the understanding of artificial immune systems and its applications
- To understand issues in developing collective and behavioral systems

UNIT I	EVOLUTIONARY SYSTEMS	9
Evolutionary algorithm, components of evolutionary algorithm representation (definition of individuals), Evaluation function (Fitness function), Population, parent selection Mechanism, Variation Operators, Survivor Selection Mechanism (Replacement), Initialization, Termination Condition, evolutionary algorithm case study Cellular systems, cellular automata, modeling with cellular systems, other cellular systems, computation with cellular systems, artificial life: analysis and synthesis of cellular systems.		CO1
UNIT II	**NEURAL AND DEVELOPMENTAL AND IMMUNE SYSTEMS**	**9**
Biological nervous systems, artificial neural networks, neuron models, architecture, signal encoding ,synaptic plasticity, unsupervised learning, supervised learning, reinforcement learning, evolution of neural networks, hybrid neural systems, Rewriting system, synthesis of developmental system, evolutionary rewriting systems, evolutionary developmental programs, biological immune systems, lessons for artificial immune systems, algorithms and applications, shape space, negative selection algorithm, clonal selection algorithm. case study.		CO2
UNIT III	**BEHAVIORAL SYSTEMS**	**9**
Behavior is cognitive science, behavior in AI, behavior based robotics, biological inspiration for robots, robots as biological models, robot learning, evolution of behavioral systems, learning in behavioral systems, co-evolution of body and control, towards self-reproduction, simulation and reality		CO3
UNIT IV	**GENETIC AND MEMETIC ALGORITHMS**	**9**
Representation of Individuals, Mutation, Recombination, Population Models, Parent Selection, Survivor Selection, Example Application: Solving a Job Shop Scheduling Problem. Introduction to Local Search, Lamarckianism and the Baldwin Effect, Structure of a Memetic Algorithm, Heuristic or Intelligent Initialization, Hybridization within Variation Operators: Intelligent Crossover and Mutation, Local Search Acting on the output from Variation Operators ,Hybridization During the Genotype to Phenotype Mapping, Design Issues for Memetic Algorithms.		CO4
UNIT V	**COLLECTIVE SYSTEMS**	**9**
Biological self-organization, Particle Swarm Optimization (PSO), ant colony optimization (ACO), swarm robotics, co-evolutionary dynamics, artificial evolution of competing systems, artificial evolution of cooperation, case study.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. D. Floreano and C. Mattiussi, "Bio-Inspired Artificial Intelligence", MIT Press, 2008.
2. Tao Song, Pan Zheng, Mou Ling Dennis Wong, Xun Wang, “Bio-Inspired Computing Models and Algorithms”, ISBN: 978-981-3143-19-7, world scientific, 2019
3. F. Neumann and C. Witt, “Bioinspired Computation in combinatorial optimization: Algorithms and their computational complexity”, Springer, 2010.

REFERENCE BOOKS

1. D. E. Goldberg, “Genetic algorithms in search, optimization, and machine learning”, Addison-Wesley, 1989.
2. Simon O. Haykin, “Neural Networks and Learning Machines”, Third Edition, Prentice Hall, 2008.
3. M. Dorigo and T. Stutzle, “Ant Colony Optimization”, A Bradford Book, 2004.
4. R. C. Ebelhart, “Swarm Intelligence”, Morgan Kaufmann, 2001.

5. Xin-She Yang,Zhihua Cui Renbin Xiao Amir HosseinGandomi Mehmet Karamanoglu “Swarm Intelligence and Bio-Inspired Computation”, 1st Edition, Elsevier, 2013.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Use existing open source tools to build an application using genetic approaches
CO2	Identify different applications suitable for different types of neural networks giving justifications
CO3	Critically analyze the use of cellular systems
CO4	Differentiate the different models of immune systems
CO5	Implement the Particle swarm and Ant colony algorithms within a framework and build applications

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

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 toolsData 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 momentsCounting oneness in a window- Decaying window- Real time Analytics platform(RTAP) applicationscase 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 TrackingVehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.		CO3
UNIT IV	**BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION**	**9**
Event Modelling- Behavioural Analysis- Human Activity Recognition-Complex Activity RecognitionActivity 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	P	T	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	8
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**	**8**
Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains:Design goals, Consensus protocols for Permissioned Blockchains		CO2
UNIT III	**Hyperledger Fabric**	**8**
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		**8**
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		**8**
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 Blockchain Cryptography, Privacy and Security on Blockchain		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. MsteringBitcoin: 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	P	T	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	8
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 c hatbotcreating Bot framework project –examining default code –iinitial 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**	**8**
Building dialogs –Introducing wine Bot –implementing dialog class –dialog c onversation fl ow- dialog prompt options –calling dialog –- using Form Flow- basic form flow chat – enhancing form flow conversati ons – a dvanced templates and patterns -customizing Form Flow-configuring property –message method and common parameters .		CO2
UNIT III	**NATURAL LANGUAGE PROCESSING WITH LUIS**	**8**
Learning essential LUIS concepts –creating models –building intents –introducing winebotLuis –handling entities – Managing advanced conversation –managing dialog stack – navigating to other dialogs-managing c onversations with chaining –wine bot chain program –LINQ to dialog –formatting text output		CO3
UNIT IV	**CHANNELS AND GUI**	**8**
Attaching cards –Music chat BOT overview –building blocks-working wi th a ttac hments – di splaying c ards – adaptive cards –layout with containers –using controls –handling actions – configuring channels –creating email , SMS and Web Bots		CO4
UNIT V	**APIS INTEGRATION AND VOICE**	**8**
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" ,Pea rson 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	PO 10	PO 11	PO 12	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

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**	**P**	**T**	**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

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 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

ML1822	HUMAN ROBOT INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Understand the fundamental concepts of robots , sensors and hardware systems
- To have in depth understanding of various sensors, its elements and characteristics.
- To Understand the integration of robot working in the real world into programming languages
- To Understand the theoretical aspects of robotics from the basics to advanced applications

UNIT I	INTRODUCTION TO ROBOTICS	9
Introduction To Robotics - Robot features, sensors, manipulators - Application areas - State of Robotics research and adoption - Robotic hardware systems - Kinematics and inverse kinematics -Sensors, sensor data interpretation and sensor fusion - Path planning - Configuration spaces.		CO1
UNIT II	**ROBOT SENSING**	**9**
Robot Sensing - Categories of sensors in robots - Range sensing: Triangulation, Structured Lighting Approach, Time-of-Flight Range Finders -Proximity Sensing: Inductive sensors, Hall-effect sensors, Capacitive sensors, Ultrasonic sensors, Optical Proximity sensors -Touch sensors: Binary sensors, Analog sensors - Force and Torque sensing: Elements of wrist sensor, Resolving forces and moments - Sensor calibration		CO2
UNIT III	**ROBOT VISION**	**9**
Robot Vision - Imaging geometry - Perspective transformations - Camera model - Camera calibration - Stereo imaging - Basic relationship between pixels - Preprocessing - Smoothing - Enhancement - Edge detection - Thresholding - Segmentation - Use of motion -Description - Recognition.		CO3
UNIT IV	**ROBOT PROGRAMMING LANGUAGES**	**9**
Robot Programming Languages - Characteristics of robot-level languages: Position specification, Motion specification, Sensing and flow of control, Programming support - Characteristics of taskLevel languages: World modeling, Task specification, Robot program synthesis		CO4
UNIT V	**HUMAN-ROBOT INTERACTION**	**9**
Human-Robot Interaction - Basics - Implicit vs Explicit interaction - HRI experimentation design - Intelligent interaction - Multi-agent systems Applications.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. K.S.Fu, R.C.Gonzalez, C.S.G.Lee,"Robotics - Control, Sensing, Vision and Intelligence", Tata McGraw Hill, Second Edition,2008
2. R.K.Mittal, I.JNagrath, "Robotics and Control", Tata McGraw Hill, Second Edition, 2007

REFERENCE BOOKS

1.Computational Principles of Mobile Robotics. Gregory Dudek and Michael Jenkin. 2nd ed. CambridgeUniversity Press, 2010.
2. Fundamentals of robotic mechanical systems: theory, methods, and algorithms. Jorge Angeles. New York,Springer, 2003.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understanding the fundamental concepts of robots , sensors and hardware systems
CO2	In depth understanding of various sensors, its elements and characteristics.
CO3	Understanding the integration of robot working in the real world into programming languages
CO4	Understanding the theoretical aspects of robotics from the basics to advanced applications
CO5	To Build a real time Robots

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

ML1823	AGILE SOFTWARE DEVELOPMENT	L	P	T	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	8
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**	**8**
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**	**8**
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**	**8**
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**	**8**
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	P	T	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	8
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**	**8**
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**	**8**
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**	**8**
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**	**8**
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

REFERENCE 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, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3. Ali Bashashati, MehrdadFatourechi, 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**		
	PO1	**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**	**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

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

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	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 – 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 INPUTANDTOPOLOGY**	**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 QUALITYANDSTANDARDS**	**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 MANAGEMENTANDOUTPUT**	**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

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.

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

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

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.

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..

TOTAL : 60 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	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 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

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 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 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	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 : 45 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	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	REINCARNATION THROUGH VALUE EDUCATION	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:

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**
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:

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
Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63		CO5
		TOTAL : 45 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	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	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	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:

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	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'sParables–Tamildynasty:Valor, Administration,Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.		CO5
		TOTAL : 45 PERIODS

REFERENCE:

1. . Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Puranaanuru,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	-	-	-
