You Choose, We Do It
St. JOSEPH'S COLLEGE OF ENGINEERING
(An Autonomous Institution)
St. Joseph's Group of Institutions
OMR, Chennai - 119

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI

REGULATIONS – 2021

(Applicable to the students admitted in the AY 2021-2022)

(Approved in the Second Board of Studies meeting held on 21st December 2021 and Academic Council Meeting held on 2nd March 2022)

St. Joseph's College of Engineering

Department of Electronics and Communication Engineering

B.E. Electronics and Communication Engineering

REGULATIONS – 2021

(Applicable to the students admitted in the AY 2021-2022)

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

VISION

- To emerge as a globally renowned department in Electronics and Communication Engineering, fostering versatile professionals through interdisciplinary and multidisciplinary learning, advanced innovation, and transformative research which contributes meaningfully to technological progress and socio-economic development worldwide.

MISSION

- **Professionalism:**
  Strive for excellence in teaching and learning by cultivating an enriching academic environment where every student is encouraged and supported to achieve their highest potential through interdisciplinary exposure and integrated development.
- **Core Competence:**
  Foster creativity, collaboration, and ethical values by encouraging multidisciplinary perspectives that prepare students to meet the dynamic demands of the industry and effectively address societal needs.
- **Research:**
  Advance knowledge through impactful, interdisciplinary, and multidisciplinary research that addresses critical challenges in industry and society, while expanding the frontiers of electronic circuit and communication technologies.
- **Industrial Interaction:**
  Promote continuous learning and professional growth by integrating modern technologies and fostering industry-academia partnerships that support interdisciplinary collaboration and practical application of knowledge.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO 1: To establish a strong foundational knowledge in core scientific principles, enabling students to pursue advanced studies in Electronics and Communication Engineering.

PEO 2: To equip students with the necessary skills and knowledge to excel as professionals in electronics and communication industries, as well as in higher education and research domains.

PEO 3: To foster a mindset of lifelong learning, encouraging the adoption and application of emerging technologies and innovative ideas in a continually evolving field.

PEO 4: To develop the ability to critically evaluate existing research, and to ethically design and implement innovative, research-driven solutions for real-world problems.

PEO 5: To instill a strong sense of professional responsibility, ethics, and the capacity to understand and address engineering challenges within a broader societal framework.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

1.Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2.Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3.Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5.Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6.The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

9.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.

10.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.

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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: To analyze, design and develop solutions by applying foundational concepts of electronics and communication engineering.

PSO2: To apply design principles and best practices for developing quality products for scientific and business applications.

PSO3: To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

Mapping of Programme Educational Objectives (PEOs) with the Program Outcomes (POs) and Program Specific Outcomes (PSOs)

PEOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I		✓	✓			✓	✓	✓	✓		✓	✓	✓	✓	✓
II	✓		✓		✓	✓		✓	✓	✓	✓		✓	✓	
III		✓	✓	✓	✓		✓			✓	✓	✓	✓	✓	✓
IV	✓			✓	✓	✓	✓		✓	✓		✓		✓	✓

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

YEAR	SEM	COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
YEAR 1	SEM 1	Communicative English	✓	✓	✓	✓					✓	✓		✓
		Engineering Mathematics- I	✓	✓	✓	✓	✓							✓
		Engineering Physics	✓	✓	✓	✓	✓		✓					✓

YEAR	SEM	COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Engineering Chemistry	✓	✓	✓	✓	✓	✓	✓					✓
		Problem solving and Python Programming	✓	✓	✓	✓	✓					✓	✓	✓
		Engineering Graphics	✓	✓	✓		✓				✓	✓		✓
		Python Programming Laboratory	✓	✓	✓		✓					✓	✓	✓
		Physics and Chemistry Laboratory	✓	✓		✓	✓	✓	✓					✓
	SEM 2	Professional English	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
		Engineering Mathematics -II	✓	✓	✓	✓	✓							✓
		Physics for Electronics Engineering	✓	✓	✓	✓	✓				✓	✓		✓
		Environmental Science and Engineering	✓	✓	✓	✓		✓	✓	✓			✓	✓
		Circuit Analysis	✓	✓	✓	✓	✓				✓	✓		✓
		Electronic Devices	✓	✓	✓	✓	✓				✓	✓		✓
		Engineering Practices Laboratory	✓		✓	✓	✓				✓			✓
		Circuits and Devices Laboratory	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓
YEAR 2	SEM 3	Linear Algebra and Partial Differential Equations	✓	✓	✓	✓	✓				✓	✓		✓
		Electronic Circuits - I	✓	✓	✓	✓	✓				✓	✓		✓
		Signals and Systems	✓	✓	✓	✓	✓				✓	✓		✓

YEAR	SEM	COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Digital Electronics	✓	✓	✓	✓	✓	✓			✓	✓		✓
		Electromagnetic Fields	✓	✓	✓	✓	✓		✓			✓	✓	✓
		Basic Electrical and Instrumentation Engineering	✓	✓			✓						✓	✓
		Audit Course	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Analog and Digital Circuits Laboratory	✓	✓	✓	✓	✓					✓		✓
		Professional Skills Laboratory								✓	✓	✓	✓	✓
	SEM 4	Probability and Random Processes	✓	✓			✓							✓
		Electronic Circuits- II	✓	✓	✓	✓	✓							✓
		Communication Theory	✓	✓	✓	✓	✓				✓	✓	✓	✓
		Linear Integrated Circuits	✓	✓	✓	✓	✓						✓	✓
		Data Structures	✓	✓	✓	✓	✓							✓
		Control Systems Engineering	✓	✓	✓	✓	✓							✓
		Circuits Design Simulation and Linear Integrated Circuits Laboratory	✓	✓	✓	✓	✓						✓	✓
		Data Structures Laboratory using C	✓	✓	✓	✓	✓				✓	✓	✓	✓
YEAR 3	SEM 5	Digital Communication	✓	✓	✓	✓	✓							✓
		Discrete-Time Signal Processing	✓	✓	✓	✓	✓							✓
		Communication Networks	✓	✓			✓							✓

YEAR	SEM	COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Transmission lines and RF Systems	✓	✓	✓	✓	✓							✓
		Professional Elective -I	✓	✓	✓	✓	✓							✓
		Open Elective -I	✓	✓	✓	✓	✓							✓
		Digital Signal Processing Laboratory	✓	✓	✓	✓	✓							✓
		Communication Systems Laboratory	✓	✓	✓	✓	✓							✓
		Communication Networks Laboratory	✓	✓		✓	✓					✓		✓
		Internship*	✓	✓	✓	✓	✓							✓
	SEM 6	VLSI Design	✓	✓	✓		✓						✓	✓
		Wireless Communication	✓	✓	✓	✓	✓						✓	✓
		Antennas and Microwave Engineering	✓	✓	✓	✓	✓						✓	✓
		Microprocessors and Microcontrollers	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓
		Professional Elective –II	✓	✓	✓	✓	✓						✓	✓
		Digital Image Processing (Lab Integrated)	✓	✓		✓	✓						✓	✓
		Microprocessors and Microcontrollers Laboratory	✓	✓	✓		✓						✓	✓
		VLSI Design Laboratory	✓	✓	✓	✓	✓	✓					✓	✓
		Mini Project	✓	✓	✓	✓	✓						✓	✓
		Value Added Course**	✓	✓	✓	✓	✓						✓	✓
YEAR 4	SEM 7	Adaptive Learning Techniques	✓	✓	✓	✓	✓	✓					✓	✓
		Optical Communication	✓	✓	✓	✓	✓						✓	✓

YEAR	SEM	COURSE TITLE	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
		Embedded Systems and IoT	✓	✓	✓	✓	✓	✓	✓			✓		✓
		Adhoc and Wireless Sensor Networks	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓
		Open Elective – II	✓	✓	✓	✓	✓						✓	✓
		Professional Elective - III	✓	✓	✓	✓	✓							✓
		Advanced Communication Laboratory	✓	✓		✓	✓						✓	✓
		Embedded Laboratory	✓	✓	✓	✓	✓				✓	✓	✓	✓
		Internship***	✓	✓	✓	✓	✓						✓	✓
	SEM 8	Professional Elective – IV	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
		Professional Elective - V	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Project work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

St. Joseph's College of Engineering

Department of Electronics & Communication Engineering

B.E. ELECTRONICS & COMMUNICATION ENGINEERING

REGULATIONS – 2021
(Applicable to the students admitted in the AY 2021-2022)

CURRICULUM FOR I TO VIII SEMESTERS

SEMESTER I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
LABORATORY COURSES								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**30**	**17**	**1**	**12**	**24**

SEMESTER II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	HS1201	Professional English	HSMC	3	3	0	0	3
2.	MA1202	Engineering Mathematics -II	BSC	4	3	1	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3
5.	EC1205	Circuit Analysis	PCC	3	3	0	0	3
6.	EC1206	Electronic Devices	PCC	3	3	0	0	3
LABORATORY COURSES								
7.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8.	EC1208	Circuits and Devices Laboratory	PCC	4	0	0	4	2
TOTAL				**27**	**18**	**1**	**8**	**23**

SEMESTER III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	MA1352	Linear Algebra and Partial Differential Equations	BSC	4	3	1	0	4
2.	EC1302	Electronic Circuits - I	PCC	3	3	0	0	3
3.	EC1303	Signals and Systems	PCC	3	3	0	0	3
4.	EC1304	Digital Electronics	PCC	3	3	0	0	3
5.	EC1305	Electromagnetic Fields	PCC	3	3	0	0	3
6.	EE1351	Basic Electrical and Instrumentation Engineering	ESC	3	3	0	0	3
7.		Audit Course	AC	2	2	0	0	0
LABORATORY COURSES								
8.	EC1307	Analog and Digital Circuits Laboratory	PCC	4	0	0	4	2
9.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
TOTAL				**27**	**20**	**1**	**6**	**22**

SEMESTER IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	MA1451	Probability and Random Processes	BSC	4	3	1	0	4
2.	EC1402	Electronic Circuits- II	PCC	3	3	0	0	3
3.	EC1403	Communication Theory	PCC	3	3	0	0	3
4.	EC1404	Linear Integrated Circuits	PCC	3	3	0	0	3
5.	CS1302	Data Structures	ESC	3	3	0	0	3
6.	EC1406	Control Systems Engineering	ESC	3	3	0	0	3
LABORATORY COURSES								
7.	EC1407	Circuits Design Simulation and Linear Integrated Circuits Laboratory	PCC	4	0	0	4	2
8.	CS1307	Data Structures Laboratory using C	ESC	4	0	0	4	2
TOTAL				**27**	**18**	**1**	**8**	**23**

SEMESTER V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	EC1501	Digital Communication	PCC	3	3	0	0	3
2.	EC1502	Discrete-Time Signal Processing	PCC	4	3	1	0	4
3.	EC1503	Communication Networks	PCC	3	3	0	0	3
4.	EC1504	Transmission lines and RF Systems	PCC	3	3	0	0	3
5.		Professional Elective -I	PEC	3	3	0	0	3
6.		Open Elective -I	OEC	3	3	0	0	3
LABORATORY COURSES								
7.	EC1507	Digital Signal Processing Laboratory	PCC	4	0	0	4	2
8.	EC1508	Communication Systems Laboratory	PCC	4	0	0	4	2
9.	EC1509	Communication Networks Laboratory	PCC	4	0	0	4	2
10.	EC1510	Internship*	EEC	0	0	0	0	1
TOTAL				**31**	**19**	1	**12**	**26**

* Students should undergo two weeks internship during IV semester vacation which will be evaluated during V semester

SEMESTER VI

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSE WITH LABORATORY COMPONENT								
1.	EC1606	Digital Image Processing (Lab Integrated)	PCC	5	3	0	2	4
THEORY COURSES								
2.	EC1602	VLSI Design	PCC	3	3	0	0	3
3.	EC1603	Wireless Communication	PCC	3	3	0	0	3
4.	EC1604	Antennas and Microwave Engineering	PCC	3	3	0	0	3
5.	EC1605	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
6.		Professional Elective –II	PEC	3	3	0	0	3
LABORATORY COURSES								
7.	EC1607	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
8.	EC1608	VLSI Design Laboratory	PCC	4	0	0	4	2
9.	EC1609	Mini Project	EEC	2	0	0	2	1
TOTAL				**30**	**18**	**0**	**12**	**24**
Value added course** (One week)			EEC	3	1	0	2	2

** The credits earned through VAC shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree

SEMESTER VII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY COURSES								
1.	EC1701	Adaptive Learning Techniques	PCC	3	3	0	0	3
2.	EC1702	Optical Communication	PCC	3	3	0	0	3
3.	EC1703	Embedded Systems and IoT	ESC	3	3	0	0	3
4.	EC1704	Adhoc and Wireless Sensor Networks	PCC	3	3	0	0	3
5.		Open Elective – II	OEC	3	3	0	0	3
6.		Professional Elective - III	PEC	3	3	0	0	3
LABORATORY COURSES								
7.	EC1707	Advanced Communication Laboratory	PCC	4	0	0	4	2
8.	EC1708	Embedded Laboratory	PCC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**
9.	EC1709	Internship***	EEC	0	0	0	0	1

***Students should undergo two weeks internship during VI semester vacation which will be evaluated during VII semester and the credits through this internship shall be over and above the total credits requirement prescribed in the curriculum for the award of the degree

SEMESTER VIII

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective – IV	PEC	3	3	0	0	3
2.		Professional Elective - V	PEC	3	3	0	0	3
PRACTICALS								
3.	EC1803	Project work	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:180

CATEGORIZATION OF COURSES

HUMANITIES AND SOCIALSCIENCES INCLUDING MANAGEMENT COURSES (HSMC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS1101	Communicative English	HSMC	3	3	0	0	3
2.	HS1201	Professional English	HSMC	3	3	0	0	3
3.	GE1204	Environmental Science and Engineering	HSMC	3	3	0	0	3

BASIC SCIENCE COURSES (BSC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	MA1102	Engineering Mathematics- I	BSC	4	3	1	0	4
2.	PH1103	Engineering Physics	BSC	3	3	0	0	3
3.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
4.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
5.	MA1202	Engineering Mathematics- II	BSC	4	3	1	0	4
6.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
7.	MA1352	Linear Algebra and Partial Differential Equations	BSC	4	3	1	0	4
8.	MA1451	Probability and Random Processes	BSC	4	3	1	0	4

ENGINEERING SCIENCE COURSES (ESC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
2.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
3.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
4.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
5.	CS1302	Data Structures	ESC	3	3	0	0	3
6.	EE1351	Basic Electrical and Instrumentation Engineering	ESC	3	3	0	0	3
7.	CS1307	Data Structures Laboratory using C	ESC	4	0	0	4	2
8.	EC1406	Control Systems Engineering	ESC	3	3	0	0	3
9.	EC1703	Embedded Systems and IoT	ESC	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	EC1205	Circuit Analysis	PCC	3	3	0	0	3
2.	EC1206	Electronic Devices	PCC	3	3	0	0	3
3.	EC1208	Circuits & Devices Laboratory	PCC	4	0	0	4	2
4.	EC1302	Electronic Circuits- I	PCC	3	3	0	0	3
5.	EC1303	Signals and Systems	PCC	3	3	0	0	3
6.	EC1304	Digital Electronics	PCC	3	3	0	0	3
7.	EC1305	Electromagnetic Fields	PCC	3	3	0	0	3
8.	EC1307	Analog and Digital Circuits Laboratory	PCC	4	0	0	4	2
9.	EC1402	Electronic Circuits- II	PCC	3	3	0	0	3
10.	EC1403	Communication Theory	PCC	3	3	0	0	3
11.	EC1404	Linear Integrated Circuits	PCC	3	3	0	0	3
12.	EC1407	Circuits Design Simulation and Linear Integrated Circuits Laboratory	PCC	4	0	0	4	2
13.	EC1501	Digital Communication	PCC	3	3	0	0	3
14.	EC1502	Discrete-Time Signal Processing	PCC	4	3	1	0	4
15.	EC1503	Communication Networks	PCC	3	3	0	0	3
16.	EC1504	Transmission lines and RF Systems	PCC	3	3	0	0	3
17.	EC1507	Digital Signal Processing Laboratory	PCC	4	0	0	4	2
18.	EC1508	Communication Systems Laboratory	PCC	4	0	0	4	2
19.	EC1509	Communication Networks Laboratory	PCC	4	0	0	4	2
20.	EC1602	VLSI Design	PCC	3	3	0	0	3
21.	EC1603	Wireless Communication	PCC	3	3	0	0	3
22.	EC1604	Antennas and Microwave Engineering	PCC	3	3	0	0	3
23.	EC1605	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
24.	EC1606	Digital Image Processing (Lab Integrated)	PCC	5	3	0	2	4
25.	EC1607	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
26.	EC1608	VLSI Design Laboratory	PCC	4	0	0	4	2
27.	EC1701	Adaptive Learning Techniques	PCC	3	3	0	0	3
28.	EC1702	Optical Communication	PCC	3	3	0	0	3
29.	EC1704	Adhoc and Wireless Sensor Networks	PCC	3	3	0	0	3
30.	EC1707	Advanced Communication Laboratory	PCC	4	0	0	4	2
31.	EC1708	Embedded Laboratory	PCC	4	0	0	4	2

AUDIT COURSES (AC)

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

PROFESSIONAL ELECTIVES COURSES (PEC)

PROFESSIONAL ELECTIVE-I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	EC1001	Medical Electronics	PEC	3	3	0	0	3
2.	EC1002	Data Converters	PEC	3	3	0	0	3
3.	EI1864	Robotics and Automation	PEC	3	3	0	0	3
4.	EC1003	Compressive Sensing	PEC	3	3	0	0	3
5.	CS1303	Object Oriented Programming	PEC	3	3	0	0	3
6.	IT1811	Information Theory and Coding	PEC	3	3	0	0	3
7.	GE1002	Human Rights	PEC	3	3	0	0	3
8.	CE1025	Disaster Management	PEC	3	3	0	0	3
9.	MG1001	Principles of Management	PEC	3	3	0	0	3
10.	EC1004	Human Assist Devices	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE-II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	CS1616	Cryptography and Information Security	PEC	3	3	0	0	3
2.	EC1005	Multimedia Compression and Communication	PEC	3	3	0	0	3
3.	EC1006	Wireless Networks	PEC	3	3	0	0	3
4.	EC1007	Array Signal Processing	PEC	3	3	0	0	3
5.	EC1008	Advanced Digital Signal Processing	PEC	3	3	0	0	3
6.	EC1009	MEMS and NEMS	PEC	3	3	0	0	3
7.	EC1010	Optoelectronics	PEC	3	3	0	0	3
8.	EC1011	CMOS Analog IC Design	PEC	3	3	0	0	3
9.	EC1012	Mixed Signal IC Design	PEC	3	3	0	0	3
10.	EC1013	Low Power VLSI Design	PEC	3	3	0	0	3
11.	EC1040	Advanced Real time Operating systems	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE-III

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	EC1014	Space Time MIMO Wireless Communication	PEC	3	3	0	0	3
2.	EC1015	Electromagnetic Interference and Compatibility	PEC	3	3	0	0	3
3.	CS1729	Introduction to Operating Systems	PEC	3	3	0	0	3
4.	EC1016	Underwater Acoustics Signal Processing	PEC	3	3	0	0	3
5.	EC1017	Advanced Wireless Communication	PEC	3	3	0	0	3
6.	EC1018	Underwater Imaging Systems and Image Processing	PEC	3	3	0	0	3
7.	EC1019	Wearable Devices	PEC	3	3	0	0	3
8.	EC1020	5G Communication Technology	PEC	3	3	0	0	3
9.	EC1021	Medical Imaging Systems	PEC	3	3	0	0	3
10.	EC1022	Wireless Broadband Networks	PEC	3	3	0	0	3
11.	EC1039	Industrial Automation	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE-IV

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	EC1023	Photonic Networks	PEC	3	3	0	0	3
2.	EC1024	Satellite Communication	PEC	3	3	0	0	3
3.	EC1025	IoT Enabled Systems Design	PEC	3	3	0	0	3
4.	EC1026	Satellite Remote Sensing and Image Analysis	PEC	3	3	0	0	3
5.	EC1027	Cognitive Radio	PEC	3	3	0	0	3
6.	EC1028	Industrial IoT and Industry 4.0	PEC	3	3	0	0	3
7.	EC1029	Therapeutic Equipments	PEC	3	3	0	0	3
8.	EC1030	ASIC and FPGA based system Design	PEC	3	3	0	0	3
9.	EC1031	Body Area Networks	PEC	3	3	0	0	3

PROFESSIONAL ELECTIVE-V

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	EI1851	Fundamentals of Soft Computing	PEC	3	3	0	0	3
2.	EC1033	Speech and Audio Signal Processing	PEC	3	3	0	0	3
3.	CS1827	Cloud Essentials	PEC	3	3	0	0	3
4.	GE1003	Professional Ethics in Engineering	PEC	3	3	0	0	3
5.	GE1004	Fundamentals of Nanoscience	PEC	3	3	0	0	3
6.	EC1034	Video Analytics	PEC	3	3	0	0	3
7.	EC1035	Computer Vision	PEC	3	3	0	0	3
8.	EC1036	Brain Computer Interface & Applications	PEC	3	3	0	0	3
9.	EC1037	Sensors, Actuators & Interface Electronics	PEC	3	3	0	0	3
10.	EC1038	Radar Technologies	PEC	3	3	0	0	3

OPEN ELECTIVES COURSES (OEC)

OPEN ELECTIVE – I

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	OMB104	Quality for Management Science	OEC	3	3	0	0	3
2.	OEE102	Renewable Energy Sources	OEC	3	3	0	0	3
3.	OEI103	Basics of Biomedical Instrumentation	OEC	3	3	0	0	3
4.	OEE106	Energy Conservation and Management	OEC	3	3	0	0	3
5.	OCE102	Introduction to Geographic Information System	OEC	3	3	0	0	3
6.	OBT105	Introduction to Nanoscience and Nanotechnology	OEC	3	3	0	0	3
7.	OEI110	Drone Technologies	PEC	3	3	0	0	3

OPEN ELECTIVE – II

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	OME104	Industrial Safety Engineering	OEC	3	3	0	0	3
2.	OEI101	Sensors and Transducers	OEC	3	3	0	0	3
3.	OCS104	Fundamentals of Database Design	OEC	3	3	0	0	3
4.	OCS105	Data Analytics with R Programming	OEC	3	3	0	0	3
5.	OEI105	SCADA system and application Management	OEC	3	3	0	0	3
6.	OBT107	Introduction of Cell Biology	OEC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	HS1310	Professional Skills Laboratory	EEC	2	0	0	2	1
2.	EC1510	Internship	EEC	2 Weeks				1
3.	EC1609	Mini Project	EEC	2	0	0	2	1
4.	EC1803	Project Work	EEC	20	0	0	20	10

VALUE ADDED COURSE

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	ECV101	Artificial Intelligence and Deep Learning	EEC	3	1	0	2	2
2.	ECV102	Image Processing and Machine Learning using Computer vision	EEC	3	1	0	2	2
3.	ECV103	Embedded systems and IoT using Node MCU	EEC	3	1	0	2	2
4.	ECV104	PCB design & Enclosure design for High frequency Electronic Product	EEC	3	1	0	2	2
5.	ECV105	Full stack Web Development	EEC	3	1	0	2	2
6.	ECV106	Unmanned Aerial Vehicle and its Applications	EEC	3	1	0	2	2
7.	ECV107	Cloud Computing	EEC	3	1	0	2	2
8.	ECV108	Embedded C with RTOS and IoT	EEC	3	1	0	2	2
9.	ECV109	LabView based Real Time Applications development using industrial Controller	EEC	3	1	0	2	2
10.	ECV110	Robotics and its Applications	EEC	3	1	0	2	2

LIST OF OPEN ELECTIVES OFFERED TO OTHER DEPARTMENTS

S. No.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	OEC101	Introduction to Signals and Systems	OEC	3	3	0	0	3
2.	OEC102	Communication Systems	OEC	3	3	0	0	3
3.	OEC103	Basics of Embedded Systems and IoT	OEC	3	3	0	0	3
4.	OEC104	Biomedical Image Processing	OEC	3	3	0	0	3
5.	OEC105	Wireless Communication and Networks	OEC	3	3	0	0	3
6.	OEC106	PCB Design	OEC	3	3	0	0	3

SUMMARY OF CREDITS

S. No.	SUBJECT AREA	CREDITS PER SEMESTER								TOTAL CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	6	-	-	-	-	-	-	09
2	BSC	12	7	4	4	-	-	-	-	27
3	ESC	9	2	3	8	-	-	3	-	25
4	PCC	-	8	14	11	19	20	13	-	85
5	PEC	-	-	-	-	3	3	3	6	15
6	OEC	-	-	-	-	3	-	3	-	06
7	EEC	-	-	1	-	1	1	-	10	13
8	AC	-	-	0	-	-	-	-	-	0
Total		**24**	**23**	**22**	**23**	**26**	**24**	**22**	**16**	**180**

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 180

I SEMESTER

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

OBJECTIVES:

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

UNIT I: SHARING INFORMATION RELATED TO ONESELF/ FAMILY & FRIENDS **9**

Reading– critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh-Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development- - prefixes- suffixes- articles - Polite Expressions. **CO1**

UNIT II: GENERAL READING AND FREE WRITING **9**

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations); Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking– describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words. **CO2**

UNIT III: GRAMMAR AND LANGUAGE DEVELOPMENT **9**

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing– types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison-pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs. **CO3**

UNIT IV: READING AND LANGUAGE DEVELOPMENT **9**

Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing-letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking –Speaking about friends/ places/ hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development-synonyms-antonyms- Single word substitutes- Collocations **CO4**

UNIT V: EXTENDED WRITING **9**

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing-brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2021.
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning, USA: 2007
3. Redston, Chris & Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
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, the students will be able to

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

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

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

UNIT I: MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms **CO1**

UNIT II: CALCULUS OF ONE VARIABLE **12**

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity. **CO2**

UNIT III: CALCULUS OF SEVERAL VARIABLES **12**

Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers. **CO3**

UNIT IV: INTEGRAL CALCULUS **12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals. **CO4**

UNIT V: MULTIPLE INTEGRALS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

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

MAPPING OF COs WITH POs AND PSOs

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

PH1103	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make the students conversant with

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

UNIT I: 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: QUANTUM PHYSICS **9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope- tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy. **CO4**

UNIT V: CRYSTAL PHYSICS **9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative). **CO5**

TOTAL PERIODS: 45

ST. JOSEPH'S COLLEGE OF ENGINEERING
CHENNAI - 600 119
You Choose, We Do It

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.

REFERENCES:

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

COURSE OUTCOMES

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

CO1 The elastic property and stress strain diagram, determination of rigidity modulus by torsional pendulum and Young’s modulus by various methods.

CO2 Principle of laser, Einstein’s coefficients of laser action, semiconductor laser and its applications, optical fibers and their applications in sensors and communication system.

CO3 The heat transfer through solids and the determination of thermal conductivity in a bad conductor by Lee’s disc method and radial flow of heat.

CO4 The quantum concepts and its use to explain black body radiation, Compton effect and wave equation for matter waves, 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 OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	-	-	-	-	-	-	1	3	2	1
CO2	3	2	3	2	1	-	2	-	-	-	-	2	3	3	3
CO3	3	2	2	2	1	-	2	-	-	-	-	1	3	2	1
CO4	3	3	3	3	1	-	-	-	-	-	-	2	3	3	2
CO5	3	2	2	2	1	-	1	-	-	-	-	1	3	2	1

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

OBJECTIVES:

To make the student conversant with the

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

UNIT I: WATER AND ITS TREATMENT **9**

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement, boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis. **CO1**

UNIT II: SURFACE CHEMISTRY AND CATALYSIS **9**

Surface chemistry : Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **CO2**

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT III: PHASE RULE AND ALLOYS **9**

Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **CO3**

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.

UNIT IV: FUELS AND COMBUSTION **9**

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate) – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **CO4**

Combustion of fuels: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.

UNIT V: NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell. **CO5**

Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.

TOTAL PERIODS: 45

TEXT BOOKS:

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed., Dhanpat Rai Pub. Co., New Delhi, (2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand& Co.Ltd., New Delhi(2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. NewDelhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company(P) Ltd., Chennai, (2009).

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University, Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media, New Delhi., (2010)
6. A. Sheik Mideen, Engineering Chemistry, Airwalk Publications, Chennai (2018)

COURSE OUTCOMES

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

CO1 Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.

CO2 Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.

CO3 Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys, phase rule, reduced phase and its applications in alloying.

CO4 Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.

CO5 Able to understand conventional, non-conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

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

UNIT I: ALGORITHMIC PROBLEM SOLVING **9**

Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi. **CO1**

UNIT II: INTRODUCTION TO PYTHON **9**

Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab, pycharm and jupyter idle(s), Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs. **CO2**

UNIT III: CONTROL FLOW, FUNCTIONS AND STRINGS **9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search **CO3**

UNIT IV: LISTS, TUPLES, DICTIONARIES **9**

Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram. **CO4**

UNIT V: FILES, MODULES, PACKAGES **9**

Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. John V Guttag, — Introduction to Computation and Programming Using Python", Revisedvand expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming invPython: 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, the 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		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	–	–	–	–	–	–	2	3	2	3
CO2	2	3	3	–	3	–	–	–	–	2	2	2	2	3	3
CO3	2	3	3	–	3	–	–	–	–	–	–	3	2	3	3
CO4	2	2	3	–	3	–	–	–	–	–	–	2	3	3	3
CO5	2	2	3	–	3	–	–	–	–	–	–	2	2	3	3

GE1106	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES:

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

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and 1dimensioning.

UNIT I: PLANE CURVES AND FREEHAND SKETCHING **7 + 12**

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloidal curves - construction of involutes of square and circle - Drawing of tangents and normal to the above curves. **CO1**

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three-Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects (Draw without using drawing instruments)

UNIT II: PROJECTION OF POINTS, LINES AND PLANE SURFACE **6 + 12**

Orthographic projection - principles-Principal planes - First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method. **CO2**

UNIT III: PROJECTION OF SOLIDS **5 + 12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes when the solid is simply suspended by rotating object method. **CO3**

UNIT IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5 + 12**

Sectioning of simple solids like prisms, pyramids, cylinder, and cone in a simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other - obtaining true shape of section. **CO4**

Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones - Graphically finding the shortest distance connecting two points.

UNIT V: ISOMETRIC AND PERSPECTIVE PROJECTIONS **6 + 12**

Principles of isometric projection - isometric scale -Isometric projections and isometric views of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method. **CO5**

TOTAL PERIODS: 90

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1 Understand the fundamentals and standards of Engineering graphics.

CO2 Perform freehand sketching of basic geometrical constructions and multiple views of Objects.

CO3 Understand the concept of orthographic projections of lines and plane surfaces.

CO4 Draw projections of the section of solids and development of surfaces.

CO5 Visualize and to project isometric and perspective sections of simple solids.

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3. Scientific problem-solving using decision making and looping.

- Armstrong number, palindrome of a number, Perfect number.

4. Simple programming for one dimensional and two-dimensional arrays.

- Transpose, addition, multiplication, scalar, determinant of a matrix

5. Program to explore string functions and recursive functions.
6. Utilizing ‘Functions’ in Python

- Find mean, median, mode for the given set of numbers in a list.
- Write a function dups to find all duplicates in the list.
- Write a function unique to find all the unique elements of a list.
- Write function to compute gcd, lcm of two numbers.

7. Demonstrate the use of Dictionaries and tuples with sample programs.
8. Implement Searching Operations: Linear and Binary Search.

- To sort the ‘n’ numbers using: Selection, Merge sort and Insertion Sort.

9. Find the most frequent words in a text of file using command line arguments.
10. Demonstrate Exceptions in Python.
    Applications**:** Implementing GUI using turtle, pygame.

TOTAL PERIODS: 60

TEXT BOOKS:

REFERENCES:

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

COURSE OUTCOMES

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

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

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

BS1108 **PHYSICS AND CHEMISTRY LABORATORY** **L T P C**

(Common for all branches of B.E. /B. Tech Programmes) **0 0 4 2**

OBJECTIVES:

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

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

LIST OF EXPERIMENTS– PHYSICS

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

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

DEMONSTRATION EXPERIMENT

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

LIST OF EXPERIMENTS – CHEMISTRY

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

1. Estimation of HCl using Na2CO3 as primary standard and determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
10. Conductometric titration of strong acid vs strong base.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

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

MAPPING OF COs WITH POs AND PSOs

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

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
	(Common to all Branches)	3	0	0	3

OBJECTIVES:

The Course prepares second semester engineering and Technology students to:

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

UNIT I: INTRODUCTION TO PROFESSIONAL ENGLISH **9**

Listening: Listening to technical talks with comprehension tasks - Speaking–conversation methods in real life occurrences using expressions of different emotions and imperative usages- Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations-Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words. **CO1**

UNIT II: READING AND STUDY SKILLS **9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). - Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs – easily confused words Language Development- impersonal passive voice, numerical adjectives. **CO2**

UNIT III: TECHNICAL WRITING AND GRAMMAR **9**

Listening–listening to conversation–effective use of words and their sound aspects, stress, into nation & pronunciation- Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis. **CO3**

UNIT IV: REPORT WRITING **9**

Listening **–** Model debates & documentaries and making notes. Speaking– expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter – Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals. **CO4**

UNIT V: GROUP DISCUSSION AND JOB APPLICATIONS **9**

Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

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

MAPPING OF COs WITH POs AND PSOs

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

MA1202	ENGINEERING MATHEMATICS – II	L	T	P	C
		3	1	0	4

OBJECTIVES:

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

UNIT I: ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters– Homogenous equation of Euler‘s and Legendre‘s type – System of simultaneous first order linear differential equations with constant coefficients. **CO1**

UNIT II: VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green‘s, Gauss divergence and Stoke‘s theorems – Verification and simple application in evaluating line, surface and volume integrals. **CO2**

UNIT III: COMPLEX VARIABLES **12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates (C-R equations) - Properties – Harmonic conjugates – Construction of analytic function (Milne-Thomson method) – Conformal mapping – Standard transformations W = Z + C, CZ, 1/Z - Bilinear transformation. **CO3**

UNIT IV: COMPLEX INTEGRATION **12**

Cauchy’s integral theorem –Cauchy’s integral formula – Taylor’s and Laurent’s series – Singularities – Residues – Cauchy’s Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour(excluding poles on the real line). **CO4**

UNIT V: LAPLACE TRANSFORMS **12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function - Basic properties - Shifting theorems – transforms of derivatives and integrals –Transform of periodic functions - Inverse transforms using properties, partial fractions and Convolution theorem – Application to solution of linear second order ordinary differential equations with constant coefficients. **CO5**

TOTAL PERIODS: 90

TEXT BOOKS:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 44th Edition, 2018.
2. Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., Advanced Engineering Mathematics, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2017.
2. Jain R.K. and Iyengar S.R.K., Advanced Engineering Mathematics, Narosa Publications, New Delhi, 3rd Edition, 2007.

3. O'Neil, P.V. Advanced Engineering Mathematics, Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, Engineering Mathematics, Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. T. Veerarajan. Engineering Mathematics – II, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

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

CO1 The students will be imbibed with techniques in solving ordinary differential equations that arises in most of the engineering problems

CO2 The students will be acquainted with the concepts of vector calculus like Gradient, Divergence, Curl, Directional derivative, Irrotational vector and Solenoidal vector. The course gives an understanding of Vector integration, needed for problems in all engineering disciplines.

CO3 The students will develop an understanding of the standard techniques of complex variable and mapping so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.

CO4 The student will be exposed to the concept of Cauchy's integral theorem, Taylor and Laurent expansions, Singular points, Application of residue theorem to evaluate complex integrals.

CO5 Students will understand the purpose of using transforms to create new domain which can give easier ways to handle the problem that is being investigated.

MAPPING OF COs WITH POs AND PSOs

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

PH1253	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
	(Common to EEE, ECE and EIE branches)	3	0	0	3

OBJECTIVES:

Enable the students to

- Understand the transport properties of conducting materials and their modeling using classical and quantum theories,
- Acquire knowledge in semiconductors and their applications in various devices
- Grasp the principles of magnetic and dielectric materials and their applications
- Understand the functioning of optical materials for
- Understand the basics of quantum structures, properties of nano materials and their applications.

UNIT I: CONDUCTINGMATERIALS **9**

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi-Dirac statistics - Density of energy states - Electron in periodic potential: Bloch theorem - metals and insulators - Energy bands in solids - tight binding approximation - Electron effective mass - concept of hole. **CO1**

UNIT II: PHYSICS OF SEMICONDUCTOR DEVICES **9**

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n- type & p-type semiconductors - carrier transport: velocity-electric field relations - drift and diffusion transport - Einstein's relation - Hall effect and devices - Zener and avalanche breakdown in p-n junction diode - Zener diode as voltage regulator - Ohmic contacts - tunnel diode - Schottky diode - MOS Capacitor. **CO2**

UNIT III: MAGNETIC ANDDIELECTRIC MATERIALS **9**

Origin of magnetic moment - Bohr magneton - Microscopic and macroscopic classification of magnetic materials : diamagnetic, paramagnetic and ferromagnetic materials - Domain theory - Hysteresis (based on domain theory) - soft and hard magnetic materials - Ferrites - applications. Dielectric materials: Polarization processes - internal field - Clausius-Mosotti relation - dielectric loss - dielectric breakdown. **CO3**

UNIT IV: OPTICAL MATERIALS **9**

Classification of optical materials - carrier generation and recombination processes - Absorption, emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in p-n junction diode - solar cell - photo detectors - LED - Organic LED - excitons - quantum confined Stark effect - quantum dot laser, quantum well laser. **CO4**

UNIT V: NANO ELECTRONIC DEVICES **9**

Introduction - electron density in bulk material - size dependence of Fermi energy - quantum confinement - quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - resonant tunneling - quantum interference effects - mesoscopic structures - Coulomb blockade effects - Single electron phenomena and Single electron Transistor - magnetic semiconductors - spintronics, Spintronic Devices: Spin Valve, Spin FET- Carbon nanotubes: Types, Preparation-CVD, Properties and applications. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ben Streetman and Sanjay Banerjee Solid State Electronic Devices, Prentice Hall, 6th Edition, 2005.
2. Donald Neaman, Dhrubes Biswas, Semiconductor Physics and Devices (SIE) 4th Edition, 2017
3. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design",Springer, 2008
4. Adaptation by Balasubramanian, R, Callister "Material Science and Engineering", Wiley India Pvt.Ltd., 2nd Edition, 2014.
5. Mani.P, "Physics for Electronics Engineering", Dhanam Publishers, 2017.
6. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.

REFERENCES:

1. Traugott Fischer, "Materials Science for Engineering Students", Ist Edition,Elsevier, 2009
2. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2009.
3. Rogers, B., Adams, J.& Pennathur, S."Nanotechnology: Understanding Small Systems". CRC Press,2014
4. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education,2009
5. Kwok Ng, Simon Sze, and Yiming Li," Physics of Semiconductor Devices", 2006.

COURSE OUTCOMES

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

CO1	Gain knowledge on classical and quantum free electron theories and formation of energy band structures.
CO2	Gain knowledge on semiconducting devices and its applications.
CO3	Acquire knowledge on magnetic and dielectric materials and their applications.
CO4	Understand the relationship of optoelectronic materials and their applications.
CO5	Acquire knowledge about the nano structures and its applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1205	CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology.

UNIT I: BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY **12**

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees –Cut sets - Fundamental cut sets - Cut set matrix – Tie sets - Link currents and Tie set schedules -Twig voltages and Cut set schedules, Duality and dual networks **CO1**

UNIT II: NETWORK THEOREMS FOR DC AND AC CIRCUITS **12**

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem, application of Network theorems- Network reduction: voltage and current division, source transformation – star delta conversion. **CO2**

UNIT III: RESONANCE AND COUPLED CIRCUITS **12**

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency – Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Self-inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multilinking coupled circuits - Series, Parallel connection of coupled inductors - Single tuned coupled circuits. **CO3**

UNIT IV: TRANSIENT ANALYSIS **12**

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation. **CO4**

UNIT V: TWO PORT NETWORKS **12**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid (H) Parameters, Interconnection of two port networks, Symmetrical properties of T and π networks. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Eighth Edition, 11th Reprint 2016.
2. Joseph Edminister and Mahmood Nahvi, "Electric Circuits‖, Schaum's Outline Series", TataMcGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

REFERENCES:

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9th Reprint 2015.
2. A.Bruce Carlson, "Circuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2nd Indian Reprint 2009.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

COURSE OUTCOMES

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

CO1 To Develop the capacity and analyze electrical circuits, apply the circuit theorems in real time.

CO2 To impart knowledge on solving circuits using network theorems.

CO3 To introduce the phenomenon of resonance in coupled circuits.

CO4 To educate on obtaining the transient response of circuits.

CO5 To model any device using two port networks.

MAPPING OF COs WITH POs AND PSOs

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

EC1206 **ELECTRONIC DEVICES** **L T P C**

3 0 0 3

OBJECTIVES:

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field-effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.

UNIT I: SEMICONDUCTOR DIODE **9**

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes. **CO1**

UNIT II: BIPOLAR JUNCTION TRANSISTORS **9**

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi-Emitter Transistor. **CO2**

UNIT III: FIELD EFFECT TRANSISTORS **9**

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET. **CO3**

UNIT IV: SPECIAL SEMICONDUCTOR DEVICES **9**

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR. **CO4**

UNIT V: POWER DEVICES AND DISPLAY DEVICES **9**

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Phototransistor, Opto Coupler, Solar cell, CCD. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Donald A Neaman, “Semiconductor Physics and Devices”, Fourth Edition, Tata Mc GrawHillInc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj. A, “Electronic Devices and circuits”, Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, “Electron Devices and Circuit Theory” Pearson Prentice Hall, 10th edition, July 2008.
2. R.S.Sedha, “ A Text Book of Applied Electronics” S.Chand Publications, 2006.
3. Yang, “Fundamentals of Semiconductor Devices”, McGraw Hill International Edition, 1978.

COURSE OUTCOMES

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

CO1 To analyze the operation and characteristics of the PN junction diode.

CO2 To analyze the operation and characteristics of Bipolar junction transistor (BJT).

CO3 To understand and analyze the Field-effect transistor – JFET, MOSFET.

CO4 To study and analyze the special semiconductor devices like MESFET, FINFET, PINFET, CNTFET, Varactor diode, Tunnel Diode, GaAs Devices, LASER, and LDR Diode.

CO5 To understand the basic concepts of Power and Display devices

MAPPING OF COs WITH POs AND PSOs

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

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to All branches)	L	T	P	C
		3	0	0	3

OBJECTIVES:

OBJECTIVES

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

UNIT I: ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY **11**

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem.

Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity. **CO1**

UNIT II: ENVIRONMENTAL POLLUTION **9**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural. **CO2**

UNIT III: NATURAL RESOURCES **9**

Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain. **CO3**

UNIT IV: SOCIAL ISSUES AND THE ENVIRONMENT **8**

From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness. **CO4**

UNIT V: HUMAN POPULATION AND THE ENVIRONMENT **8**

Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies **CO5**

TOTAL PERIODS: 45

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).

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, 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 will be able to

CO1 To obtain knowledge about environment, ecosystems and biodiversity.

CO2 To take measures to control environmental pollution.

CO3 To gain knowledge about natural resources and energy sources.

CO4 To find and implement scientific, technological, economic and political solutions to 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 OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	–	–	–	3	3	2	–	–	–	2	–	–	–
CO2	2	3	2	–	–	3	3	2	–	–	–	2	–	–	–
CO3	2	2	–	–	–	2	3	–	–	–	–	2	–	–	–
CO4	3	3	3	2	–	3	3	2	–	–	2	2	–	–	–
CO5	2	2	–	–	–	3	3	2	–	–	–	2	–	–	–

GE1207 **ENGINEERING PRACTICES LABORATORY** **L T P C**

(Common to ALL Branches) **0 0 4 2**

OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)

UNIT 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.

UNIT II: MECHANICAL ENGINEERING PRACTICE **18**

Welding:

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

(b) Gas welding practice **CO2**

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Prepration of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

UNIT 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: **CO1**

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.

UNIT 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: **CO2**

(a) Forming & Bending:

(b) Model making – Trays and funnels.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Prepration of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

UNIT 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.

UNIT 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. **CO4**
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1 Fabricate carpentry components and pipe connections including plumbing works.

CO2 Use welding equipments to join the structures, carry out the basic machining operations, and make the models using sheet metal works

CO3 Illustrate on centrifugal pump, air conditioner, operations of smithy, foundary and fittings

CO4 Carry out basic home electrical works and appliances, measure the electrical quantities

CO5 Elaborate on the electronic components and gates, soldering practices.

MAPPING OF COs WITH POs AND PSOs

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

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs andother fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer2 Nos

(b) Demolition Hammer 2 Nos
(c) Circular Saw 2 Nos
(d) Planer 2 Nos
(e) Hand Drilling Machine2 Nos
(f) Jigsaw 2 Nos

2. 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 otherwelding 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-conditionerOne each.

3. ELECTRICAL

1. Assorted electrical components for house wiring15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos

(b) Digital Live-wire detector 2 Nos

4. ELECTRONICS

1. Soldering guns 10 Nos.
2. Assorted electronic components for making circuits 50 Nos.
3. Small PCBs 10 Nos.
4. Multimeters 10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply

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

EC1208 **CIRCUITS AND DEVICES LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- To learn the characteristics of basic electronic devices such as Diode, BJT, FET, SCR
- To understand the working of RL, RC and RLC circuits
- To gain hand on experience in Thevenin & Norton theorems, KVL & KCL, and Superposition Theorems.

1. Characteristics of PN Junction Diode
2. Zener diode Characteristics and Regulator using Zener diode
3. Common Emitter input-output Characteristics
4. Common Base input-output Characteristics
5. FET Characteristics
6. SCR Characteristics
7. Clipper and Clamper & FWR
8. Verifications of Thevenin & Norton theorem
9. Verifications of KVL & KCL
10. Verifications of Super Position Theorem
11. Verifications of maximum power transfer & reciprocity theorem
12. Determination of Resonance Frequency of Series & Parallel RLC Circuits
13. Transient analysis of RL and RC circuits

LABORATORY REQUIREMENTS

BC 107, BC 148,2N2646, BFW10	-	25 each
1N4007, Zener diodes	-	25 each
Resistors, Capacitors, Inductors	-	sufficient quantities
Bread Boards	-	15 Nos.
CRO (30MHz)	-	15 Nos.
Function Generators (3MHz)	-	10 Nos.
Dual Regulated Power Supplies (0 – 30V)	-	10 Nos.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1 Analyze the characteristics of basic electronic devices

CO2 Design RL and RC circuits

CO3 Verify Thevenin's& Norton's theorem KVL & KCL, and Super Position Theorems

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

MA1352 LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS

L	**T**	**P**	**C**
3	**1**	**0**	**4**

OBJECTIVES:

- To understand the basis and dimension of vector space.
- To understand the concept of linear transformation, inner product spaces and process of orthogonalization.
- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series which plays a vital role in many engineering problems.
- To acquaint the student with Fourier series techniques in solving boundary value problems

UNIT I: VECTOR SPACES **12**

Vector spaces, Subspaces, Linear combinations, Linear independence and linear dependence, Bases and dimensions. **CO1**

UNIT II: LINEAR TRANSFORMATION AND DIAGONALIZATION **12**

Linear transformation, Null spaces and ranges, Dimension theorem, Matrix representation of a linear transformations. Inner product, norms - Gram Schmidt orthogonalization process. **CO2**

UNIT III: PARTIAL DIFFERENTIAL EQUATIONS **12**

Formation of PDE - Classification of partial differential equations, Solutions of first order equations: Standard types, Lagrange's linear equation, solution of linear equations of second order with constant coefficients, linear non-homogeneous partial differential equations. **CO3**

UNIT IV: FOURIER SERIES **12**

Dirichlet's conditions, General Fourier series, odd and even function, Half range cosine series and half range sine series, Parseval's identity, Harmonic analysis. **CO4**

UNIT V: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS **12**

Solutions of one-dimensional wave equation, Solutions of one-dimensional heat equation, Steady state solution of two-dimensional heat equation. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Friedberg S.H, Insel A.J. and Spence L, Linear Algebra, Fifth edition, Pearson, 2018.
2. B.S. Grewal, Higher engineering mathematics, Khanna publishers, New Delhi 44th edition, 2017.
3. Strang G, Linear algebra for everyone, Wellesley Cambridge press, first edition, 2020.

REFERENCES:

1. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. James, G. "Advanced Modern Engineering Mathematics‖, Pearson Education, 2007.
3. Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan, S. "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
5. Lay, D.C. "Linear Algebra and its Applications", 5th Edition, Pearson Education, 2015.
6. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning, 2007.
7. Strang, G. "Linear Algebra and its applications", Thomson (Brooks), New Delhi, 2005.

COURSE OUTCOMES

CO1 Find the basis and dimension of vector space

CO2 Find the matrix of linear transformation and orthonormal basis of inner product space.

CO3 Understand how to solve various types of partial differential equations.

CO4 Find the Fourier series of periodic functions.

CO5 Solve one and two dimensional heat flow and one dimensional wave equations by Fourier series techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	-	-	-	2	2	-	2	2	1	1
CO2	3	3	2	2	1	-	-	-	2	2	-	2	2	1	1
CO3	3	3	2	2	1	-	-	-	2	2	-	2	1	1	1
CO4	3	2	2	2	1	-	-	-	2	2	-	2	1	1	1
CO5	3	2	2	2	1	-	-	-	2	2	-	2	1	1	1

EC1302	ELECTRONIC CIRCUITS – I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the DC biasing methods of transistors and verify its performance.
- To design and analyze single stage and multistage BJT amplifier circuits.
- To design & analyze the small signal JFET & MOSFET amplifiers.
- To analyze the frequency response of small signal JFET & MOSFET amplifiers.
- To design, analyze and troubleshoot the fault analysis of the regulated DC power supplies.

UNIT I: BIASING OF DISCRETE BJT, JFET AND MOSFET **9**

BJT– Need for biasing - DC Load Line and Bias Point – DC analysis of Transistor circuits - Various biasing methods of BJT – Bias Circuit Design - Thermal stability - Stability factors - Bias compensation techniques using Diode, thermistor and sensistor - JFET - DC Load Line and Bias Point - Various biasing methods of JFET - JFET Bias Circuit Design - MOSFET Biasing. **CO1**

UNIT II: BJT AMPLIFIERS **9**

Small Signal analysis of CE, CC and CB amplifiers using Hybrid-π equivalent circuits - AC Load Line Analysis- Darlington Amplifier –Miller's Theorem- Bootstrap technique - Cascade, Cascode configurations - Differential amplifier, Basic BJT differential pair – Small signal analysis and CMRR **CO2**

UNIT III: SINGLE STAGE FET, MOSFET AMPLIFIERS **9**

Small Signal equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π equivalent circuits - Basic FET differential pair- BiCMOS circuits. **CO3**

UNIT IV: FREQUENCY RESPONSE OF AMPLIFIERS **9**

Amplifier frequency response – Frequency response of transistor amplifiers with circuit Capacitors – BJT frequency response – short circuit current gain - cut off frequency – f_α, f_β and unity gain bandwidth – Miller effect on capacitors - frequency response of FET – High frequency analysis of CE and MOSFET CS amplifier. **CO4**

UNIT V: POWER SUPPLIES AND ELECTRONIC DEVICE TESTING **9**

Linear mode power supply - Rectifiers - Filters - Half-Wave Rectifier Power Supply - Full-Wave Rectifier Power Supply - Voltage regulators: Voltage regulation - Linear series, shunt and switching Voltage Regulators - Over voltage protection - BJT and MOSFET – Switched mode power supply (SMPS) - Power Supply Performance and Testing - Troubleshooting and Fault Analysis. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3rd Edition, Mc-Graw Hill Education (India) Private Ltd., 2010. (Unit I-IV)
2. Robert L. Boylestad and Louis Nasheresky, —Electronic Devices and Circuit Theoryǁ, 11th Edition, Pearson Education, 2013. (Unit V)

REFERENCES:

1. Millman J, Halkias.C.and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
2. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4th Edition,Mc Graw Hill Education (India) Private Ltd., 2017.
3. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.
4. David A. Bell, Electronic Devices & Circuits, 5th Edition, Oxford University Press,2008
5. Anwar A. Khan and Kanchan K. Dey, A First Course on Electronics, PHI, 2006.
6. Rashid M, Microelectronics Circuits, Thomson Learning, 2007.

COURSE OUTCOMES

On completion of the course, the students will be able to

CO1 acquire knowledge about different BJT and FET biasing circuits.

CO2 analyze the performance of small signal BJT, multistage and Differential amplifiers.

CO3 analyze the performance of single stage FET, MOSFET amplifiers.

CO4 analyze the performance of Frequency response characteristics of BJT and FET and MOSFET amplifiers.

CO5 design and troubleshoot the regulated DC power supplies

MAPPING OF COs WITH POs AND PSOs

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

EC1303	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform &Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To characterize LTI systems in the Time domain and various Transform domains.

UNIT I: CLASSIFICATION OF SIGNALS AND SYSTEMS **9**

Introduction, Continuous-Time signals, Discrete-Time signals, Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic and Aperiodic signals, Deterministic and Random signals, Symmetric and asymmetric signals, Energy and Power signals, Continuous-Time systems, Discrete-Time systems-Basic system properties – Static and Dynamic systems, Linear and Nonlinear systems, Time-variant and Time invariant systems, Causal and Non-causal systems, Stable and Unstable systems. **CO1**

UNIT II: ANALYSIS OF CONTINUOUS TIME SIGNALS **9**

Fourier series representation of continuous-Time periodic signals, Convergence of Fourier Series, Gibb's phenomenon. Fourier series representation of Discrete-Time periodic signals, Continuous-Time Fourier Transform, Representation of Aperiodic signals using Continuous-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Continuous-Time Fourier Transform, Inverse Fourier Transform, The Laplace Transform, The Region of Convergence for Laplace Transforms, Properties of the Laplace Transform, Inverse Laplace Transform **CO2**

UNIT III: ANALYSIS OF LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS **9**

LTI systems characterized by Linear Constant Coefficient Differential Equations using the Laplace Transform, System Function, Impulse Response, Step response and response with initial conditions, System Function Algebra and Block Diagram Representation, Interconnection of systems, Convolution integral Representation of LTI systems, LTI systems characterized by Linear Constant Coefficient Differential Equations using Continuous-Time Fourier Transform, Frequency Response, Impulse Response, Step response and response. **CO3**

UNIT IV: ANALYSIS OF DISCRETE-TIME SIGNALS **9**

Sampling theorem, Sampling theorem for Band limited signals, The Effect of under sampling: Aliasing, The Discrete-Time Fourier Transform - Representation of Aperiodic signals using Discrete-Time Fourier Transform, The Fourier Transform for Periodic Signals, Properties of the Discrete-Time Fourier Transform, Inverse Fourier Transform, The z-Transform, The Region of Convergence for the z- Transform, Properties of the z- Transform, Inverse z-Transform **CO4**

UNIT V: LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS **9**

LTI systems characterized by Linear Constant Coefficient Difference Equations using the z-Transform, System Function, Impulse Response, Step response and response with initial conditions, System Function Algebra and Block Diagram Representation, Interconnection of systems, Convolution sum Representation of LTI systems, LTI systems characterized by Linear Constant Coefficient Difference Equations using Discrete-Time Fourier Transform, Frequency Response, Impulse Response, Step response and response. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2007.

REFERENCES:

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and D.Ronald Fannin, “Signals and Systems : Continuous and Discrete”,Fourth Edition Pearson, 2007.
3. Simon Haykin and Barry Van Veen “Signals & Systems”, Second Edition Wiley 2007.

COURSE OUTCOMES

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

CO1 To be able to determine the classification of systems based on their properties

CO2 Apply the Laplace transform and continuous-time Fourier transform of continuous-time signals.

CO3 Apply the Laplace transform and continuous-time Fourier transform of continuous-time systems.

CO4 Apply the z-Transform and discrete-time Fourier transform of discrete-time signals.

CO5 Apply the z-Transform and discrete-time Fourier transform of discrete-time systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	-	-	-	2	2	-	2	3	2	1
CO2	3	3	2	2	1	-	-	-	2	2	-	2	3	2	1
CO3	3	3	2	2	1	-	-	-	2	2	-	2	3	2	1
CO4	3	3	2	2	1	-	-	-	2	2	-	2	3	2	1
CO5	3	3	2	2	1	-	-	-	2	2	-	2	3	2	1

EC1304	DIGITAL ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

UNIT I: DIGITAL FUNDAMENTALS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1' s and 2' s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization. **CO1**

UNIT II: COMBINATIONAL CIRCUIT DESIGN **9**

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Parity generator and checker, Code converter. **CO2**

UNIT III: SYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design of sequence detector –Design-Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. **CO3**

UNIT IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS **9**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits. **CO4**

UNIT V: MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS **9**

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan- in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, —Digital Design‖, 5th Edition, Pearson, 2014.

REFERENCES:

1. Charles H.Roth. — Fundamentals of Logic Design‖, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, — Digital Fundamentals‖, 10th Edition, Pearson Education Inc, 2011
3. S.Salivahanan and S.Arivazhagan—Digital Electronics‖, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini — Digital Electronics‖, Wiley, 2014.
5. A.Anand Kumar — Fundamentals of Digital Circuits‖, 4th Edition, PHI Learning Private Limited 2016
6. Soumitra Kumar Mandal — Digital Electronics‖, McGraw Hill Education Private Limited, 2016.

COURSE OUTCOMES

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

CO1 Use digital electronics in the present contemporary world

CO2 Design various combinational digital circuits using logic gates

CO3 Do the analysis and design procedures for synchronous and asynchronous sequential circuits

CO4 Use the semiconductor memories and related technology

CO5 Use electronic circuits involved in the design of logic gates

MAPPING OF COs WITH POs AND PSOs

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

EC1305	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain basic mathematical understanding of vector algebra
- To gain conceptual and basic mathematical understanding of Electric and Magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

UNIT I: INTRODUCTION TO VECTOR ANALYSIS **9**

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem **CO1**

UNIT II: ELECTROSTATICS **9**

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Electric flux density and dielectric constant, Conductors in static electric field, Dielectrics in static electric field, Current density, Ohm's law, Continuity equation, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations **CO2**

UNIT III: MAGNETOSTATICS **9**

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques **CO3**

UNIT IV: TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS **9**

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields **CO4**

UNIT V: PLANE ELECTROMAGNETIC WAVES **9**

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. William H Hayt and Jr John A Buck, “Engineering Electromagnetics”, Tata Mc Graw-Hill Publishing Company Ltd, New Delhi, 2008.
2. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989
3. Sadiku MH, “Principles of Electromagnetics”, Oxford University Press Inc, New Delhi, 2009.

REFERENCES:

1. John D Kraus and Daniel A Fleisch, “Electromagnetics with Applications”, Mc Graw Hill Book Co, 2005
2. Karl E Longman and Sava V Savov, “Fundamentals of Electromagnetics”, Prentice Hall of India, New Delhi, 2006
3. Ashutosh Pramanic, “Electromagnetism”, Prentice Hall of India, New Delhi, 2006.

COURSE OUTCOMES

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

CO1 To Understand the basics of vector algebra and its significance in coordinate systems

CO2 To analyse electric field, electric potential and behaviour of conductors, dielectrics in static electric fields

CO3 To analyse magnetic field, magnetic potential and behaviour of magnetic materials in static magnetic fields

CO4 To analyse the relation between the electric fields and magnetic fields under time varying fields using Maxwell’s and Wave Equations

CO5 To understand the wave propagation in conductors and dielectrics

MAPPING OF COs WITH POs AND PSOs

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

EE1351	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Operation of Three phase electrical circuits and power measurement
- To understand concepts of AC machines.
- To learn basic measurement concepts.
- To learn the concepts of electronic measurements.
- To learn about importance of digital instruments in measurements

UNIT I: AC CIRCUITS AND POWER SYSTEMS **9**

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement – Transmission & Distribution of electrical energy – Over head Vs Underground system – Protection of power system – types of tariff – power factor improvement **CO1**

UNIT II: TRANSFORMER **9**

Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no–load phasor diagram — Transformer on–load phasor diagram — Equivalent circuit of transformer – Regulation of transformer –Transformer losses and efficiency-All day efficiency –auto transformers. **CO2**

UNIT III: INDUCTION MACHINES AND SYNCHRONOUS MACHINES **9**

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit – Construction of single-phase induction motors – Types of single phase induction motors – Double revolving field theory – starting methods – Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors. **CO3**

UNIT IV: BASICS OF MEASUREMENT AND INSTRUMENTATION **9**

Static and Dynamic Characteristics of Measurement – Errors in Measurement – Classification of Transducers – Variable resistive – Strain gauge, thermistor RTD – transducer – Variable Capacitive Transducer – Capacitor Microphone – Piezo Electric Transducer – Variable Inductive transducer – LVDT, RVDT **CO4**

UNIT V: ANALOG AND DIGITAL INSTRUMENTS **9**

DVM, DMM – Storage Oscilloscope. Comparison of Analog and Digital Modes of operation, Application of measurement system, Errors. Measurement of R, L and C, Wheatstone, Kelvin, Maxwell, Anderson, Schering and Wien bridges Measurement of Inductance, Capacitance, Effective resistance at high frequency, Q-Meter. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Third Reprint, 2016.
2. Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGraw Hill Education(India) Private Limited, 2010.
3. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011.

REFERENCES:

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2015.
2. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013.
3. Rajendra Prasad, "Fundamentals of Electrical engineering", Prentice Hall of India, 2006.
4. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, 24th reprint 2016.
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education (India) Private Limited, 2009.

COURSE OUTCOMES

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

CO1 Understand the concept of three phase electrical circuits and power measurement.

CO2 Understand the concepts in transformers.

CO3 Understand the concepts of AC machines.

CO4 Understand the basic measurement and instrumentation based devices.

CO5 Understand the relevance of digital instruments in measurements.

MAPPING OF COs WITH POs AND PSOs

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

EC1307	ANALOG AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- Study the Frequency response of CE, CB and CC Amplifier
- Learn the frequency response of CS Amplifiers
- Study the Transfer characteristics of differential amplifier
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
- Perform SPICE simulation of Electronic Circuits
- Design and implement the Combinational and sequential logic circuits

LIST OF ANALOG EXPERIMENTS:

1. Design of Regulated Power supplies
2. Frequency Response of CE, CB, CC and CS amplifiers
3. Darlington Amplifier
4. Cascode and Cascade amplifiers
5. Determination of bandwidth of single stage and multistage amplifiers
6. Analysis of BJT with Fixed bias and Voltage divider bias using Spice / Multisim
7. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice/ Multisim
8. Analysis of Cascode and Cascade amplifiers using Spice/ Multisim
9. Analysis of Frequency Response of BJT and FET using Spice/ Multisim

LIST OF DIGITAL EXPERIMENTS:

1. Design and Implementation of Half adder, Full adder, Half subtractor and Full subtractor
2. Design and implementation of BCD to Excess-3, Excess-3 to BCD, Binary to Gray and Gray to Binary code converters
3. Design and implementation of 4 bit binary Adder/ Subtractor using IC 7483
4. Design and implementation of encoder and decoder using logic gates
5. Design and implementation of Multiplexer and De-multiplexer using logic gates
6. Construction and verification of 4 bit ripple counter and Mod-10 Ripple counters
7. Design and implementation of 3-bit synchronous up/down counter
8. Implementation of Shift Registers (i) SISO,(ii)SIPO,(iii) PIPO

EQUIPMENTS FOR ANALOG LAB

CRO/DSO (30MHz)	-	15 Nos.
Signal Generator /Function Generators (3 MHz)	-	15 Nos.
Dual Regulated Power Supplies (0 – 30V)	-	15 Nos.
Standalone desktop PCs with SPICE software	-	15 Nos.
Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	-	50 Nos.

Components and Accessories: Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers

SPICE Circuit Simulation Software: (any public domain or commercial software)

EQUIPMENTS FOR DIGITAL LAB

Dual power supply/ single mode power supply	-	15 Nos.
IC Trainer Kit	-	15 Nos.
Bread Boards	-	15 Nos.
Seven segment display	-	15 Nos.
Multimeter	-	15 Nos.
ICs	-	each 50 Nos.

7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 /74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 / 7485 / 7473 / 74138 / 7411 / 7474

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1 Design and Test BJT/JFET amplifiers, cascade and cascode amplifiers

CO2 Measure CMRR in differential Amplifiers

CO3 Design and Test rectifiers, filters and regulated power supplies

CO4 Simulate and analyze amplifiers circuits using Pspice/Multisim

CO5 Design and Test the digital logic Circuits

MAPPING OF COs WITH POs AND PSOs

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

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

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

UNIT I: **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs. **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 PERIODS: 30

REFERENCES:

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

COURSE OUTCOMES

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

CO1 Make effective presentations

CO2 Participate confidently in Group Discussions

CO3 Attend job interviews and be successful in them.

CO4 Develop adequate Soft Skills required for the workplace

CO5 Develop their speaking skills to enable them 1speak fluently in real contexts

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

MA1451 **PROBABILITY AND RANDOM PROCESSES** **L T P C**

3 1 0 4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT I: RANDOM VARIABLES **12**

Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. **CO1**

UNIT II: TWO – DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression **CO2**

UNIT III: RANDOM PROCESSES **12**

Classification – Stationary process – Markov process - Poisson process – Random telegraph process. **CO3**

UNIT IV: CORRELATION AND SPECTRAL DENSITIES **12**

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties. **CO4**

UNIT V: LINEAR SYSTEMS WITH RANDOM INPUTS **12**

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and Cross correlation functions of input and output. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. Ibe,O.C.," Fundamentals of Applied Probability and Random Processes ", 2nd Edition, Academic press, 2014.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", 4th Edition, New Delhi, McGraw Hill Education, 2017.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd Indian Edition, 2012.
2. Hwei Hsu, "Schaum‘s Outline of Theory and Problems of Probability, Random
3. Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
4. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
5. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.
6. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

COURSE OUTCOMES

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

CO1 Able to get the exposure to random variable and well founded the knowledge of standard distributions which can be described real life phenomena.

CO2 Able to handle situations involving more than one random variable and functions.

CO3 Able to acquire skills and knowledge of applications of random phenomena with respect to time in probabilistic manner.

CO4 Able to find the relation between two or more random variables, the nature of relationship and degree of relationship.

CO5 Able to find the functional relationship between the input, output signals and able to analyze the response of random inputs to linear time invariant systems.

MAPPING OF COs WITH POs AND PSOs

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

EC1402	ELECTRONIC CIRCUITS- II	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Study and analyse the negative feedback amplifiers
- To Study and analyse the positive feedback amplifiers
- To design and analyse the performance of Turned amplifiers
- To design and construct wave shaping circuits
- To Study and analyse the performance of power amplifiers and DC converters

UNIT I: FEEDBACK AMPLIFIERS AND STABILITY **9**

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, series-shunt, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation. **CO1**

UNIT II: OSCILLATORS **9**

Barkhausen criterion for oscillation –Analysis of RC oscillators: Phase shift, Wien bridge - Analysis of LC- oscillators: Hartley, Colpitt's & Clapp oscillators- Armstrong Oscillator and crystal oscillators – Oscillator amplitude stabilization **CO2**

UNIT III: TUNED AMPLIFIERS **9**

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers –Analysis of capacitor coupled single tuned amplifier – Effect of cascading single tuned amplifiers on bandwidth – Double Tuned Amplifier (Characteristics Study) - Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization – Broad band neutralization : Hazeltine & Neutrodyne neutralization methods- Narrow band neutralization **CO3**

UNIT IV: WAVE SHAPING AND MULTIVIBRATOR CIRCUITS **9**

RC integrator and differentiator circuits – Diode clampers and clippers –Multivibrators: Collector coupled Astable, Monostable & Bistable multivibrators -Triggering methods of Bistable and Monotable multivibrators - Schmitt Trigger- UJT relaxation oscillator. **CO4**

UNIT V: POWER AMPLIFIERS AND DC CONVERTERS **9**

Power amplifiers- class A-Class B-Class AB-Class C- Temperature Effect - Distortions in Power Amplifier – DC-DC Converters : Buck, Boost and Buck-Boost- Quantitative analysis only **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sedra and Smith, "Micro Electronic Circuits", Sixth Edition, Oxford University Press, 2011. (UNIT I, III,IV,V)
2. Jacob Millman, "Microelectronics", McGraw Hill, 2nd Edition, Reprinted, 2009. (UNIT I,II,IV,V)

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., "Pulse Digital and Switching Waveforms", TMH, 2000.
4. Rao B. Visvesvara "Electronic Circuits-II" Pearson Education India 2018
5. S Salivahanan, N Suresh Kumar "Electronic Circuits – II" McGraw Hill India 2018

COURSE OUTCOMES

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

CO1 Analyze different types of negative feedback amplifiers design and Stability

CO2 Analyze different types of sinusoidal oscillators design

CO3 Analyze the characteristics of different types of tuned amplifiers and its Stability

CO4 Understand the design and characteristics of different types of wave shaping circuits

CO5 Analyze the performance of power amplifiers and also investigate the performance of DC convertors

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

EC1403 **COMMUNICATION THEORY** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the concepts of various amplitude modulations and their spectral characteristics.
- To analyze the concepts of angle modulation.
- To understand random processes and their characteristics.
- To know the effect of noise on communication systems.
- To study the limits set by Information Theory.

UNIT I: AMPLITUDE MODULATION **9**

Amplitude Modulation- DSBSC, SSB, VSB – Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope –comparison of different AM techniques, Superheterodyne Receiver-FDM **CO1**

UNIT II: ANGLE MODULATION **9**

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth – FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator – PLL as FM Demodulator. **CO2**

UNIT III: RANDOM PROCESS **9**

Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process through a LTI filter. **CO3**

UNIT IV: NOISE CHARACTERIZATION **9**

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and quadrature, Envelope and Phase – Noise performance analysis in AM & FM systems – Threshold effect, Pre-emphasis and de-emphasis for FM. **CO4**

UNIT V: INFORMATION THEORY **9**

Discrete Memoryless source, Information, Entropy, Mutual Information – Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2006.
2. S. Haykin, “Digital Communications”, John Wiley, 2005.

REFERENCES:

1. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.
2. B.Sklar, “Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007
3. H P Hsu, Schaum Outline Series – “Analog and Digital Communications” TMH 2006
4. Couch.L., “Modern Communication Systems”, Pearson, 2001.
5. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006

COURSE OUTCOMES

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

CO1 Design AM communication systems
CO2 Design Angle modulated communication systems
CO3 Apply the concepts of Random Process to the design of Communication systems
CO4 Analyze the noise performance of AM and FM systems
CO5 Configure Source coding schemes

MAPPING OF COs WITH POs AND PSOs

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

EC1404	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of waveform generators, and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of some special function ICs

UNIT I: BASICS OF OPERATIONAL AMPLIFIERS **9**

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations. **CO1**

UNIT II: APPLICATIONS OF OPERATIONAL AMPLIFIERS **9**

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters. **CO2**

UNIT III: WAVEFORM GENERATORS AND PLL **9**

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation. **CO3**

UNIT IV: ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS **9**

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters. **CO4**

UNIT V: SPECIAL FUNCTION ICS **9**

Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier, Optocoupler and fibre optic IC. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)

REFERENCES:

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. B.S.Sonde, "System design using Integrated Circuits", 2nd Edition, New Age Pub, 2001.
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 5th Edition, 2009.
5. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 4th Edition, 2001.
6. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2nd Edition, 4th Reprint, 2016.

COURSE OUTCOMES

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

CO1 Analyse the internal structure of operational amplifiers

CO2 Design linear and non-linear applications of operational amplifiers.

CO3 Able to generate waveforms using operational amplifiers and design applications of PLL

CO4 Able to design ADC and DAC using operational amplifiers

CO5 Able to explain the concepts of special function ICs

MAPPING OF COs WITH POs AND PSOs

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

CS1302	DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I: LINEAR DATA STRUCTURES – LIST **9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal). **CO1**

UNIT II: LINEAR DATA STRUCTURES – STACKS, QUEUES **9**

Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues. **CO2**

UNIT III: NON-LINEAR DATA STRUCTURES – TREES **9**

Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap. **CO3**

UNIT IV: NON-LINEAR DATA STRUCTURES – GRAPHS **9**

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph. **CO4**

UNIT V: SEARCHING, SORTING AND HASHING TECHNIQUES **9**

Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley, 2013.
2. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python", Second Edition, 2013.
3. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

REFERENCES:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1996
2. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2011.

COURSE OUTCOMES

Upon completion of the course, the 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	2	-	2	-	-	-	-	-	-	1	3	2	-
CO2	3	3	3	-	2	-	-	-	-	-	-	1	3	3	-
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3	-
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3	3
CO5	3	3	2	1	2	-	-	-	-	-	-	3	3	-	3

EC1406 **CONTROL SYSTEMS ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I: SYSTEMS COMPONENTS AND THEIR REPRESENTATION **9**

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system **CO1**

UNIT II: TIME RESPONSE ANALYSIS **9**

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems **CO2**

UNIT III: FREQUENCY RESPONSE AND SYSTEM ANALYSIS **9**

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation. **CO3**

UNIT IV: CONCEPTS OF STABILITY ANALYSIS **9**

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion. **CO4**

UNIT V: CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS **9**

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCES:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5 th Edition, 2007.
2. K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
3. S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.

COURSE OUTCOMES

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

CO1 Identify the various control system components and their representations.

CO2 Analyze the various time domain parameters.

CO3 Analysis the various frequency response plots and its system.

CO4 Apply the concepts of various system stability criterions.

CO5 Design various transfer functions of digital control system using state variable models

MAPPING OF COs WITH POs AND PSOs

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

EC1407	CIRCUITS DESIGN SIMULATION AND LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance calculation
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. Single Tuned Amplifier
5. RC Integrator and Differentiator circuits
6. Astable and Monostable Multivibrators
7. Clippers and Clampers
8. Integrator and Differentiator.
9. Instrumentation amplifier.
10. Active low-pass, High-pass and band-pass filters.
11. Astable & Monostable multivibrators using Op-amp
12. Schmitt Trigger using op-amp.
13. Phase shift and Wien bridge oscillators using Op-amp.
14. Astable and Monostable multivibrators using NE555 Timer.
15. Study of SMPS

SIMULATION USING SPICE (Using Transistor)

1. Tuned Collector Oscillator
2. Twin-T Oscillator /Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Monostable multivibrator with emitter timing and base timing
7. Analysis of Power Amplifier
8. Active low-pass, High-pass and band-pass filters using Op-amp
9. Astable and Monostable multivibrators using NE555 Timer

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

S.NO	EQUIPMENTS	-	15 Nos.
1	CRO (Min 30MHz)	-	15 Nos.
2	Signal Generator /Function Generators (2 MHz)	-	15 Nos.
3	Dual Regulated Power Supplies (0 – 30V)	-	15 Nos.
4	Digital Multimeter	-	2 Nos.
5	Digital LCR Meter	-	15 Nos.
6	Standalone desktops PC	-	50 Nos.
7	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	-	

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1 Analyze various types of feedback amplifiers

CO2 Design various types of oscillators.

CO3 Design tune damplifiers.

CO4 Design wave-shaping circuits and multivibrators

CO5 Design and simulate feedback amplifiers, oscillators, tuned amplifiers.

MAPPING OF COs WITH POs AND PSOs

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

CS1307	DATA STRUCTURES LABORATORY USING C	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

1. IMPLIMENTATION OF LIST

Write C programs to

a. Array implementation of Stack ADTs
b. Array implementation of Queue ADTs.

2. LIST ADT

Array implementation of List ADT.

3. IMPLEMENTATION OF STACK AND QUEUE

Write C programs to

a. Design and implement Single Linked List.
b. Design and implement Stack and its operations using List.
c. Design and implement Queue and its operations using List.

4. APPLICATIONS OF LINEAR DATA STRUCTURE

Write C programs to

a. Design and implement polynomial ADT using list
b. Uses Stack operations to convert infix expression into postfix expression.
c. Uses Stack operations for evaluating the postfix expression.

5. IMPLEMENTATION OF TREE

a. Write a C program to Design and implement binary search tree.

6. IMPLEMENTATION OF ADVANCED TREE

a. Design and Implement AVL tree using Templates.
b. Design and Implement heap tree using Templates.

7. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS

Write C programs for the following:

a. Design and Implement Dijkstra‘s algorithm
b. Design and Implement Floyd Warshall algorithm.

8. IMPLEMENTATION OF MINIMUM SPANNING TREE

Write C programs for the following:

a. Design and Implement Kruskal’s algorithm.
b. Design and Implement Prim’s algorithm.

9. GRAPH TRAVERSAL & SORTING

Write C programs to implement the following algorithms:

a. Depth first search.
b. Breadth first search.
c. Topological Sorting

10. SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION

a. Write C programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
   i. Insertion sort
   ii. Selection sort
   iii. Quick sort
   iv. Merge sort
b. Write C programs for implement linear search and binary search.
c. Write C programs for implement Hashing – any two collision techniques

TOTAL PERIODS: 60

COURSE OUTCOMES

Upon completion of the course, the 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	2	2	1	3	-	-	-	2	2	1	2	3	2	2
CO2	3	3	3	1	3	-	-	-	2	2	1	2	3	3	2
CO3	3	3	2	2	3	-	-	-	1	2	1	3	3	2	3
CO4															
CO5															

EC1501	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the principles of Information coding Techniques
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various band pass signaling schemes
- To know the fundamentals of channel coding

UNIT I: INFORMATION THEORY **9**

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memory less channels – Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law – Source coding theorem - Shannon - Fano & Huffman codes. **CO1**

UNIT II: WAVEFORM CODING & REPRESENTATION **9**

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ &NRZ – Bipolar NRZ – Manchester **CO2**

UNIT III: BASEBAND TRANSMISSION & RECEPTION **9**

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding -Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization **CO3**

UNIT IV: DIGITAL MODULATION SCHEME **9**

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK,BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers -Principle of DPSK. **CO4**

UNIT V: ERROR CONTROL CODING **9**

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. S. Haykin, “Digital Communications”, John Wiley, 2005

REFERENCES:

1. B. Sklar, “Digital Communication Fundamentals and Applications”, 2nd Edition, Pearson Education, 2009
2. B.P.Lathi, “Modern Digital and Analog Communication Systems” 3rd Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series “Analog and Digital Communications”, TMH 2006
4. J.G Proakis, “Digital Communication”, 4th Edition, Tata Mc Graw Hill Company, 2001.

COURSE OUTCOMES

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

CO1 Design and implement different source coding techniques and the limits of channel

CO2 Design and analysis of adaptive quantized schemes and different line code schemes

CO3 Design and implement base band transmission schemes.

CO4 Analyze the spectral characteristics of band pass signalling schemes and their noise performance

CO5 Design error control coding schemes

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM 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	3	-	2
CO2	3	3	3	2	2	-	-	-	-	-	-	2	3	-	2
CO3	3	3	3	2	2	-	-	-	-	-	-	2	3	-	2
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3	-	3
CO5	3	3	3	2	2	-	-	-	-	-	-	2	3	-	3

EC1502 **DISCRETE-TIME SIGNAL PROCESSING** **L T P C**

3 1 0 4

OBJECTIVES:

- To learn discrete Fourier transform, properties and its application to linear filtering
- To know the characteristics of IIR filters and learn the design of infinite impulse response filters for filtering undesired signals
- To know the characteristics of FIR filters and learn the design of finite impulse response filters for filtering undesired signals
- To understand Finite word length effects
- To study the concept of Multirate signal processing and applications

UNIT I: DISCRETE FOURIER TRANSFORM **12**

Review of signals and systems- Discrete Fourier Transform (DFT) - Deriving DFT from DTFT, properties of DFT — Circular convolution - Filtering long data sequences - Overlap save and Overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time Fast Fourier transform (DIT-FFT), Decimation-in-frequency Fast Fourier transform (DIF-FFT), Linear filtering using FFT. **CO1**

UNIT II: INFINITE IMPULSE RESPONSE FILTER DESIGN **12**

Structures of IIR Filter — Analog filter design - Butterworth filter, Chebyshev filter — Design of Discrete time IIR filter from analog filter-Impulse Invariance method, Bilinear transformation, Approximation of derivatives – Frequency transformation in the analog domain. **CO2**

UNIT III: FIR FILTER DESIGN **12**

Structures of FIR Filter- Design of Linear phase FIR filter — Fourier Series method - Windowing techniques (Rectangular, Hamming, Hanning) and Frequency sampling method. **CO3**

UNIT IV: FINITE WORDLENGTH EFFECTS **12**

Fixed point and Floating point number representations –Quantization- Truncation and Rounding errors - Finite word length effects in digital Filters- Quantization noise — Coefficient quantization error — Product quantization error — Overflowerror — round off noise power - limit cycle oscillations due to product round off and overflowerrors – Principle of scaling. **CO4**

UNIT V: MULTIRATE DSP AND ITS APPLICATIONS **12**

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor — Adaptive Filters: Introduction, Applications of adaptive filters -Adaptive noise cancellation, Adaptive equalizer, Adaptive echo canceller, Sub band coding. **CO5**

TOTAL PERIODS: 60

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. S. Haykin, "Digital Communications", John Wiley, 2005

REFERENCES:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill,2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
5. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill,2007.
6. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
7. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

COURSE OUTCOMES

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

CO1 Able to analyze the signal performance in frequency domain using DFT

CO2 Able to design IIR filters using different transformation techniques.

CO3 Able to design FIR filters using different methods and also investigate its structure realization.

CO4 Able to analyze finite word length effects for real time implementation

CO5 Able to analyze the Multirate Signal Processing and applications of Adaptive filters

MAPPING OF COs WITH POs AND PSOs

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

EC1503	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand various network architectures, physical media, channel access techniques and the related link level protocols.
- To understand the evolving nature of access techniques in wired and wireless media and IP addressing.
- To explain the routing protocols, switch basics and Global Internet and analyze the Multicast Addressing and Multicast Routing.
- To get the knowledge about the transport layer protocols, Congestion control and avoidance in networks and QoS issues.
- To understand the various types of Application layer protocols such as SMTP, POP3, IMAP, MIME, HTTP, Web services, DNS, SNMP.

UNIT I: FUNDAMENTALS & LINK LAYER **9**

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Model – Physical Layer –Introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction **CO1**

UNIT II: MEDIA ACCESS & INTERNETWORKING **9**

Overview of Data link Control - Media access - Random, Controlled and channelization, IEEE Standards IEEE 802.3, IEEE 802.4, IEEE 802.5 - Wireless LANs – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee. Network layer services – Packet Switching – IPV4 Address – Network layer protocols (ICMP, IGMP) **CO2**

UNIT III: ROUTING **9**

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6 **CO3**

UNIT IV: TRANSPORT LAYER **9**

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection - TCP Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements. **CO4**

UNIT V: APPLICATION LAYER **9**

Application Layer Paradigms – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Network Security – Firewalls- Network management protocol **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw – Hill, 2013 (UNIT I –V)

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2nd Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
4. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

COURSE OUTCOMES

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

CO1	Identify the components required to build different types of networks and the functionality of each layer
CO2	Understand the functionality of Layer2 for given application
CO3	Understand IPV4 and IPV6 network configuration
CO4	Trace the flow of information from one end to another end in the network
CO5	Understand the use of various Application layer Protocols

MAPPING OF COs WITH POs AND PSOs

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

EC1504	TRANSMISSION LINES AND RF SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics.
- To give thorough understanding about high frequency line, power and impedance measurements.
- To impart technical knowledge in impedance matching using smith chart.
- To introduce wave behaviour along uniform guiding structures.
- To get acquaintance with RF filter and amplifier design.

UNIT I: TRANSMISSION LINE THEORY **9**

General theory of Transmission lines- Characteristic impedance, propagation constant, attenuation and phase constants, wavelength, velocity of propagation; General Solution of transmission line- Calculation of current, voltage, power delivered and efficiency of transmission; Calculation of Input and Transfer impedance- Open and short circuited lines; The Infinite line; Waveform distortion- Conditions for Distortion less line; Loading and different methods of loading; Line not terminated with Z_0- reflection coefficient, reflection factor and reflection loss. **CO1**

UNIT II: HIGH FREQUENCY TRANSMISSION LINES **9**

Transmission line equations at radio frequencies; Parameters of the open -wire line and Coaxial cable at high frequencies, Constants for the line of zero dissipation; Voltage and current on the dissipation-less line; Standing Waves, Nodes, Standing Wave Ratio; Input impedance- dissipation-less line, open circuited lines, short circuited lines, eighth-wave line, half wave line, quarter-wave line; Power and impedance measurement on lines, Smith chart- Measurement of impedance, admittance, reflection coefficient, VSWR, insertion loss, return loss and attenuation using Smith chart. **CO2**

UNIT III: IMPEDANCE MATCHING IN HIGH FREQUENCY LINES **9**

Impedance matching- Quarter wave transformer, Matching with Lumped Elements, Single stub matching, Double stub matching; Design of Impedance matching networks using smith chart: Lumped element (L – section) matching, Single stub matching and Double stub matching. **CO3**

UNIT IV: WAVEGUIDES **9**

Overview of Maxwell's Equation and Wave Equations, General Wave behavior along uniform guiding structures: Transverse Electric (TE) Waves, Transverse Magnetic (TM) Waves, Transverse Electromagnetic (TEM) Waves. General solutions for TE, TM and TEM waves- parallel plate waveguide, rectangular waveguide, and circular waveguide. Characteristics of wave guide: guide wavelength, cut off wave length, cut off frequency, wave impedance, phase constant, phase velocity, group velocity, power and attenuation. **CO4**

UNIT V: RF SYSTEM DESIGN CONCEPTS **9**

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015.
2. Mathew M. Radmanesh,"Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002.
3. David M. Pozar, “Microwave Engineering”, 2012, 4th edition, Wiley, India.
4. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems Prentice Hall of India", 2006.

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko,"RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition,2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2004.
3. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005.
4. David K. Cheng, “Field and Wave Electromagnetics””, 2nd edition, Pearson, Noida, India, 2014.

COURSE OUTCOMES

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

CO1 Explain the characteristics of transmission lines and its losses.

CO2 Analyze the characteristics of a dissipation less transmission line.

CO3 Design impedance matching networks for unmatched lines and learn the importance of Smith chart in the above application.

CO4 Able to analyze transmission of electromagnetic waves in unguided and guided media.

CO5 Able to design RF system transceiver employing active RF components.

MAPPING OF COs WITH POs AND PSOs

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

EC1507	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- To perform basic signal processing operations such as Linear convolution, Circular convolution, Auto-correlation, Cross-correlation and Frequency analysis in MATLAB.
- To implement FIR and IIR filters in MATLAB and DSP processor
- To implement up-sampling and down-sampling in DSP processor

LIST OF EXPERIMENTS: MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto-correlation and Cross-correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations

DSP PROCESSOR BASED IMPLEMENTATION

1. Linear convolution
2. Circular convolution
3. Design and demonstration of FIR Filter for Low-pass, High-pass, Band-pass and Band-stop filtering
4. Design and demonstration of Butterworth and Chebyshev IIR Filters for Low-pass, High -pass, Band-pass and Band-stop filtering
5. Implement an Up-sampling and Down-sampling operation in DSP Processor

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1	Perform basic signal processing operations such as Linear convolution, Circular convolution, Autocorrelation, Cross-correlation and Frequency analysis using MATLAB
CO2	Design FIR and IIR filters using MATLAB
CO3	Implement linear and circular convolution in DSP processor
CO4	Design and implement FIR and IIR filters in DSP processor for performing filtering operation over real-time signals
CO5	Implement Up-sampling and Down-sampling in DSP processor

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

EC1508 **COMMUNICATION SYSTEMS LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made to:

- To visualize the effect of sampling and TDM in a transceiver
- To implement AM & FM modulation and demodulation
- To implement Line Coding, PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. Simulation of ASK, FSK, and BPSK generation schemes
9. Simulation of DPSK, QPSK and QAM generation schemes
10. Simulation of signal constellations of BPSK, QPSK and QAM
11. Simulation of ASK, FSK and BPSK detection schemes
12. Simulation of Linear Block and Cyclic error control coding schemes
13. Simulation of Convolutional coding scheme
14. Simulation of error performance of ASK, FSK, BPSK, QPSK, DPSK and QAM
15. Communication link simulation

TOTAL PERIODS: 60

LAB Requirements for a Batch of 30 students (3 students per experiment):

i) Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
ii) CROs/DSOs – 15 Nos, Function Generators – 15 Nos.
iii) MATLAB or Octave or LabVIEW or any equivalent software package for simulation experiments
iv) PCs - 15 Nos

COURSE OUTCOMES

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

CO1 Simulate & validate the various functional modules of a communication system

CO2 Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes

CO3 Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system

CO4 Compare and contrast the error performance of various digital modulation schemes

CO5 Simulate end-to-end communication Link

MAPPING OF COs WITH POs AND PSOs

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

EC1509	COMMUNICATION NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- Learn to communicate between two desktop computers
- Learn to implement the different protocols
- Be familiar with IP Configuration
- Be familiar with the various routing algorithms
- Be familiar with simulation tools

LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Implementation of IP Commands such as ping, Traceroute, nslookup.
6. Implementation of IP address configuration.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Implementation of distance vector routing algorithm
9. Implementation of Link state routing algorithm
10. Implementation of Encryption and Decryption Algorithms using any programming language

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

SOFTWARE

- C / Python / Java / Equivalent Compiler
- MATLAB SOFTWARE (Few experiments can be practiced with MATLAB)
- Network simulator like NS2/ NS3 / Glomosim/OPNET/

30 Equivalent HARDWARE

Standalone Desktops **30 Nos**

COURSE OUTCOMES

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

CO1	Communicate between two desktop computers
CO2	Implement the different protocols
CO3	Implementation of IP Configuration
CO4	Implement and compare the various routing algorithms
CO5	Implement algorithms simulation tool.

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

EC1605 MICROPROCESSORS AND MICROCONTROLLERS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller MSP430 based system

UNIT I: 8086 MICROPROCESSOR **9**

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set-Assembler directives – 8086 Signals – Basic configurations of 8086 - Minimum and Maximum mode – Assembly language programming – Interrupts and interrupt service routines. **CO1**

UNIT II: 8086 INTERFACING **9**

Parallel communication interface (8255) – Serial communication interface (8251) – D/A Interface and Waveform generation – A/D Interface – Timer (8253) – Keyboard /display controller (8279) – Assembly language programming **CO2**

UNIT III: 8051 MICROCONTROLLER **9**

Microprocessor Vs Micro Controller – Von Neumann Vs Harvard Architecture – Architecture of 8051 – Memory Organization – Special Function Registers (SFRs) – Instruction set – Addressing modes – Interrupts – Timers – Serial Port – External Memory Interface – Stepper Motor Interface-Assembly language programming. **CO3**

UNIT IV: MSP430 - 16 BIT MICROCONTROLLER **9**

MSP430 RISC CPU architecture – Clock system – Memory subsystem – Addressing Modes – Instruction set – On chip peripherals. **CO4**

UNIT V: ADVANCED FEATURES OF MSP430 **9**

Low power features of MSP430 – Power Management Module – Functions, Interrupts, and Low-Power Modes - Clock request feature – Mixing scheme of the MSP430 pins – Programming using C and assembly language - Debugging through Emulation Vs Simulation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals " 3rd edition, Tata McGrawHill,2012
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011. (UNIT IV-V)
3. Kenneth J.Ayala, "The 8051 Microcontroller-Architecture, Programming and Applications" West Publishing company, 3rd edition.
4. John Davies, “MSP430 Microcontroller Basics”, Elsevier, 2008.

COURSE OUTCOMES

By the end of this course, the student should be able

CO1 To understand the Architecture of 8086 microprocessor

CO2 To learn the design aspects of I/O and Memory Interfacing

CO3 To understand the Architecture of 8051 Microcontroller

CO4 To understand the architecture of MSP430 microcontroller and its onboard Peripherals

CO5 To design and implement MSP430 microcontroller based systems

MAPPING OF COs WITH POs AND PSOs

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

EC1602	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits & its characteristics and CMOS Fabrication Technologies.
- Learn the design and realization of combinational digital circuits.
- Learn the design and realization of sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I: INTRODUCTION TO MOS TRANSISTOR **9**

Introduction to VLSI Design, MOS Transistor, CMOS logic, Inverter, CMOS Fabrication Technologies, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling. **CO1**

UNIT II: COMBINATIONAL MOS LOGIC CIRCUITS **9**

Circuit Families: Introduction, Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL. Power: Dynamic Power, Static Power, Low power design principles, Low Power Architecture. **CO2**

UNIT III: SEQUENTIAL CIRCUIT DESIGN **9**

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design. **CO3**

UNIT IV: DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM **9**

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry. **CO4**

UNIT V: FPGA ARCHITECTURES AND TESTING **9**

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Testing: Introduction, Manufacturing Test Principles, Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2017 (UNIT I,II,V)
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design perspective", Second Edition, Pearson, 2016.(UNIT III,IV)

REFERENCES:

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim CMOS Digital Integrated Circuits: Analysis Design",4th edition McGraw Hill Education,2013
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI, David E.Boyee, "CMOS Circuit Design, Layout & Simulation", Prentice Hall of India 2005.

COURSE OUTCOMES

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

CO1 Realize the concepts of digital building blocks using MOStransistor.

CO2 Design combinational MOS circuits and powerstrategies.

CO3 Design and construct Sequential Circuits and Timingsystems.

CO4 Design arithmetic building blocks and memorysubsystems.

CO5 Apply and implement FPGA design flow andtesting.

MAPPING OF COs WITH POs AND PSOs

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

EC1603	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the characteristic of wireless channel
- To understand the design of a cellular system
- To study the various digital signalling techniques
- To understand multipath mitigation techniques
- To understand the concepts of MIMO system

UNIT I: WIRELESS CHANNELS **9**

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters- Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading. **CO1**

UNIT II: CELLULAR ARCHITECTURE **9**

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity-trunking & grade of service – Coverage and capacity improvement. **CO2**

UNIT III: DIGITAL SIGNALING FOR FADING CHANNELS **9**

Structure of a wireless communication link, Principles of Offset-QPSK, pi/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR. **CO3**

UNIT IV: MULTIPATH MITIGATION TECHNIQUES **9**

Equalization – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver. **CO4**

UNIT V: MULTIPLE INPUT MULTIPLE OUTPUT SYSTEMS **9**

MIMO systems – spatial multiplexing -System model - Channel state information-capacity in flat-fading and non-fading channels-Impact of the channel diversity- Linear precoding. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Rappaport,T.S., —Wireless communications‖, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, —Wireless Communications‖, John Wiley – India, 2006. (UNIT III,V)

REFERENCES:

1. Andrea Goldsmith,-Wireless Communication, Cambridge University Press, 2011
2. Aditya K Jagannatham, - Principles of Modern Wireless Communication Systems, Theory and Practice, McGraw Hill Education,2016
3. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000
4. David Tse and Pramod Viswanath, — Fundamentals of Wireless Communication, Cambridge University Press, 2005.
5. Upena Dalal, —Wireless Communication, Oxford University Press, 2009.

COURSE OUTCOMES

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

CO1 Characterize a wireless channel and evolve the system design specifications

CO2 Design a cellular system based on resource availability and traffic demands

CO3 Identify suitable signalling scheme for the wireless channel and system under consideration

CO4 Identify suitable multipath mitigation techniques to improve performance

CO5 Analyse and design MIMO systems

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

EC1604 **ANTENNAS AND MICROWAVE ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles in antenna and microwave system design.
- To enhance the student knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications

UNIT I: INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS **9**

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver. **CO1**

UNIT II: ANTENNA RADIATION MECHANISMS AND DESIGN ASPECTS **9**

Retarded potentials, Radiation Mechanisms of Linear Wire antennas: Half-wave dipole, Quarter-wave monopole; Loop antennas; Aperture antennas: Horn Antennas,Slot Antennas, Reflector antennas; Microstrip antennas; Frequency independent antennas:Spiral antennas,Log-Periodic Dipole Array – Design considerations and applications. **CO2**

UNIT III: ANTENNA ARRAYS AND APPLICATIONS **9**

Two-element array, Array factor, Pattern multiplication, uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas. **CO3**

UNIT IV: PASSIVE AND ACTIVE MICROWAVE DEVICES **9**

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator; Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes; Microwave tubes: Klystron, TWT, Magnetron. **CO4**

UNIT V: MICROWAVE DESIGN PRINCIPLES **9**

Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antenna and Wave Propagation: Fourth Edition, Tata McGraw –Hill, 2006. (UNIT I, II, III)
2. David M.Pozar, “Microwave Engineering”, Fourth Edition, Wiley India, 2012. (UNIT I, IV, V).

REFERENCES:

1. Constantine A.Balanis,”Antenna Theory Analysis and Design”, Third edition, John Wiley India Pvt Ltd., 2005.
2. R.E.Collin, “Fundamentals for Microwave Engineering”, Second edition, IEEE Press, 2001.
3. Samuel Y. Liao, “Microwave Devices and Circuits”, Third edition, Pearson Education India, 2003.

COURSE OUTCOMES

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

CO1 Understand the theoretical principles and basic of Microwave evaluate the Antenna parameters.

CO2 Design and assess the performance of different types of Antennas.

CO3 Understand and acquire knowledge about Antenna and Array and its application.

CO4 Ability to analyze the microwave active and passive components such as Power dividers, hybrid junctions and understand the operational concepts of microwave vacuum tubes-based oscillators and amplifiers.

CO5 Ability to Design a Microwave amplifier and oscillator system for practical application specifications.

MAPPING OF COs WITH POs AND PSOs

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

EC1606	DIGITAL IMAGE PROCESSING (LAB INTEGRATED)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To become familiar with digital image fundamentals and basics of MATLAB
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain and understand their operations through MATLAB
- To learn concepts of degradation function and restoration techniques.
- To study image segmentation and corresponding programs using MATLAB
- To become familiar with image representation, description and object recognition methods and the corresponding programs using MATLAB

UNIT I: DIGITAL IMAGE FUNDAMENTALS **9+2**

Steps in Digital Image Processing – Elements of Visual Perception-Image Sampling and Quantization – Relationships between pixels -Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

Lab Component **CO1**

Fundamentals of MATLAB programming

- Reading, writing and displaying an image.
- Different types of images.

UNIT II: IMAGE ENHANCEMENT **9+8**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Lab Component **CO2**

Implement the following in Matlab

- Gray Level Transformation and Histogram calculation of an image.
- Linear and Non-linear Spatial Filtering of an image.
- DFT filtering of an image.

UNIT III: IMAGE RESTORATION **9+2**

Image Restoration - Degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Lab Component **CO3**

Implement the following in MATLAB

- Inverse and Wiener Filtering of images.

UNIT IV: IMAGE SEGMENTATION **9+8**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- Erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm. **CO4**

Lab Component

Implement the following in MATLAB

- Edge detection.
- Otsu and Canny edge detection.
- Morphological operators
- Watershed Segmentation Algorithm.

UNIT V: IMAGE REPRESENTATION, DESCRIPTION AND OBJECT DETECTION 9+10

Representation – Descriptors – Principal Components – Topological feature, Texture - Patterns and Pattern Classes – Recognition based on Decision theoretic approach – Structural Methods

Lab Component

Implement the following in MATLAB

- Boundary and Regional descriptors **CO5**
- Principal Component extraction of an image
- Minimum Distance Classifier
- Design and implement a simple image-based application.
- MATLAB program for representation, description and object recognition

TOTAL PERIODS: 75

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1	To become familiar with digital image fundamentals and basics of MATLAB
CO2	To get exposed to simple image enhancement techniques in Spatial and Frequency domain and understand their operations through MATLAB
CO3	To learn concepts of degradation function and restoration techniques.
CO4	To study the image segmentation and the corresponding programs using MATLAB
CO5	To become familiar with image representation, description and object recognition methods

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

EC1607 **MICROPROCESSORS AND MICROCONTROLLERS LABORATORY**

L	**T**	**P**	**C**
4	**0**	**0**	**2**

OBJECTIVES:

The student should be made to:

- To Introduce concepts of 8086 and 8051 Assembly Language Programming
- To write and execute ALP for arithmetic and logical operations in 8086 and 8051
- To acquire knowledge of interfacing 8086 and 8051 with I/O devices
- To program Timers/Counters and Serial ports of 8051
- To introduce C programming for MSP430 in Code Composer Studio

LIST OF EXPERIMENTS:

8086 Programs using kits

1. Basic arithmetic and Logical operations
2. Code conversion and Decimal arithmetic operations
3. Matrix operations
4. String manipulations
5. Sorting and Searching

Peripherals and Interfacing

1. Traffic light controller Interface
2. Stepper motor control Interface
3. Key board and Display Interface
4. Parallel interface
5. A/D and D/A interface
6. Timer Interface

8051 Programs and Interfacing

1. Basic arithmetic and Logical operations
2. Square and Cube program, 2‘s complement of a number, Unpacked BCD to ASCII

3. 8051 Timer/Counter Programming
4. 8051 Parallel and Serial Port Programming
5. Stepper motor control Interface

MSP430 Programs and Interfacing using CCS

1. Arithmetic Instructions – Addition, subtraction, multiplication and division
2. Square, Cube
3. ADC & DAC Interface
4. Stepper motor control interface to MSP

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR A BATCH OF 30

HARDWARE

- 8086 development kits - 30 nos
- Interfacing Units - Each 5 nos
- 8051 Microcontroller kit - 30 nos
- MSP430 Microcontroller kit – 10 Nos
- PC (INTEL 7) – 10 Nos.

SOFTWARE:

Code Composer Studio (IDE for MSP430 Experiments)

COURSE OUTCOMES

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

CO1	Write and execute 8086 Assembly Language Programs for Arithmetic and Logical operations
CO2	Interface different I/Os with 8086 Microprocessor and 8051 Microcontroller
CO3	Write and execute 8051 Assembly Language Programs for Arithmetic and Logical operations
CO4	To perform Serial port and Timer/Counter Programming in 8051
CO5	Write and execute C programs for Arithmetic, Logical operations and Interfacing using MSP430 Microcontroller

MAPPING OF COs WITH POs AND PSOs

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

EC1608	VLSI DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms
- To provide hands on design experience to implement IOT based applications using FPGA

LIST OF EXPERIMENTS:

Part I: Digital System Design using HDL & FPGA (24 Periods)

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Compare pre synthesis and post synthesis simulation for experiments 1 to 6.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Part II: Digital Circuit Design (24 Periods)

1. Design and simulate a CMOS inverter using digital flow
2. Design and simulate a CMOS Basic Gates & Flip-Flops
3. Design and simulate a 4-bit synchronous counter using a Flip-Flops Manual/ Automatic Layout Generation and Post Layout Extraction for experiments 7 to 9
4. Analyze the power, area and timing for experiments 7 to 9 by performing Pre Layout and Post Layout Simulations.by Xilinx/Altera FPGA
5. Compare pre synthesis and post synthesis simulation for experiments 1 to 6.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

Part-III Analog Circuit Design (12 Periods)

1. Design and Simulate a CMOS Inverting Amplifier.
2. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
3. Analyze the input impedance, output impedance, gain and bandwidth for experiments 10 and 11 by performing Schematic Simulations.

4. Design and simulate simple 5 transistor differential amplifier. Analyze Gain,
5. Bandwidth and CMRR by performing Schematic Simulations.

Requirements: Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools

Part-IV Implementation of IOT applications using FPGA (12 Periods)

1. Measurement and Analysis: Develop the acceleration and vibration measurement of an object and generate the analysis report.
2. Real-Time Tank Level Control: Prototype the RT tank level observation and automatic pump control using sensors and actuators.
3. Remote Monitoring using IoT: Monitor the ambient light intensity and transfer the data to the cloud using IOT protocol.

Requirements: NI myRIO FPGA board and Lab View software tool

LIST OF EQUIPMENT FOR A BATCH OF 30

S.NO	EQUIPMENT	REQUIRED
1.	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 User License
2.	Xilinx/Altera/equivalent FPGA Boards	10 nos.
3.	Cadence/Synopsis/Mentor Graphics/ Tanner/ equivalent EDA Tools	10 User License
4.	Personal Computer	30 Nos.

TOTAL PERIODS: 60

COURSE OUTCOMES

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

CO1 Write HDL code for basic as well as advanced digital integrated circuit

CO2 Import the logic modules into FPGA Boards

CO3 Synthesize Place and Route the digital IP's

CO4 Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA

CO5 Design and develop IOT based real time applications using FPGA & Lab View software tool

MAPPING OF COs WITH POs AND PSOs

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

EC1701	ADAPTIVE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of Machine Learning.
- To learn Regression algorithms and their applications.
- To learn Supervised Classification algorithms, Ensemble techniques and their applications.
- To understand unsupervised learning and EM algorithms.
- To acquire knowledge about ANN and Deep Learning.

UNIT I: LEARNING FROM DATA **9**

Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Reinforcement Learning- Basic Concepts in Machine Learning – Machine Learning Process – CRISP DM, Testing Machine Learning Algorithms– Errors, Performance metrics- overfitting, under fitting and generalization - Bias -Variance Trade off, no free lunch theorem-Turning Data into Probabilities: Centrality theorem, distributions – Bayes Theorem. **CO1**

UNIT II: REGRESSION FOR PREDICTIVE MODELING **9**

Linear Models for Regression – Linear Basis Function Models –Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms: Simple Linear Regression – Multiple Linear Regression- Applications of Regression Models **CO2**

UNIT III: CLASSIFICATION AND ENSEMBLE TECHNIQUES **9**

Classification – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models.

Common Classification Algorithms: Logistic Regression, k-Nearest Neighbours – Naive Bayes Classifiers – Decision Trees – Random Forest model – Support Vector Machines- Ensemble Learning: Voting - Bagging– Boosting. Applications of Classification Models **CO3**

UNIT IV: SELF-ORGANIZING DATA ANALYSIS **9**

Mixture Models and Expectation Maximization (EM) — Dirichlet Process Mixture Models- K-Means Clustering– Spectral Clustering – Hierarchical Clustering.

Curse of Dimensionality – Dimensionality Reduction – Linear Discriminate Analysis (LDA)- Principal Component Analysis (PCA) **CO4**

UNIT V: BUILDING ADAPTIVE SYSTEMS WITH DEEP LEARNING **9**

Neuron - Perceptron learning - Activation functions- Models of a neuron: shallow networks to deep networks, feed-forward neural networks – Multi-layer feedforward neural network, back propagation algorithm - convergence of back-propagation - Gradient descent algorithm, Convolutional Neural Network. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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, the students will be able to

CO1 Gain knowledge about basic concepts of Machine Learning Techniques

CO2 Understand and Apply Regression Algorithms for various applications

CO3 Understand Supervised Learning Classification models and Analyze Ensemble Techniques

CO4 Understand various Unsupervised Learning Algorithms

CO5 Design deep neural network models

MAPPING OF COs WITH POs AND PSOs

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

EC1702 **OPTICAL COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

- To study about the various optical fiber modes, configuration and classification of optical fibers
- To understand the transmission characteristics of optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

UNIT I: INTRODUCTION TO OPTICAL FIBERS **9**

Introduction-general optical fiber communication system-basic optical laws and definitions-Total Internal Reflection-Acceptance Angle- Numerical Aperture-Skew Ray optical modes and configurations-mode analysis for optical propagation through fibers-modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes-fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber-single mode fiber-graded index fiber. **CO1**

UNIT II: TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER **9**

Attenuation-absorption—scattering losses-bending losses-core and cladding losses-signal dispersion–inter symbol interference and bandwidth-intra model dispersion-material dispersion-waveguide dispersion-polarization mode dispersion-intermodal dispersion-dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile- cutoff wave length-dispersion calculation-mode field diameter. **CO2**

UNIT III: OPTICAL SOURCES AND DETECTORS **9**

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort effect. Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors. **CO3**

UNIT IV: OPTICAL RECEIVER, MEASUREMENTS AND COUPLING **9**

Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit. Optical power measurement-attenuation measurement-dispersion measurement-Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing-Optical Fiber connectors. **CO4**

UNIT V: OPTICAL COMMUNICATION SYSTEMS AND NETWORKS **9**

System design consideration Point–to–Point link design–Link power budget–rise time budget, WDM–Passive DWDM Components-Erbium Doped Fiber Amplifier(EDFA)-Elements of optical networks-SONET/SDH-Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. P Chakrabarti, ‘Optical Fiber Communication’, McGraw Hill Education (India)Private Limited, 2016 (UNIT I, II, III)
2. Gred Keiser, ’Optical Fiber Communication’, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, IV, V)

REFERENCES:

1. John M.Senior, ‘Optical fiber communication’, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, ‘Optical Networks’, Second Edition, Elsevier, 2004.
3. J.Gower, ‘Optical Communication System’, Prentice Hall of India, 2001.
4. Govind P.Agrawal, ‘Fiber-optic communication systems’, Third edition, John Wiley & sons, 2004.

COURSE OUTCOMES

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

CO1 Realize basic elements in optical fibers, different modes and configurations.

CO2 Analyze the transmission characteristics associated with dispersion and polarization techniques.

CO3 Design optical sources and detectors with their use in optical communication system.

CO4 Construct fiber optic receiver systems, measurements and coupling techniques.

CO5 Design optical communication systems and its networks.

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

EC1703 **EMBEDDED SYSTEMS AND IOT**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

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

UNIT I: **INTRODUCTION TO EMBEDDEDSYSTEM DESIGN** **9**

Complex systems and microprocessors– Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques- Distributed embedded systems – MPSoCs and shared memory multiprocessors –Design example: Model train controller. **CO1**

UNIT II: **ARM ARCHITECTURE AND PERIPHERAL INTERFACING** **9**

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU **CO2**

UNIT III: **EMBEDDED PROGRAMMING AND OPERATING SYSTEM** **9**

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing-Introduction – Multiple tasks and Multiple processes – Multirate systems- Pre-emptive real-time operating systems- Priority based scheduling-Evaluating operating system performance – Example Real time operating systems-POSIX-Windows CE. **CO3**

UNIT IV: **INTRODUCTION TO IOT** **9**

Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT, Embedded Systems and M2M - Industry 4.0 concepts- Passive and active sensors - Different applications of sensors - Multi-sensors - Pre-processing - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring. **CO4**

UNIT V: COMMUNICATION PROTOCOLS FOR EMBEDDED AND IOT **9**

Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C), IoT Infrastructure - 6LowPAN - IPv6 - URIs, Communication/ Transport - Wi-Fi, Bluetooth, ZigBee, LPWAN. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

By the end of this course, the student should be able to:

CO1 Understand the Embedded System Design Process

CO2 Describe the architecture and programming of ARM processor

CO3 Outline the concepts of embedded system programming and operating system

CO4 Explain the basic concepts of IOT

CO5 Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

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

EC1704	AD HOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

UNIT I: AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS **9**

Introduction to Wireless Networks- Infrastructure and Infrastructure less networks, Key definitions of adhoc networks, advantages of ad-hoc network, Elements of Ad hoc Wireless Networks, unique constraints and challenges, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV). **CO1**

UNIT II: SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES **9**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit. **CO2**

UNIT III: WSN NETWORKING CONCEPTS AND PROTOCOLS **9**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol. **CO3**

UNIT IV: SENSOR NETWORK SECURITY **9**

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management. Reliability requirements in sensor networks. **CO4**

UNIT V: SENSOR NETWORK PLATFORMS AND TOOLS **9**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – nS2 and its extension to sensor networks, COOJA, TOSSIM, Case Study: Intelligent Traffic monitoring - Target detection and tracking - Contour/edge detection - Field sampling. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, —Ad Hoc Wireless Networks Architectures and Protocols, Prentice Hall, PTR, 2004. (UNIT I)
2. Holger Karl, Andreas willig, —Protocol and Architecture for Wireless Sensor Networks, John wiley publication, Jan 2006.(UNIT II-V)

REFERENCES:

1. Feng Zhao, Leonidas Guibas, —Wireless Sensor Networks: an information processing approach, Elsevier publication, 2004.
2. Charles E. Perkins, —Ad Hoc Networkingll, Addison Wesley, 2000.

COURSE OUTCOMES

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

CO1 Know the basics of Ad hoc networks and Wireless Sensor Networks

CO2 Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement

CO3 Apply the knowledge to identify appropriate physical and MAC layer protocols

CO4 Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CO5 Be familiar with the OS used in Wireless Sensor Networks and build basic modules

MAPPING OF COs WITH POs AND PSOs

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

EC1707	ADVANCED COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The student should be made to:

- Understand the working principle of optical sources, detector, fibers
- Develop understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand and capture an experimental approach to digital wireless communication
- Understand actual communication waveforms that will be sent and received across wireless Channel

LIST OF OPTICAL EXPERIMENTS

1. Measurement of bending and fiber attenuation losses.
2. Numerical Aperture calculation of Fiber.
3. DC Characteristics of LED and PIN Photo diode.

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios
4. OFDM Signal Transmission and Reception using Software Defined Radios

LIST OF MICROWAVE EXPERIMENTS

1. Reflex Klystron Characteristics
2. S matrix characterization of E, H and hybrid TEEs
3. Radiation Pattern Measurement of Horn Antenna
4. VSWR and Impedance Measurement
5. Characterization of Directional Couplers, Isolators, Circulators
6. Gunn Diode Characteristics
7. Microwave IC – Filter Characteristics

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	
1	Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter	2 Nos
2	Trainer kit for determining the mode characteristics, losses in optical fiber	2 Nos
3	Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope	2 Nos
4	Kit for measuring Numerical aperture and Attenuation of fiber	2 Nos
5	Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement, Pulse broadening.	2 Nos

6	MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors	2 sets
7	LEDs with ST / SC / E2000 receptacles – 650 / 850 nm	2 sets
8	PIN PDs with ST / SC / E2000 receptacles – 650 /850 nm	2 sets
9	Digital Communications Teaching Bundle (LabVIEW/MATLAB/Equivalent software tools)	10 Users
10	Transmit/receive pair of NI USRP-2920 transceivers (50 MHz to 2.2 GHz)	2 Nos

COURSE OUTCOMES

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

CO1 Analyze the performance of simple optical link by measurement of losses

CO2 Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER

CO3 Estimate the Wireless Channel Characteristics and Analyze the performance of Wireless Communication System

CO4 Test microwave and optical components. Understand the intricacies in Microwave System design.

CO5 Analyse the radiation of pattern of antenna.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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
CO2	3	3	-	3	3	-	-	-	-	-	-	2	3	2	3
CO3	3	3	-	3	3	-	-	-	-	-	-	3	3	2	3
CO4	3	2	-	3	3	-	-	-	-	-	2	3	3	2	3
CO5	3	3	-	2	3	-	-	-	-	-	-	3	3	2	3

EC1708	EMBEDDED LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The students should be made to:

- To learn the working of ARM processor
- To understand the Building Blocks of Embedded Systems
- To learn the concept of interfacing
- To write programs to interface I/O s with processor
- To Study the interrupt performance

LIST OF EXPERIMENTS

1. Study of ARM Evaluation system
2. Flashing of LEDS.
3. Interfacing LED and SWITCHES.
4. Interfacing ADC and DAC.
5. Interfacing stepper motor and temperature sensor.
6. Interfacing real time clock and serial port.
7. Interfacing PWM.
8. Interfacing keyboard and LCD.
9. Interfacing EPROM and interrupt
10. Interrupt performance characteristics of ARM and FPGA

Implementing zigbee protocol with ARM

TOTAL PERIODS: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS (3 students per batch)

1. Embedded trainer kits with ARM board 10Nos
2. Embedded trainer kits suitable for wireless communication 10Nos
3. Adequate quantities of Hardware, software and consumables

COURSE OUTCOMES

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

CO1 Write programs in ARM for a specific application

CO2 Write programs for interfacing keyboard, display, motor and sensor.

CO3 Interface A/D and D/A convertors with ARM system.

CO4 To analyze the performance of interrupt characteristics of ARM and FPGA and

CO5 To formulate a mini project using embedded system.

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

EC1001 **MEDICAL ELECTRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

UNIT I: ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING **9**

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics **CO1**

UNIT II: BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT **9**

PH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters. **CO2**

UNIT III: ASSIST DEVICES **9**

Cardiac Pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems. **CO3**

UNIT IV: PHYSICAL MEDICINE AND BIOTELEMETRY **9**

Diathermies- Shortwave, Ultrasonic and Microwave type and their applications, Surgical Diathermy, Biotelemetry. **CO4**

UNIT V: RECENT TRENDS IN MEDICAL INSTRUMENTATION **9**

Medical Information systems, Telemedicine, Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, IoT healthcare, Lab on a chip. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Leslie Cromwell, ―Biomedical Instrumentation and Measurement‖, Prentice Hall of India, New Delhi, 2007. (UNIT I – V)

REFERENCES:

1. Khandpur, R.S., ―Handbook of Biomedical Instrumentation‖, TATA Mc Graw-Hill, New Delhi, 2003.
2. John G.Webster, ―Medical Instrumentation Application and Design‖, 3rd Edition, Wiley IndiaEdition,2007
3. Joseph J.Carr and John M.Brown, ―Introduction to Biomedical Equipment Technology‖, John Wiley and Sons, New York,2004.

COURSE OUTCOMES

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

CO1 Know the human body electro-physiological parameters and recording of bio-potentials

CO2 Comprehend the non-electrical physiological parameters and their measurement body temperature, blood pressure, pulse, blood cell count, blood flow meter etc

CO3 Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators

CO4 Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods

CO5 Know about recent trends in medical instrumentation

MAPPING OF COs WITH POs AND PSOs

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

EC1002	DATA CONVERTERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To design MOS circuits applied for various building blocks of data conversion stages namely Anti aliasing filters, Quantization Noise
- To design D/A converters, sample and hold circuits
- To design CMOS realization of various comparator architecture and switched capacitor amplifiers
- To, study the various CMOS design considerations of ADC architectures used in practice including SAR, Pipeline, Flash ADCs
- To study the general design principles design sigma delta converters

UNIT I: INTRODUCTION **9**

Quantization noise, anti aliasing filters, gain and offset errors, definitions of INL and DNL, SNR, SFDR, ENOB of ADC/DACs, finite duration pulse aperture effects, transistor matching, Bandgap reference design. **CO1**

UNIT II: D/A CONVERTER DESIGN, SAMPLE AND HOLD CIRCUITS **9**

Current Steering DACs, current cell design issues. Properties of MOS Switches, charge injection, bootstrapping, sampling jitter, thermal noise, Quantization noise and nonlinearity effects. **CO2**

UNIT III: COMPARATOR DESIGN **9**

Comparator architectures, metastability and yield, Clock feed through effects, switched capacitor amplifiers and offset cancellation. **CO3**

UNIT IV: ADC/DAC ARCHITECTURES **9**

SAR, Flash, Pipeline and time interleaved ADC topologies and their CMOS realizations issues. Error correction procedures for ADCs. **CO4**

UNIT V: OVER SAMPLING CONVERTERS **9**

Delta sigma modulators, alternative modulator architectures, quantization and noise shaping, decimation filtering, implementation of Delta sigma modulators, delta sigma DACs **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Marcel Pelgrom, "Analog to Digital Conversion", Springer Verlag, 2nd Edition, 2013.
2. Shanthi Pavan, Richard Schreier, Gabor C. Temes, "Understanding Delta-Sigma Data Converters", Willey –IEEE Press, 2 nd Edition, 2017

REFERENCES:

1. Franco Malobreti "Data Converters", Springer Verlag, 2007
2. VLSI Data Conversion Circuits EE658 recorded lectures available at http://www.ee.iitm.ac.in/~nagendra/videolecture

COURSE OUTCOMES

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

CO1	To carry out the design of the various building blocks used in mixed signal (A/D and D/A converters) CMOS IC Design
CO2	To carry out the design of the D/A converter and sample and hold circuits
CO3	To carry out the design of the comparator circuits
CO4	To carry out the CMOS design of D/A and A/D converter architectures
CO5	To carry out the design of oversampling converters- Delta sigma modulators

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

EI1864 **ROBOTICS AND AUTOMATION**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

The student should be made:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I: BASIC CONCEPTS **9**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov's laws of robotics – dynamic stabilization of robots - Introduction about Robotic languages. **CO1**

UNIT II: POWER SOURCES, SENSORS AND ACTUATORS **9**

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors. **CO2**

UNIT III: MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION **9**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – various types of grippers – design considerations. **CO3**

UNIT IV: KINEMATICS AND PATH PLANNING **9**

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages **CO4**

UNIT V: DYNAMICS AND CONTROL APPLICATIONS **9**

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator. Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002

REFERENCES:

1. Deb. S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl. C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter. R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. R.K. Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
5. John.J.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
6. Issac Asimov, I Robot, Ballantine Books, New York, 1986.

COURSE OUTCOMES

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

CO1 Understand the evolution of robot technology and its applications.

CO2 Known the mathematical representation of different types of robots

CO3 Get exposed to the case studies and design of robot machine interface.

CO4 Familiarize various control schemes of Robotics control.

CO5 Known various robots applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1003	COMPRESSIVE SENSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To present the basic theory and ideas showing when it is possible to reconstruct sparse or nearly sparse signals from under sampled data
- To expose students to recent ideas in modern convex optimization allowing rapid signal recovery
- To give students a sense of real time applications that might benefit from compressive sensing ideas

UNIT I: INTRODUCTION TO COMPRESSED SENSING **9**

Introduction; Motivation; Mathematical Background; Traditional Sampling; Traditional Compression; Conventional Data Acquisition System; Drawbacks of Transform coding; Compressed Sensing (CS). **CO1**

UNIT II: SPARSITY AND SIGNAL RECOVERY **9**

Signal Representation; Basis vectors; Sensing matrices; Restricted Isometric Property; Coherence; Stable recovery; Number of measurements. **CO2**

UNIT III: RECOVERY ALGORITHMS **9**

Basis Pursuit algorithm: L1 minimization; Matching pursuit: Orthogonal Matching Pursuit(OMP), Stagewise OMP, Regularized OMP, Compressive Sampling Matching Pursuit (CoSaMP); Iterative Thresholding algorithm: Hard thresholding, Soft thresholding; Model based : Model based CoSaMP, Model based HIT. **CO3**

UNIT IV: COMPRESSIVE SENSING FOR WSN **9**

Basics of WSN; Wireless Sensor without Compressive Sensing; Wireless Sensor with Compressive Sensing; Compressive Wireless Sensing: Spatial compression in WSNs, Projections in WSNs, Compressed Sensing in WSNs. **CO4**

UNIT V: APPLICATIONS OF COMPRESSIVE SENSING **9**

Compressed Sensing for Real-Time Energy-Efficient Compression on Wireless Body Sensor Nodes; Compressive sensing in video surveillance; An Application of Compressive Sensing for Image Fusion; Single-Pixel Imaging via Compressive Sampling. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Radha S, Hemalatha R, Aasha Nandhini S, —Compressive Sensing for Wireless Communication: Challenges and Opportunities‖, River publication, 2016. (UNIT I-V)
2. Mark A. Davenport, Marco F. Duarte, Yonina C. Eldar and Gitta Kutyniok, —Introduction to Compressed Sensing,‖ in Compressed Sensing: Theory and Applications,
3. Y. Eldar and G.Kutyniok, eds., Cambridge University Press, 2011 (UNIT I)

REFERENCES:

1. Duarte, M.F.; Davenport, M.A.; Takhar, D.; Laska, J.N.; Ting Sun; Kelly, K.F.; Baraniuk, R.G.; "Single-Pixel Imaging via Compressive Sampling," Signal Processing Magazine, IEEE, vol.25, no.2, pp.83-91, March 2008.
2. Tao Wan.; Zengchang Qin.; — An application of compressive sensing for image fusion‖, CIVR '10 Proceedings of the ACM International Conference on Image and Video Retrieval, Pages 3-9.

3. H. Mamaghanian, N. Khaled, D. Atienza and P. Vandergheynst "Compressed sensing for real-time energy-efficient ecg compression on wireless body sensor nodes", IEEE Trans. Biomed. Eng., vol. 58, no. 9, pp.2456 -2466 2011.

COURSE OUTCOMES

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

CO1 Appreciate the motivation and the necessity for compressed sensing technology.

CO2 Familiar about the recent ideas in modern convex optimization allowing rapid signal recovery

CO3 Able to reconstruct sparse or nearly sparse signals from under sampled data

CO4 Able to extend wireless sensor network with and without compressive sensing

CO5 Design a new algorithm or modify an existing algorithm for different application areas in wireless sensor network.

MAPPING OF COs WITH POs AND PSOs

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

CS1303	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT I: JAVA FUNDAMENTALS **9**

Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and StringBuffer **CO1**

UNIT II: OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE **9**

Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes. **CO2**

UNIT III: EXCEPTIONS, COLLECTIONS AND STREAMS **9**

Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. **CO3**

UNIT IV: CONCURRENT PROGRAMMING AND GUI PROGRAMMING **9**

Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag. **CO4**

UNIT V: JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING **9**

Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang, “Introduction to Java programming”, 7th Edition, Pearson education, 2010.
3. C Xavier, “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

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

CO1 Understand the fundamental ideas behind the object-oriented approach to programming

CO2 To inculcate concepts of inheritance to create new classes from existing one & design the classes needed given a problem specification

CO3 Able to create the good application with proper Exception Handling Mechanisms.

CO4 A modern coverage of concurrent programming that focuses on high-level synchronization constructs and the concept of event handling used in GUI.

CO5 An in-depth exposure to the object-oriented programming paradigm, which builds upon programming experience gained in computer science classes.

MAPPING OF COs WITH POs AND PSOs

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

IT1811	INFORMATION THEORY AND CODING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand error–control coding.
- Understand encoding and decoding of digital data streams.
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- Be aware of compression and decompression techniques.
- Learn the concepts of multimedia communication.

UNIT I: INFORMATION THEORY **9**

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit. **CO1**

UNIT II: SOURCE CODING: TEXT, AUDIO AND SPEECH **9**

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding **CO2**

UNIT III: SOURCE CODING: IMAGE AND VIDEO **9**

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard **CO3**

UNIT IV: ERROR CONTROL CODING: BLOCK CODES **9**

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC **CO4**

UNIT V: ERROR CONTROL CODING: CONVOLUTIONAL CODES **9**

Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. R Bose, “Information Theory, Coding and Crptography”, TMH 2007
2. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002

REFERENCES:

1. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
2. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007
3. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

COURSE OUTCOMES

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

CO1 Design an application with error–control

CO2 Use compression and decompression techniques

CO3 Apply the concepts of multimedia communication

CO4 Apply the concepts of error control coding: block codes

CO5 Apply the concepts of error control coding: convolutional codes

MAPPING OF COs WITH POs AND PSOs

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

GE1002 **HUMAN RIGHTS** **L T P C**

3 0 0 3

OBJECTIVES:

- To sensitize the Engineering students to various aspects of Human Rights.
- To educate on the evolution of human rights movement.
- To create awareness and understanding on the international deliberations towards human rights.
- To educate on constitutional rights and provisions related to human rights in India.
- Create awareness on support organisations in Human Rights in India.

UNIT I: INTRODUCTION **9**

Human Rights- Meaning, origin and development; Notion and classification of Rights - Natural, Moral and Legal Rights, Civil and Political rights, economic, social and cultural rights, collective/ Solidarity rights. **CO1**

UNIT II: EVOLUTION OF HUMAN RIGHTS MOVEMENT **9**

Evolution of the concept of Human rights- Magana Carta, Geneva Convection of 1864, Universal Declaration of Human rights 1948;Theories of Human rights. **CO2**

UNIT III: INTERNATIONAL PRESPECTIVES **9**

Theories and perspective of UN Laws; UN Agencies to monitor and compliance. **CO3**

UNIT IV: HUMAN RIGHTS IN INDIA **9**

Human Rights in India; Constitutional Provisions/ Guarantees. **CO4**

UNIT V: HUMAN RIGHTS SUPPORT ORGANISATION **9**

Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disable persons, including aged and HIV infected people; Implementation of Human Rights - National and State Human Rights Commission; Judiciary; Role of NGO's, Media, Educational Institutions, Social Movements. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Kapoor S.K., “Human Rights under International law and Indian laws", Central law agency, Allahabad, 2014.
2. Chandra U., “Human Rights", Allahabad law agency, Allahabad, 2014.
3. Upendra Baxi, The future of Human Rights, Oxford University Press, New Delhi.

COURSE OUTCOMES

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

CO1 Understand the definition and types of human rights

CO2 Understand the evolution and theories of human rights

CO3 Understand the theories and perspectives of human rights

CO4 Know about human rights in India

CO5 Know about human rights of people of various classes and implementation of human rights

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	-	-	-	-	-
CO2	-	-	-	-	-	3	3	-	-	2	-	-	-	-	-
CO3	-	-	-	-	-	3	3	-	-	2	-	-	-	-	-
CO4	-	-	-	3	-	3	3	-	-	2	-	-	-	-	-
CO5	-	-	-	3	-	3	3	-	-	2	-	-	-	-	-

CE1025	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR).
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I: INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters. **CO1**

UNIT II: APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies. **CO2**

UNIT III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources. **CO3**

UNIT IV: DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. **CO4**

UNIT V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Singhal J.P. —Disaster Managementǁ, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN13: 978-9380386423
2. Tushar Bhattacharya, —Disaster Science and Managementǁ, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

COURSE OUTCOMES

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

CO1 Differentiate the types of disasters, causes and their impact on environment and society

CO2 Assess vulnerability and various methods of risk reduction measures as well as mitigation

CO3 Enhance awareness of institutional processes in the country

CO4 Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

CO5 Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

MAPPING OF COs WITH POs AND PSOs

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

MG1001	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the students to study the evolution of Management.
- To study the functions and principles of management.
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

UNIT I: INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur – Types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company – Public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management. **CO1**

UNIT II: PLANNING **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process. **CO2**

UNIT III: ORGANIZING **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management. **CO3**

UNIT IV: DIRECTING **9**

Foundations of individual and group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT. **CO4**

UNIT V: CONTROLLING **9**

System and process of controlling – Budgetary and non–budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India), Pvt. Ltd., 15th Edition, 2020.

REFERENCES:

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.

3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 6th Edition 2017.

COURSE OUTCOMES

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

CO1 Ability to understand the various terms and definitions related to management and organization.

CO2 Ability to acquire the skill of planning and various strategies of management in an organization.

CO3 Ability to understand the various hierarchies of management and also get an insight into an HR values in an organization management.

CO4 Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.

CO5 Ability to analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization.

MAPPING OF COs WITH POs AND PSOs

COs	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	-	-	-	-
CO2	2	3	-	-	-	3	-	-	-	-	2	-	-	-	-
CO3	-	-	3	-	-	3	-	-	-	2	2	-	-	-	-
CO4	-	-	-	3	-	3	3	-	-	2	3	-	-	-	-
CO5	-	-	-	3	2	3	-	-	-	2	3	2	-	-	-

EC1004	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the role and importance of an Artificial Heart Lung system
- To study various mechanical techniques that help a non-functioning heart
- To learn the functioning of the unit that clears urea from the blood
- To study about Ventilators and Hearing Aids
- To study about recent techniques used in modern clinical applications

UNIT I: HEART LUNG MACHINE AND ARTIFICIAL HEART **9**

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart. Case study. **CO1**

UNIT II: CARDIAC ASSIST DEVICES **9**

Assisted through Respiration, Right and left Ventricular Bypass Pump, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques. Case study. **CO2**

UNIT III: ARTIFICIAL KIDNEY **9**

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of haemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. **CO3**

UNIT IV: RESPIRATORY AND HEARING AIDS **9**

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction. **CO4**

UNIT V: RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, Classification of Visual Impairments, Prevention and cure of visual impairments, Haptic Devices **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2. John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCES:

1. Andreas.F. Von racum, “Hand book of bio material evaluation”, Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004.
3. D.S. Sunder, “Rehabilitation Medicine”, 3rd Edition, Jaypee Medical Publication, 2010

COURSE OUTCOMES

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

CO1 Explain the principles and construction of an artificial heart.

CO2 Understand various mechanical techniques that improve therapeutic technology.

CO3 Explain the functioning of a Dialyzer.

CO4 Describe tests to assess hearing loss and develop wearable devices for the same.

CO5 Analyze and research on electrical stimulation and Haptic Devices.

MAPPING OF COs WITH POs AND PSOs

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

CS1616 CRYPTOGRAPHY AND INFORMATION SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To define security attacks, services and mechanisms.
- To understand block ciphering techniques and number theory.
- To understand public-key cryptography and hash functions.
- To define cryptographic data integrity algorithms and mutual trust.
- To discuss various security practices and system security measures.

UNIT I: INTRODUCTION **9**

Computer Security Concepts – The OSI Security Architecture - Security Attacks, Services and Mechanisms - Model for network security – Classical Encryption Techniques: Substitution Techniques, Transposition Techniques, Steganography – Legal and Ethical Aspects. **CO1**

UNIT II: BLOCK CIPHERS & NUMBER THEORY **9**

Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm.

Number theory: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem. **CO2**

UNIT III: PUBLIC KEY CRYPTOGRAPHY & HASH FUNCTONS **9**

Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange- Elliptic curve arithmetic-Elliptic curve cryptography.

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC **CO3**

UNIT IV: DIGITAL SIGNATURES & SECURITY PRACTICE **9**

Digital signature and authentication protocols – DSS – Entity Authentication: Biometrics, Passwords, Challenge Response protocols- El Gamal – Schnorr – X.509 Certificates - User Authentication- Kerberos. **CO4**

UNIT V: E-MAIL, IP, WEB & SYSTEM SECURITY **9**

Electronic Mail security: PGP, S/MIME – IP security – Web Security: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS) – System Security: Intruders – Malicious software – viruses – Firewalls. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1 Describe the key security requirements of confidentiality, Integrity and availability.

CO2 Apply the different cryptographic operations of block ciphering techniques.

CO3 Examines of public key cryptosystem and hash functions.

CO4 Describe the various cryptographic data integrity algorithms and various aspects of key management and distribution.

CO5 Understand various network Security practices and System level security issues.

MAPPING OF COs WITH POs AND PSOs

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

EC1005	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the compression schemes for audio and voice
- To understand the compression schemes image and video
- To understand the compression schemes for text
- To understand the QoS issues in multimedia network
- To know the communication protocols for multimedia networking

UNIT I: AUDIO COMPRESSION **9**

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP) **CO1**

UNIT II: IMAGE AND VIDEO COMPRESSION **9**

Graphics Interchange format- Tagged image file format-Digitized documents- Digitized pictures-JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2. **CO2**

UNIT III: TEXT COMPRESSION **9**

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding **CO3**

UNIT IV: GUARANTEED SERVICE MODEL **9**

Best Effort service model – Network Performance Parameters – Quality of Service and metrics - Scheduling and Dropping policies – FQ and its variants – Random Early Detection – Admission Control – Resource Reservation – RSVP - Traffic Shaping Algorithms – An Overview of QoS Architectures- Intserv, Diffserv architectures **CO4**

UNIT V: MULTIMEDIA COMMUNICATION **9**

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, Media Synchronization – Models for Temporal Specifications – Streaming of Audio and Video – Jitter removal – Fixed playout and Adaptive playout – Recovery from packet loss – RTSP– Multimedia Communication Standards – RTP/RTCP – SIP and H.323 **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Fred Halsall, —Multimedia communication- Applications, Networks, Protocols and Standards‖, Pearson education, 2007.

REFERENCES:

1. Tay Vaughan, —Multimedia Making it work, McGraw-Hill Osborne Media, 2006.
2. Kurose and W. Ross, —Computer Networking —A Top Down Approach, Pearson education 3rd ed, 2005.
3. KR. Rao,Z S Bojkovic, D A Milovanovic, —Multimedia Communication Systems: Techniques, Standards, and Networks, Pearson Education 2007
4. R. Steimnetz, K. Nahrstedt, —Multimedia Computing, Communications and Applications,Pearson Education, First ed, 1995.
5. Nalin K Sharda, Multimedia Information Networking‘, Prentice Hall of India, 1999
6. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, Multimedia Wireless Networks: Technologies, Standards and QoS‘, Prentice Hall, 2003.

COURSE OUTCOMES

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

CO1 Design audio compression techniques

CO2 Configure image and video compression techniques

CO3 Design text compression techniques

CO4 Select suitable service model for specific application

CO5 Configure multimedia communication network

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

EC1006 **WIRELESS NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

UNIT I: WIRELESS LAN **9**

Introduction-WLAN technologies - IEEE802.11- System architecture- protocol architecture- 802.11b, 802.11a – Hiper LAN: WATM, BRAN- HiperLAN2 – Bluetooth: Architecture - WPAN – IEEE 802.15.4 - Wireless USB, Zigbee, 6LoWPAN - Wireless HART **CO1**

UNIT II: MOBILE NETWORK LAYER **9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP **CO2**

UNIT III: 3G OVERVIEW **9**

Overview of Terrestrial Radio access network-UMTS Core network Architecture: UMTS, 3GPP, Architecture, User equipment, CDMA2000 - Overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA. **CO3**

UNIT IV: 4G NETWORKS **9**

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO. **CO4**

UNIT V: 5G NETWORKS **9**

Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, Ultra-Dense Network Architecture and Technologies for 5G-Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM)-Principles, Transceiver Block diagram-MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, —Wireless Communications and networking‖, First Edition, Elsevier 2007.(Unit-IV)
3. Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.(Unit V)

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, —Wireless Networking, First Edition, Elsevier 2011.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016
4. Saad Z Asif, “5G Mobile Communication,Concepts and Challenges", CRC Press
5. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018.

COURSE OUTCOMES

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

CO1 Know the basics of Ad hoc networks and Wireless Sensor Networks

CO2 Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement

CO3 Apply the knowledge to identify appropriate physical and MAC layer protocols

CO4 Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CO5 Be familiar with the OS used in Wireless Sensor Networks and build basic modules

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM 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	2	-	-	-	2	3	1	3	2	2
CO2	3	3	3	3	2	2	1	-	-	2	3	1	3	2	2
CO3	3	3	3	3	2	2	-	-	-	2	3	1	3	2	2
CO4	3	3	3	3	2	2	1	1	-	3	3	2	3	3	3
CO5	3	3	3	3	3	2	1	1	-	3	3	2	3	3	3

EC1007 **ARRAY SIGNAL PROCESSING** **L T P C**

3 0 0 3

OBJECTIVES:

- To know the basics of antenna array fundamentals and principles of the random process.
- To understand the spatial sampling and different types of sensor arrays.
- To understand the spatial domain frequency representation, analysis and processing.
- To understand the various statistical techniques for signal parameter estimation.
- To study different applications of the Array signal processing.

UNIT I: ARRAY PROCESSING FUNDAMENTALS **9**

Antenna parameters, Basic Antenna elements, Array Fundamentals - Element pattern, Directivity, Power Gain, Polarization, Array pattern, Array gain, Effective array aperture, Random process - Autocorrelation and power spectral density - properties, Noise in communication. **CO1**

UNIT II: SPATIAL SIGNALS AND SENSOR ARRAYS **9**

Signals in space and time, Spatial frequency, Direction vs. frequency, Wave fields, Far-field and Near-field signals, Spatial sampling, Nyquist criterion, Sensor arrays - Uniform linear arrays, planar and random arrays, Array transfer (steering) vector, Array steering vector for ULA, Broadband arrays. **CO2**

UNIT III: SPATIAL FREQUENCY **9**

Aliasing in the spatial frequency domain, Spatial Frequency Transform, Spatial spectrum, Spatial Domain Filtering, Beamforming, Spatially white signal. **CO3**

UNIT IV: DIRECTION OF ARRIVAL ESTIMATION **9**

Array correlation matrix, Non-parametric methods - Beamforming and Capon methods, Resolution of Beamforming method, Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques, Spatial Smoothing. **CO4**

UNIT V: APPLICATIONS OF ARRAY SIGNAL PROCESSING **9**

RADAR, Sonar, Seismic, Acoustics, Wireless Communications and networks and Radio Astronomy signal processing applications. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dan E. Dudgeon and Don H. Johnson, “Array Signal Processing: Concepts and Techniques”, Prentice-Hall, 1993 (UNIT II, III and V)
2. Frank Gross, “Smart Antennas for Wireless Communication with MATLAB”, New York: McGraw Hill, 2005 (UNIT I and IV)

REFERENCES:

1. Simon Haykin and K. J. Ray Liu, “Handbook of Array Signal Processing and Sensor Networks”, Wiley, 2009.
2. Harry L. Van Trees, “Optimum Array Processing: Part IV of Detection, Estimation, and Modulation Theory”, Wiley, 2002.
3. Prabhakar S. Naidu, “Sensor Array Signal Processing”, CRC Press, 2nd edition, 2009.

COURSE OUTCOMES

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

CO1 Able to understand the principle of spatial sampling and spatial aliasing in array signal processing.

CO2 Able to design sensor array-based signal acquisition systems.

CO3 Able to analyze the sensor array signals in the spatial domain.

CO4 Able to develop signal parameter estimation and beamforming methods.

CO5 Able to know about the widespread applications of array signal processing.

MAPPING OF COs WITH POs AND PSOs

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

EC1008	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-resolution analysis

UNIT I: DISCRETE- RANDOM PROCESSES **9**

Random variables - ensemble averages a review, random processes – ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA. **CO1**

UNIT II: SPECTRUM ESTIMATION **9**

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion. **CO2**

UNIT III: OPTIMUM FILTERS **9**

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter. **CO3**

UNIT IV: ADAPTIVE FILTERS **9**

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization. **CO4**

UNIT V: MULTI RESOLUTION ANALYSIS **9**

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008. (UNIT I-IV)
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993 (UNIT V)

REFERENCES:

1. John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applicationsll, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

COURSE OUTCOMES

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

CO1 Articulate and apply the concepts of special random processes in practical applications

CO2 Choose appropriate spectrum estimation techniques for a given random process

CO3 Apply optimum filters appropriately for a given communication application

CO4 Apply appropriate adaptive algorithm for processing non-stationary signals

CO5 Apply and analyse wavelet transforms for signal and image processing based applications

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

EC1009 **MEMS AND NEMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the concepts of micro and nano electromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To introduce the concepts of quantum mechanics and nano systems.

UNIT I: INTRODUCTION TO MEMS AND NEMS **9**

New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals. **CO1**

UNIT II: MEMS FABRICATION TECHNOLOGIES **9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA. **CO2**

UNIT III: MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressuresensors, Case study: Piezoelectric energy harvester **CO3**

UNIT IV: MICRO ACTUATORS **9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study:RF Switch. **CO4**

UNIT V: NANO DEVICES **9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Marc Madou, — Fundamentals of Microfabrication, CRC press 1997.
2. Stephen D. Senturia, Micro system Design, Kluwer Academic Publishers,2001.

REFERENCES:

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture,Tata Mcraw Hill, 2002.
2. Chang Liu, —Foundations of MEMSǁ, Pearson education India limited, 2006,
3. Sergey Edward Lyshevski, —MEMS and NEMS: Systems, Devices, and Structuresǁ CRC Press, 2002.

COURSE OUTCOMES

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

CO1 Ability to understand the operation of micro devices, micro systems and their applications.

CO2 Ability to design the micro devices, micro systems using the MEMS fabrication process.

CO3 Gain knowledge of basic approaches for various sensor designs.

CO4 Gain knowledge of basic approaches for various actuator designs.

CO5 Develop experience on micro/nano systems for photonics.

MAPPING OF COs WITH POs AND PSOs

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

EC1010	OPTOELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To review basic semiconductor theory.
- To introduce the concepts ofLED.
- To teach the principle of stimulated emission and devices based on it.
- To equip the student with the knowledge of Photovoltaics and display devices.
- To introduce the knowledge of optolectronic modulators.

UNIT I: SEMICONDUCTOR THEORY **9**

Basic quantum mechanics, semiconductor statistics, carrier transport, optical processes, and junction theory, Properties of simple and compound semiconductors, Optical absorption, Optical recombination, Recombination and carrier lifetime. **CO1**

UNIT II: LIGHT EMITTING DIODES **9**

Energy Bands. Direct and Indirect Bandgap Semiconductors: E-k Diagrams. pn Junction Principles. The pn Junction Band Diagram. Light Emitting Diodes. LED Materials. Heterojunction High Intensity LEDs. LED Characteristics. LEDs for Optical Fiber Communications, White LED for display and lighting applications. **CO2**

UNIT III: STIMULATED EMISSION DEVICES **9**

Stimulated Emission and Photon Amplification. Stimulated Emission Rate and Einstein Coefficients. Optical Fiber Amplifiers. LASER Oscillation Conditions. Principle of the Laser Diode. Heterostructure Laser Diodes. Rate Equation- Characteristics. Light Emitters for Optical Fiber Communications. Quantum Well and Quantum dot Devices. Vertical Cavity Surface Emitting Lasers (VCSELs). Optical Laser Amplifiers. **CO3**

UNIT IV: PHOTOVOLTAICS AND DISPLAY DEVICES **9**

Photovoltaic Device Principles. pn Junction Photovoltaic I-V Characteristics. Solar Cells Materials, Devices and Efficiencies. Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Liquid crystal displays, Reflective and Trans reflective types, TFT displays, Plasma displays, LED TV. **CO4**

UNIT V: POLARIZATION AND MODULATION OF LIGHT **9**

Polarization. Light Propagation in an Anisotropic Medium: Birefringence. Electro-Optic Effects. Acousto-Optic Modulator. Magneto-Optic Effects. Integrated Optical Modulators Electro- absorption modulators. Non-Linear Optics and Second Harmonic Generation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. S. O. Kasap, "Optoelectronics and Photonics: Principles and Practices", Pearson,2013.
2. Michael Parker, "Physics of optoelectronics", CRC press,2018.

REFERENCES:

1. P. N. Prasad, "Nanophotonics", John Wiley & Sons,2004.
2. Deng-Ke Yang, Shin Tson Wu, "Fundamentals of Liquid Crystal Devices", Revised edition, John Wiley and sons,2015.
3. Saleh and Teich, "Fundamentals of Photonics", Wiley Interscience, 2nd Edition, 2013.
4. J. Singh, "Electronic and Optoelectronic Properties of Semiconductor Structures Cambridge university press, 2007.

COURSE OUTCOMES

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

CO1 Understand various kinds of semiconductor materials used in optoelectronics

CO2 Understand the mechanisms of light absorption and emission in p-n junctions

CO3 Understand the principles of stimulated emission devices.

CO4 Understand about various photo voltaics and display devices.

CO5 Understand the process and use of polarization and modulation of light.

MAPPING OF COs WITH POs AND PSOs

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

EC1011 **CMOS ANALOG IC DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

- To study the fundamentals of analog circuits and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation,
- Capacitor switches and PLLs

UNIT I: INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS **9**

Concepts of Analog Design-General consideration of MOS devices–MOS I/V Characteristics–Second order effects – OS device models. Basic current mirrors, Cascode current mirrors- Active current mirrors- Large and Small signal analysis-Common mode properties. **CO1**

UNIT II: AMPLIFIERS AND FEEDBACK **9**

Basic Concepts–Common source stage-Source follower-Common gate stage-Cascode stage. Single ended and differential operation-Basic Differential pair-Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading-Effect of feedback on Noise. **CO2**

UNIT III: FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE **9**

General considerations-Miller Effect and Association of Poles with Nodes, Common source stage-Source followers-Common gate stage-Cascode stage-Differential pair. Noise-Statistical characteristics of noise- Types of noise-Representation of noise in circuits-Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth. **CO3**

UNIT IV: OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION **9**

General Considerations-One and Two Stage Op Amps-Gain Boosting-Comparison-Common mode feedback-Input range limitations-Slew rate-Power Supply Rejection-Noise in Op Amps- General consideration of stability and frequency compensation-Multi pole system-Phase margin- Frequency compensation-Compensation of two stage op Amps- Other compensation techniques. **CO4**

UNIT V: SWITCHED CAPACITOR CIRCUITSAND PLLS **9**

General Considerations- Sampling switches-Switched Capacitor Amplifiers-Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL-Charge pump PLLs- Non ideal Effects in PLLs- Delay locked loops- its Applications. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Behzad Razavi,-Design of Analog CMOS Integrated Circuits ǁ,Tata Mc Graw Hill, 2001,33rd re-print,2016.

REFERENCES:

1. PhillipAllenandDouglasHolmberg-CMOSAnalogCircuitDesignǁSecondEdition,Oxford University Press,2004.
2. PaulR.Gray,PaulJ.Hurst,StephenH.Lewis,RobertG.Meyer,AnalysisandDesignof Analog IntegratedCircuits,5th Edition,Wiley,2009
3. Grebene,-Bipolar and MOS Analog Integrated circuit design, John Wiley & sons, Inc., 2003

COURSE OUTCOMES

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

CO1 Realize the concepts of Analog MOS devices and current mirror circuits.

CO2 Design different configuration of Amplifiers and feedback circuits.

CO3 Analyze the characteristics of frequency response of the amplifier and its noise.

CO4 Analyze the performance of the stability and frequency compensation techniques of Op- Amp Circuits.

CO5 Construct switched capacitor circuits and PLLs

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

EC1012 **MIXED SIGNAL IC DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLL

UNIT I: SUBMICRON CMOS CIRCUIT DESIGN **9**

Introduction to analog VLSI and mixed signal issues in CMOS technologies MOS transistor. Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise. **CO1**

UNIT II: INTEGRATOR BASED CMOS FILTERS **9**

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, g_m- C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping. **CO2**

UNIT III: DATA CONVERTER ARCHITECTURES **9**

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Multi-stage flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC. **CO3**

UNIT IV: DATA CONVERTER MODELING AND SNR **9**

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR. **CO4**

UNIT V: SPECIALIZED IC'S AND PLL **9**

Specialized IC's: 555 Timer-Monostable, multivibrator, astable multivibratorLC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. D. A. Johns and K. Martin, Analog Integrated Circuit Design, Wiley Student Edition, 2002.
2. P. R. Gray and R. G. Meyer, Analysis and design of Analog Integrated circuits 4th Edition,Wiley Student Edition, 2001.

REFERENCES:

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.
3. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33rd Re- print, 2016.

COURSE OUTCOMES

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

CO1 Apply the concepts for mixed signal MOS circuit

CO2 Analyze the characteristics of IC based CMOS filters.

CO3 Design of various data converter architecture circuits.

CO4 Analyze the signal to noise ratio and modeling of mixed signals.

CO5 Design of oscillators and phase lock loop circuit.

MAPPING OF COs WITH POs AND PSOs

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

EC1013	LOW POWER VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand physics of power dissipation in an IC.
- Understand various power optimization techniques for computing circuits.
- Identify suitable techniques to reduce the power dissipation and design memory circuits with low power dissipation.
- Understand power analysis and power estimation methods.
- Understand concepts of synthesis and software design for low power.

UNIT I: POWER DISSIPATION IN CMOS **9**

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design. **CO1**

UNIT II: POWER OPTIMIZATION **9**

Logic level power optimization – Circuit level low power design – Standard Adder Cells, CMOS Adders Architectures-BiCMOS adders - Low Voltage Low Power Design Techniques, Current Mode Adders -Types of Multiplier Architectures, Braun, Booth and Wallace Tree Multipliers and their performance comparison. **CO2**

UNIT III: DESIGN OF LOW POWER CMOS CIRCUITS **9**

Computer arithmetic techniques for low power system – low voltage low power static Random access and dynamic Random access memories – low power clock, Inter connect and layout design – Advanced techniques – Special techniques. **CO3**

UNIT IV: POWER ESTIMATION **9**

Power Estimation techniques – logic power estimation – Simulation power analysis –Probabilistic power analysis. **CO4**

UNIT V: SYNTHESIS AND SOFTWARE DESIGN FOR LOW POWER **9**

Synthesis for low power – Behavioural level transform – software design for low power. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.
2. Gary Yeap, “Practical low power digital VLSI design”, Kluwer, 1998.

REFERENCES:

1. Abdelatif Belaouar, Mohamed. I. Elmasry, “Low power digital VLSI design”, Kluwer, 1995.
2. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995.
3. DimitriosSoudris, C.Pignet, Costas Goutis,“Designing CMOS Circuits for Low Power”Kluwer, 2002.
4. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001.
5. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999.
6. Kiat-send Yeo, Kaushik Roy “Low-Voltage, Low-power VLSI Subsystem”, Tata McGraw-Hill, 2009

COURSE OUTCOMES

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

CO1 Identify sources of power consumption in VLSI circuits

CO2 Design power optimized computing circuits.

CO3 Use suitable techniques to reduce the power dissipation and design memory circuits with low power dissipation.

CO4 Analyze and estimate power in VLSI circuits

CO5 Synthesize VLSI circuits and develop software code for low power consumption.

MAPPING OF COs WITH POs AND PSOs

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

EC1040 **Advanced Real-Time Operating Systems**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the architecture and design principles of the QNX Neutrino Real-Time Operating System.
- To explore process, thread, and synchronization mechanisms in QNX.
- To study various inter-process communication (IPC) techniques and their implementation.
- To perform hardware programming, timing, and interrupt handling concepts in QNX.
- To gain hands-on experience in building, configuring, and deploying QNX boot/OS images.

UNIT I: INTRODUCTION TO QNX OS ARCHITECTURE **9**

Overview of QNX OS Architecture – Microkernel structure, Process Manager, POSIX standards compliance – Protected address spaces – Process and Thread model – Scheduling policies and priorities – Introduction to Inter-Process Communication (IPC) and Synchronization – Resource Managers and Shared Objects. **CO1**

UNIT II: PROCESSES, THREADS AND SYNCHRONIZATION **9**

Process Management – Creation, Termination, and Memory Protection – Thread Management – Creation, Termination, and Synchronization – Synchronization Techniques: Mutexes, Semaphores, and Condition Variables – **Hands-on Exercises:** Process and Thread creation, synchronization using mutex and condition variables. **CO2**

UNIT III: INTER-PROCESS COMMUNICATION **9**

Overview of IPC Methods in QNX – Message Passing, Pulses, and Shared Memory – Comparison of IPC Methods: Advantages and Limitations – Practical Implementation of IPC Mechanisms in QNX – **Hands-on Exercises:** Message Passing and Shared Memory communication between processes. **CO3**

UNIT IV: HARDWARE PROGRAMMING AND TIMING 9

Hardware Access Methods – IO-mapped and Memory-mapped IO – Interrupt Handling and DMA-safe Memory Allocation – QNX Timing Architecture – Periodic and One-shot Timers, Timeouts, and Delays – **Hands-on Exercises:** Interrupt Handling and Timer Mechanism implementation. **CO4**

UNIT V: BUILDING AND CONFIGURING QNX BOOT/OS IMAGES 9

Overview of QNX Boot and OS Image Structure – Components of a Boot Image: Startup Code, Kernel, Drivers, and Initialization Scripts – Steps in Building and Loading Boot Images onto Target Hardware – Introduction to Resource Managers – Developing and Configuring Resource Managers for Device Control. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. QNX Software Systems Ltd., *QNX Neutrino RTOS Programmer's Guide*, QNX Software Systems, 2019.
2. Raj Kamal, *Embedded Systems: Architecture, Programming and Design*, Tata McGraw Hill, 2020.

REFERENCES:

1. QNX Neutrino System Architecture Guide, QNX Software Systems.
2. Burns, A. and Wellings, A., *Real-Time Systems and Programming Languages*, Pearson Education, 2018.
3. Tanenbaum, A. S. and Woodhull, A. S., *Operating Systems: Design and Implementation*, Pearson, 2017.

COURSE OUTCOMES

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

CO1 Explain the architecture and design principles of the QNX microkernel-based operating system.

CO2 Demonstrate process and thread creation, management, and synchronization mechanisms.

CO3 Implement various IPC mechanisms such as message passing, pulses, and shared memory.

CO4 Develop basic hardware interfacing programs using interrupts and timing functions.

CO5 Build and configure customized QNX boot images and resource managers for target devices.

MAPPING OF COs WITH POs AND PSOs

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

CO4	3	2	3	3	3	2	1	1	–	2	2	3	3	2	3
CO5	3	3	3	3	3	2	2	1	1	2	3	3	3	3	3

EC1014 **SPACE TIME MIMO WIRELESS COMMUNICATION**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To acquire the knowledge on various modulation and coding schemes for space-time wireless communications.
- To understand the capacity of multiple antenna channels in wireless communications.
- To understand the concept of spatial diversity in wireless communications.
- To understand transmission and decoding techniques associated with wirelesscommunications.
- To understand the combination of multi-user system and multiple-antenna techniques.

UNIT I: **MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION** **9**

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Antenna array topology, Degenerate channels, reciprocity and itsimplications, Channel definitions, Physical scattering model, Fading measurements, ST multiuser and ST interference channels, ST channel estimation. **CO1**

UNIT II: **CAPACITY OF MULTIPLE ANTENNA CHANNELS** **9**

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of ricean fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels. **CO2**

UNIT III: **SPATIAL DIVERSITY** **9**

Diversity gain, Receive antenna diversity, Transmit antenna diversity, Diversity order and channel variability, space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel. **CO3**

UNIT IV: **MULTIPLE ANTENNA CODING AND RECEIVERS** **9**

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Iterative MIMO receivers, exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre- filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge. **CO4**

UNIT V: **ST OFDM AND MIMO MULTIUSER DETECTION** **9**

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO OFDM, MIMO MAC, MIMO- BC, Performance of MIMO-MU, MIMO-MU with OFDM. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. A. Paulraj, Rohit Nabar, Dhananjay Gore., “Introduction to Space Time Wireless Communication

Systems", Cambridge University Press, 2003.
2. Sergio Verdu, "Multi User Detection", Cambridge University Press, 2011.

REFERENCES:

1. Don Tarrieri, "Principles of Spread Spectrum Communication Systems", Springer, Third edition, 2015.

COURSE OUTCOMES

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

CO1 To be able to design and analyze the channel characterization.

CO2 To be able to calculate capacity of MIMO systems.

CO3 To be able to design and analyze the order diversity and channel variability.

CO4 To be able to analyze the multiple antenna coding and receivers.

CO5 To be able to analyze the MIMO multi user detection.

MAPPING OF COs WITH POs AND PSOs

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

EC1015 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand basic concepts of Electromagnetic Interference and Compatibility
- To learn Coupling mechanism
- To design and study the different methods used to prevent interference.
- To teach the importance of Electromagnetic Compatible designs
- To explain the existing standards for Electromagnetic Compatibility

UNIT I: EMI/EMC CONCEPTS **9**

EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans. **CO1**

UNIT II: EMI COUPLING PRINCIPLES **9**

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling; Field to cable coupling; Power mains and Power supply coupling; Transient EMI, ESD. **CO2**

UNIT III: EMI CONTROL **9**

Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables. **CO3**

UNIT IV: EMC DESIGN FOR CIRCUITS AND PCBS **9**

Noise from Relays and Switches; Nonlinearities in Circuits; Cross talk in transmission line and cross talk control; Component selection and mounting; PCB trace impedance; Routing; Power distribution decoupling; Zoning; Grounding; VIAs; Terminations. **CO4**

UNIT V: EMI MEASUREMENTS AND STANDARDS **9**

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Line impedance stabilization networks; EMI Rx and spectrum analyzer; Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. V.P.Kodali, —Engineering EMC Principles, Measurements and Technologies, IEEE Press, Newyork, 1996.
2. Henry W.Ott., Noise Reduction Techniques in Electronic Systems, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.

REFERENCES:

1. C.R.Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, Inc, 1992.
2. Bemhard Keiser, —Principles of Electromagnetic Compatibility, 3rd Ed, Artech house, Norwood, 1986.
3. Don R. J.White Consultant Incorporate, —Handbook of EMI/EMC, Vol I-V, 1988.

COURSE OUTCOMES

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

CO1 Identify the various types and mechanisms of Electromagnetic Interference
CO2 Study the different methods by which interference can occur.
CO3 Propose a suitable EMI mitigation technique
CO4 Learn the importance of Electromagnetic Compatible designs
CO5 Describe the various EMC Standards and methods to measure them

MAPPING OF COs WITH POs AND PSOs

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

CO2	3	2	-	-	-	2	2	-	-	-	-	1	2	-	-
CO3	2	2	3	2	2	2	3	-	-	-	-	1	3	2	2
CO4	2	-	3	1	2	3	3	2	-	-	-	1	3	2	2
CO5	2	2	2	1	3	2	2	3	-	-	-	1	2	2	2

CS1729 **INTRODUCTION TO OPERATING SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

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

UNIT I: OPERATING SYSTEM OVERVIEW **9**

Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot. **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: MEMORY MANAGEMENT **9**

Basic Memory Management, Physical address map, Contiguous Memory allocation, Fixed and variable partition, Internal and External fragmentation and Compaction, Paging - Page allocation, Protection and sharing, Disadvantages of paging. Virtual Memory, Locality of reference, Page fault, Working Set, Dirty page/Dirty bit, Demand paging, Page Replacement policies **CO3**

UNIT IV: FILE AND I/O MANAGEMENT **9**

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance. **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 - **CO5**

iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

Upon completion of the course, the 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	-	2	2	-	-	-	-	-	-	1	3	2	-
CO2	3	3	-	2	-	-	-	-	-	-	-	1	2	2	-
CO3	3	2	2	2	2	-	-	-	-	-	-	1	3	2	2
CO4	3	2	2	2	2	-	-	-	-	-	-	1	3	2	2
CO5	2	2	3	2	3	2	-	-	2	2	2	2	3	3	3

EC1016	UNDERWATER ACOUSTICS SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the characteristics of Underwater Channel
- To understand the principles of SONAR
- To understand the challenges in underwater signal processing

UNIT I: UNDERWATER ACOUSTIC CHANNEL **9**

Underwater Channel Characterization – Sound Transmission Losses-Acoustic Characteristics of surface layer-Ambient Noise in the ocean- Correlation properties of Ambient Noise. **CO1**

UNIT II: SONAR **9**

Basics of SONAR- correlation and ambiguities-Wideband Synthetic Aperture SONAR processing-Discrete Spatial arrays-Beam stearing- Target Angle Estimation –Array Shading: **CO2**

UNIT III: TARGET DETECTION **9**

Passive Acoustic signatures of Ships and Submarines-Target strength for Active Systems Hypothesis testing- receiver operating Characteristics-estimation of signal Parameters. **CO3**

UNIT IV: STATISTICAL PROCESSING & ADAPTIVE SPATIAL FILTERING **9**

Monostatic Sounding of Single point Targets-Target strength estimation from Echo ensemble Optimum Filter for Maximum SNR-High Resolution Beam Forming. **CO4**

UNIT V: UNDERWATER ACOUSTIC COMMUNICATION **9**

Underwater Bio Telemetry System -system Design principle-Speech Coding and Decoding Transmission and Detection of speech. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. Robert S.H. Istepanian and MilicaStojanovic, Underwater Acoustic Digital signal processing & communication system, Kluwer academic Publisher, 2002
2. William S. Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.

COURSE OUTCOMES

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

CO1 Able to analyze the characteristics of underwater acoustic channel

CO2 Analyze the characteristics of SONAR processing

CO3 To be able to analyze the performance of underwater signal processing systems

CO4 Able to analyze and estimate the target strength using statistical means

CO5 Able to design underwater signal processing systems

MAPPING OF COs WITH POs AND PSOs		
COs	**PROGRAM 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	3	2	2
CO2	3	3	-	3	2	-	-	-	-	-	-	1	3	2	2
CO3	3	3	-	3	3	-	-	-	-	-	-	1	3	2	2
CO4	3	3	-	3	2	-	-	-	-	-	-	1	3	2	2
CO5	3	3	3	3	3	-	-	-	-	2	2	2	3	3	3

EC1017 **ADVANCED WIRELESS COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

- Understand the principles and challenges of modern wireless communication including MIMO, SDR, CR, and secure network design
- Analyze PHY and MAC layer enhancements in Wi-Fi networks, including fast roaming and secure access mechanisms
- Design secure and efficient wireless systems using cognitive and software-defined radio approaches

UNIT I: REVIEW OF WIRELESS COMMUNICATION FUNDAMENTALS **9**

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification- channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements. **CO1**

UNIT II: ADVANCED WiFi PHYSICAL AND MAC LAYERS **9**

Evolution of Wi-Fi: Generations, IEEE 802.11 Standards - Wi-Fi Topologies - Frequency Allocation, Bandwidth, Channelization - Digital Modulation, Coding - WiFi PHY Enhancements: WiFi6/6E, MAC Framing and Operations: Beaconing, BSSID, Scanning, Frame Types - Medium Access: Carrier Sensing (Physical/Virtual), DCF, EDCA, Aggregation, Rate Adaptation - Advanced Roaming: 802.11k/v/r, Fast Roaming, DFS. **CO2**

UNIT III: SOFTWARE DEFINED RADIO **9**

software radio architecture evolution – foundations, definitions and potential benefits technology tradeoffs and architecture implications - essential functions of the software radio, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules. **CO3**

UNIT IV: COGNITIVE RADIO ARCHITECTURE **9**

Marking radio self-aware, the cognition cycle, organization of congnition tasks, primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing. **CO4**

UNIT V: SMART AND SECURE WIRELESS NETWORKS **9**

Energy-efficient wireless network design – Spectrum and load-aware network planning – Secure wireless access frameworks: RADIUS, EAP methods, PMF – Wi-Fi to Cellular Handover using EAP-SIM/AKA – OpenRoaming and seamless connectivity – Captive Portals and Authentication in Public Networks – Integration of secure access in energy-conscious architectures. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005
2. Bellalta, Boris, et al. "Next generation IEEE 802.11 Wireless Local Area Networks: Current status, future directions and open challenges." *Computer Communications* 75 (2016): 1-25.
3. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, “Cognitive Radio Communications And Networks - Principles And Practice”, Elsevier Inc. , 2010.
4. J. Mitola, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
5. Edney, Jon, and William A. Arbaugh. *Real 802.11 security: Wi-Fi protected access and 802.11 i*. Addison-Wesley Professional, 2004.

COURSE OUTCOMES

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

CO1 Understand wireless propagation phenomena, channel impairments, and model various wireless channel conditions including 5G.

CO2 Analyze Wi-Fi standards, physical and MAC layer operations, and advanced roaming mechanisms for modern WLAN systems.

CO3 Describe the architecture, programmability, and functional components of software-defined radios and their advantages.

CO4 Develop understanding of cognitive radio principles, knowledge representation, and dynamic spectrum access strategies.

CO5 Design efficient and secure wireless networks using modern authentication methods, seamless handover, and energy-aware planning.

MAPPING OF COs WITH POs AND PSOs

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

EC1018	UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental components of optical imaging
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of underwater signal processing
- To Learn the SONAR systems and various applications

UNIT I: FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM **9**

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera: Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle. Image File format: JPEG, PNG, TIFF, BMP, GIF. **CO1**

UNIT II: OPTICAL IMAGE PROCESSING **9**

Light Propagation in the Water medium and Image Formation, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Defogging, Color Correction, Morphology, Image segmentation, Pattern Recognition Challenges involved in underwater optical imaging, Underwater Image Datasets. **CO2**

UNIT III: FUNDAMENTALS OF UNDERWATER ACOUSTICS **9**

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems. **CO3**

UNIT IV: SONAR SIGNAL PROCESSING **9**

Spatial Signals-Signals in space and time, Co-ordinate systems, propagating waves, Wave number-frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, transmitting signals, Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion. **CO4**

UNIT V: DIFFERENT TYPES OF SONAR SYSTEMS **9**

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, forward looking sonar. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bernd Jahne, “Digital Image processing, Sixth Edition, Springer, 2005
2. William S Burdic, Underwater Acoustic Systems, Prentice Hall Inc., 2002.

REFERENCES:

1. Tinku&Ajoy K. Ray,"Image Processing principles & Applications, First Edition, WileyInterscience,2005
2. Xavier Lurton,"An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer,2010
3. Don H. Johnson and Dan E. Dudgeon,"Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
4. Harry L. Van Trees,"Optimum Array Processing, First Edition, Wiley-Interscience,2002
5. Richard O. Nielsen,"Sonar Signal Processing, First Edition, Artech House,1991 6. A. D. Waite,"SONAR for Practicing Engineers, Third Edition, Wiley,2002

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Understand the techniques of underwater imaging

CO2 Understand the fundamentals of underwater acoustics and ambient noise

CO3 Understand array processing techniques for underwater imaging applications

CO4 Design of Filters and impedance matching circuits

CO5 Know about SONAR systems and its applications

MAPPING OF COs WITH POs AND PSOs

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

EC1019	WEARABLE DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the motivation, guiding principles, and challenges of Wearable Computing.
- To provide the basic understanding of measurement and instrumentation systems.
- To introduce the concept of the reactive sensors and self-generating sensors.
- To impart the importance of smart sensors, sensor interface standards for wearable device applications and to provide a brief overview of the wearable technology and its impact on social life.

UNIT I: INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS **9**

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor. **CO1**

UNIT II: SIGNAL PROCESSING & ENERGY HARVESTING FOR WEARABLE DEVICES **9**

Wearability issues -physical shape and placement of sensor, Technical challenges – sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles. **CO2**

UNIT III: WIRELESS HEALTH SYSTEMS **9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques. **CO3**

UNIT IV: SMART TEXTILE **9**

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters – ECG, respiration. **CO4**

UNIT V: APPLICATIONS OF WEARABLE SYSTEMS **9**

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COURSE OUTCOMES

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

CO1 Describe the concepts of wearable system.

CO2 Explain the energy harvestings in wearable device.

CO3 Use the concepts of BAN in health care.

CO4 Illustrate the concept of smart textile

CO5 Compare the various wearable devices in healthcare system

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

EC1020 **5G COMMUNICATION TECHNOLOGY** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the evolution of cellular networks and the road map for 5G, including key standards and specifications.
- To familiarize students with the design principles of the 5G NR air interface, including spectrum allocation, modulation schemes, and multiplexing techniques.
- To provide insights into advanced concepts such as MIMO, beamforming, and 5G radio access network architecture.

UNIT I: INTRODUCTION TO 5G STANDARDS AND 5G USE CASES **9**

Evolution of Cellular Networks (1G to 5G) - AMPS, GSM, GPRS and EDGE, UMTS, LTE, and LTE-A; Road map for 5G - 5G Standards and Specifications - Key capabilities for IMT 2020, Usage Scenarios; 5G Use Cases – eMBB, URLLC & mMTC, Technical Performance Requirements, 3GPP and 3GPP Releases, 3GPP 5G Architecture - Service-Based System Architecture and Reference Point System Architecture. **CO1**

UNIT II: 5G NR AIR INTERFACE DESIGN **9**

5G NR Spectrum – FR1 & FR2, Radio Propagation Issues for mm Waves, Numerology for the Carrier, Frame Structure, Modulation Schemes – ASK, FSK, BPSK, QPSK, QAM and π/2-BPSK, 5G-NR Waveforms - OFDM, CP-OFDM, DFT-S-OFDM, WOLA, FBMC, UFMC and GFDM, Multiplexing Techniques –FDD and TDD Modes, Multiple Access Techniques – OFDMA, SC-FDMA, RMSA, MUSA and NOMA, Channel Coding – LDPC and Polar Coding, HARQ. **CO2**

UNIT III: MIMO AND BEAMFORMING **9**

Multiple-Input/Multiple-Output (MIMO) Antennas, MIMO Principles - Spatial diversity and Spatial multiplexing, SU-MIMO, Multiple-User MIMO – UL MU-MIMO and DL MU-MIMO, Advanced Cellular Antennas; Beamforming - Basic Principles and Beam Management, Beamforming Types – Analog, Digital and Hybrid Beamforming, FD-MIMO, mMIMO, Comparison between SISO, SU - MIMO, MU – MIMO and mMIMO. **CO3**

UNIT IV: 5G RADIO ACCESS NETWORK **9**

Overall RAN Architecture, RAN Interfaces, EN-DC Overall Architecture, RAN–Core Functional Split, RAN Channel Structure and signals - Logical Channels, Transport Channels and Physical Channels; RAN Protocol Architecture for user plane and control plane traffic – PHY, MAC, RLC, PDCP, SDAP/RRC - RRC State Transition Model (RRC Inactive, RRC Idle and RRC Connected) and NAS, Channel Structure, RAN – Core Network Interface Protocol Architecture, Xn Interface Protocol Architecture, NG RAN Transport Network - Possible CU, DU, and RU Combinations, vRAN, Cell Acquisition, Random Access, Link Adaptation, Data Transmission and Reception. **CO4**

UNIT V: 5G CORE NETWORK AND B5G **9**

Core Network Requirements, Core Network Functional Architecture, Quality of Service, Network Slicing, Registration Management, Connection Management, Session Management, Policy and Charging, Software-Defined Networking, Network Functions Virtualization, SDN and NFV Support for 5G, Multi-Access Edge Computing and 5G, 5G-Advanced and Journey to 6G. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dr. William Stallings, "5G Wireless - A Comprehensive Introduction", Addison-Wesley Professional, June 2021.
2. Christopher Cox, "An Introduction to 5G - The New Radio, 5G Network and Beyond", Wiley, December 2020.
3. Douglas H. Morais, "Key 5G Physical Layer Technologies - Enabling Mobile and Fixed Wireless Access", Springer, 2020.
4. Mojtaba Vaezi, Zhiguo Ding, H. Vincent Poor, "Multiple Access Techniques for 5G Wireless Networks and Beyond", Springer, 2019.
5. Jun Xu and Yifei YuanChannel, "Channel Coding in 5G New Radio", CRC Press, 2023.

REFERENCES:

1. Jyrki T. J. Penttinen, "5G Explained", Wiley, April 2019.
2. Harri Holma & Antti Toskala and Takehiro Nakamura, "5G Technology - 3GPP Evolution to 5G-Advanced", Second Edition, Wiley, February 2024.
3. Shyam Varan Nath, Ananya Simlai and Oğuzhan Kara, "Mastering 5G Network Design, Implementation, and Operations", Packt Publishing, June 2023.

COURSE OUTCOMES

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

CO1	Understand the evolution of cellular networks to 5G, including standards and key capabilities. Analyze 5G use cases and scenarios, such as eMBB, URLLC, and mMTC.
CO2	Explain 5G NR air interface design, covering spectrum considerations, modulation schemes, and multiple access techniques.
CO3	Demonstrate understanding of MIMO principles and beamforming techniques in 5G systems, including SU-MIMO, MU-MIMO and mMIMO.
CO4	Analyze the architecture and protocols of the 5G Radio Access Network (RAN), including channel structure and RAN–Core functional split.
CO5	Describe the functional architecture of the 5G Core Network, including quality of service, network slicing, SDN, NFV, and advancements towards 5G-Advanced and 6G.

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

EC1021 **MEDICAL IMAGING SYSTEMS**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

- To understand the generation of X-ray and its uses in Medical imaging
- To describe the principle of Computed Tomography.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety

UNIT I: X RAYS **9**

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography. **CO1**

UNIT II: COMPUTED TOMOGRAPHY **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method **CO2**

UNIT III: MAGNETIC RESONANCE IMAGING MRI **9**

Fundamentals of magnetic resonance- properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI. **CO3**

UNIT IV: NUCLEAR IMAGING **9**

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, **CO4**

Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET

UNIT V: RADIATION THERAPY AND RADIATION SAFETY **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman, Handbook Of Medical Imaging: Processing and Analysis (Biomedical Engineering), Academic Press, 2000
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis, SPIE Press 2000
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi “Medical Imaging Technology”, Springer Singapore, 2015

REFERENCES:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), “Medical Image Processing - Techniques and Applications “, Springer-Verlag New York, 2011.

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1 Describe the working principle of the X-ray machine and its application.

CO2 Illustrate the principle of computed tomography

CO3 Interpret the technique used for visualizing various sections of the body using MRI

CO4 Demonstrate the applications of radionuclide imaging.

CO5 Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

MAPPING OF COs WITH POs AND PSOs

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

EC1022	WIRELESS BROADBAND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made:

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To learn about evolution of 4G Networks, its architecture and applications
- To explore the architecture of 5G, 5G Modulation Schemes and to analyse the concept of MIMO and other research areas in 5G

UNIT I: WIRELESS LAN **9**

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a, 802.11ax – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART **CO1**

UNIT II: MOBILE NETWORK LAYER **9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6- Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP **CO2**

UNIT III: 3G OVERVIEW **9**

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA **CO3**

UNIT IV: 4G NETWORKS **9**

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO. **CO4**

UNIT V: 5G NETWORKS **9**

Introduction to 5G, vision and challenges, 5G NR – New Radio – air interface of 5G, radio access, 5G Use Cases – eMBB, URLLC, mMTC, Ultra-Dense Network Architecture and Technologies for 5G-Filter-bank based multi-carrier (FBMC), Universal filtered multi carrier (UFMC), Generalized frequency division multicarrier (GFDM)- Principles, 5G RAN and Core Network – NSA and SA deployments, Transceiver Block diagram-MIMO in LTE, Theoretical background, Single user MIMO, Multi-user MIMO, Capacity of massive MIMO: a summary, Basic forms of massive MIMO implementation. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Jochen Schiller, Mobile Communications‖, Second Edition, Pearson Education 2012.
2. Vijay Garg, —Wireless Communications and networking‖, First Edition, Elsevier 2007.
3. Afif Osseiran, Jose.F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadbandǁ, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, —Wireless Networking, First Edition, Elsevier 2011.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016
4. Saad Z Asif, "5G Mobile Communication, Concepts and Challenges", CRC Press
5. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press, 2018.

COURSE OUTCOMES

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

CO1 Understand wireless LAN technologies

CO2 Know about the internet protocol

CO3 Conversant with the 3G networks and its architecture

CO4 Design and implement wireless network environment for any application using latest wireless protocols and standards

CO5 Conversant with the latest 5G networks and its architecture

MAPPING OF COs WITH POs AND PSOs

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

EC1039	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims to

- To understand the fundamentals of industrial automation and its applications.
- To Learn about different types of sensors and actuators used in industrial environments.
- To Gain proficiency in PLC programming and ladder logic design
- To Design and implement HMI interfaces for industrial control systems.
- To Explore various industrial communication protocols such as Modbus, Profibus, and Ethernet/IP.

UNIT I: INTRODUCTION TO INDUSTRIAL AUTOMATION **9**

Introduction - fundamental concepts, historical evolution of automation technology, Principles and strategies of automation, Basic elements of an automated system, Impact on manufacturing processes -Applications of automation in industries - automotive, aerospace, and pharmaceuticals. **CO1**

UNIT II: SENSORS AND ACTUATORS **9**

Sensors and Transducers – Principles, Classifications, Characteristics and applications of sensors used in industrial environment: proximity sensors, temperature sensors, pressure sensors and smart sensors- Selection criteria for sensors – Sensors applications: Automotive, Home appliance and sensors for industrial environment. Actuators: Definition, types and selection of actuators, Role of actuators- solenoids, motors and valves controlling physical processes. **CO2**

UNIT III: PROGRAMMABLE LOGIC CONTROLLERS (PLCs) **9**

Programmable Logic Controllers (PLCs): Principles and functionalities - Architecture, I/O modules, PLC programming languages: Ladder Logic and Function Block Diagram, practical exercises in PLC programming, case studies in PLCs: design and implementation of logic control systems. **CO3**

UNIT IV: HUMAN-MACHINE INTERFACE (HMI) **9**

HMI: Design principles, Architecture, types, interface elements, layout, interface between human and automated system. HMI Programming and configuration, interfaces for monitoring and controlling industrial processes. **CO4**

UNIT V: INDUSTRIAL COMMUNICATION PROTOCOLS **9**

Introduction: Open System Interconnection model (OSI) of International Organization for Standardization (ISO). Industrial Communication Protocols types; Characteristics, advantages, and industrial applications of RS-232, RS-485, Modbus, Profibus, Ethernet/IP, and CAN bus – Case study: Implement and troubleshoot communication networks within automated systems. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Krishna Kant, “Computer Based Industrial Control”, Prentice-Hall Of India Pvt Limited 2nd edition, 2011.
2. D. Patranabis,”Sensors and Transducers”, 2nd edition, PHI Learning Private Limited,2004.
3. Petruzella, F.D., “Programmable Logic Controllers”, 5th Edition, McGraw-Hill Education, 2016.
4. Bill Hollifield, Dana Oliver, Ian Nimmo, Eddie Habibi, “The High Performance HMI Handbook: A Comprehensive Guide to Designing, Implementing and Maintaining Effective HMIs for Industrial Plant Operations”, Plant Automation Services, 2008

REFERENCES:

1. Frank Lamb, “Industrial Automation: Hands On”, McGraw-Hill Education, 2013.
2. David G. Alciatore and Michael B. Histand, “Introduction to Mechatronics and Measurement Systems”, 4th Edition, McGraw-Hill Education, 2012.
3. D. Popovic and V.P.Bhatkar, “Distributed computer control for industrial Automation” Marcel Dekker, Inc., Newyork ,1990.
4. Bela G.Liptak, “Instrument Engineers Handbook, Process Measurement and Analysis”, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
5. W. Bolton, “Programmable Logic Controllers”, sixth Edition , Newnes, 2015
6. Terry Bartelt, “Industrial Control Electronics: Devices, Systems and Applications”, 3rd Edition, Cengage Learning, 2010.

COURSE OUTCOMES

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

CO1 Understand industrial automation principles and applications.

CO2 Select and integrate sensors and actuators effectively.

CO3 Program PLCs proficiently using various languages.

CO4 Design and program HMIs for efficient system control.

CO5 Utilize industrial communication protocols for data exchange.

MAPPING OF COs WITH POs AND PSOs

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

EC1023	PHOTONIC NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use.
- To give thorough understanding about high frequency line, power and impedance measurements
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT I: OPTICAL SYSTEM COMPONENTS **9**

Light Propagation in optical fibers — Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components— Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters. **CO1**

UNIT II: OPTICAL NETWORK ARCHITECTURES **9**

Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks— Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture. **CO2**

UNIT III: WAVELENGTH ROUTING NETWORKS **9**

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations - Linear Light wave networks, Logically Routed Networks. **CO3**

UNIT IV: PACKET SWITCHING AND ACCESS NETWORKS **9**

Photonic Packet Switching– OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks– Network Architecture overview, Optical Access Network Architectures and OTDM networks. **CO4**

UNIT V: NETWORKDESIGNANDMANAGEMENT **9**

Transmission System Engineering— System model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management —Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Photonics Optoelectronics (pb2017) Kakani S.L. Cbs publications
2. Photonics : Optical Electronics in Modern Communications – by Variv Second Edition

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, — Optical Networks: A Practical Perspective ǁ, Harcourt Asia Pte Ltd., Second Edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy,—WDM Optical Networks: Concept, Design and Algorithms ǁ, Prentice Hall of India, Ist Edition, 2002.
3. P.E.Green, Jr.,— Fiber Optic Networks ǁ, Prentice Hall, NJ, 1993.
4. BiswanathMukherjee,OpticalWDMNetworksǁ,SpringerSeries,2006

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Use the backbone infrastructure for our present and future communication needs

CO2 Analyze the architectures and the protocol stack

CO3 Compare the differences in the design of data plane, control plane, routing

CO4 Acquiring knowledge in switching and accessing of Optical Networks

CO5 Able to design RF system transceiver employing active RF components

MAPPING OF COs WITH POs AND PSOs

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

EC1024 **SATELLITE COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

- Understand the basics of satellite orbits
- Understand the satellite segment and ear
- th segment
- Analyze the various methods of satellite multiple access methods
- Understand the applications of satellites
- Understand the basics of satellite Networks

UNIT I: SATELLITE ORBITS **9**

Orbits and launching methods of satellite: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, Look Angle Determination- Limits of visibility– eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion. **CO1**

UNIT II: SPACE SEGMENT **9**

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem- antenna polarization, polarization of satellite signals. **CO2**

UNIT III: SATELLITE LINK DESIGN **9**

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse. **CO3**

UNIT IV: SATELLITE ACCESS AND CODING METHODS **9**

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes. **CO4**

UNIT V: SATELLITE APPLICATIONS **9**

INTELSAT Series, INSAT, VSAT- Calculation of link margins for a VSAT star network. Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System, Satellite radio broadcasting. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH), installation of DBS-TV antennas. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dennis Roddy, —Satellite Communication‖, 4th Edition, Mc Graw Hill International, 2006.
2. Timothy, Pratt, Charles, W. Bostain, Jeremy E.Allnutt, "Satellite Communication", 2nd Edition, Wiley Publications, 2002.

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyder houd, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book,Artech House Bostan London, 1997.

COURSE OUTCOMES

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

CO1 Analyze the satellite orbits.
CO2 Analyze the earth segment and space segment.
CO3 Analyze the satellite Link design.
CO4 Understand Various multiple access techniques.
CO5 Design various satellite applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1025	IoT ENABLED SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of IoT.
- To acquire knowledge about the various protocols of IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications and case studies in IoT.

UNIT I: INTRODUCTION TO INTERNET OF THINGS **9**

Internet of Things-Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – Physical Design- Logical Design, IoT Enabling Technologies – IoT Architecture – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects- IoT levels and deployment templates – A panaromic view of IoT applications. **CO1**

UNIT II: MIDDLEWARE AND PROTOCOLS OF IOT **9**

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M – Interoperability challenges of IoT -Protocols for RFID, WSN, SCADA, M2M Zigbee, KNX, B ACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT. **CO2**

UNIT III: COMMUNICATION AND NETWORKING **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination. **CO3**

UNIT IV: IOT IMPLEMENTATION TOOLS **9**

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi. **CO4**

UNIT V: APPLICATIONS AND CASE STUDIES **9**

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – participatory sensing - Data Analytics for IoT– Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.

REFERENCES:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi Mongay Batalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1 Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2 Identify the architecture, infrastructure models of IoT.

CO3 Analyze the networking and how the sensors are communicated in IoT.

CO4 Analyze and design different models for IoT implementation.

CO5 Identify and design the new models for market strategic interaction.

MAPPING OF COs WITH POs AND PSOs

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

EC1026	SATELLITE REMOTE SENSING AND IMAGE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the electromagnetic remote sensing process and the data capturing mechanisms of satellite data.
- To analyze the performance of different image enhancement techniques.
- To analyze the performance of different feature extraction and classification techniques.
- To understand the different satellite data fusion and compression techniques.
- To understand the principles of microwave remote sensing techniques.

UNIT I: INTRODUCTION TO REMOTE SENSING **9**

Remote Sensing -Definition, Process, Types, Radiation principles. Spectral reflectance curve- EMR interactions with atmosphere, earth surface features. Satellite Data: Satellite Image Characteristics, Types of Resolutions. Data capturing mechanisms: Along track scanning, across track scanning. **CO1**

UNIT II: SATELLITE IMAGE ENHANCEMENT TECHNIQUES **9**

Image Preprocessing- Geometric Correction, Radiometric Correction. Satellite Image Enhancement: Radiometric Enhancement - Histogram Based Enhancements, Density Slicing, Stretching, Geometric Enhancement- Neighborhood Operations, Template Operators. **CO2**

UNIT III: FEATURE EXTRACTION AND CLASSIFCATION **9**

Types of Feature Extraction- Statistical, Structural and Spectral based approaches. Types of Classification –Supervised and Unsupervised Classification Algorithms. **CO3**

UNIT IV: SATELLITE IMAGE FUSION AND IMAGE COMPRESSION **9**

Data Fusion: Feature Space fusion, Spatial domain fusion, Scale space fusion. Data Compression: Compression by coding, Fractal Compression, Wavelet Compression. **CO4**

UNIT V: MICROWAVE REMOTE SENSING **9**

Microwave remote sensing, Side Looking Radar Systems, Synthetic Aperture Radar, Radar Image Characteristics, Radar Image Interpretation techniques, Microwave Radiometers, Microwave Scanners. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Thomas M.Lillesand, Ralph W.Kiefer, “Remote Sensing and Image Interpretation”, Fifth Edition, 2004.
2. Robert A. Schowengerdt, Remote Sensing Models & Methods For Image Processing, III Edition, 2004.

REFERENCES:

1. J. A. Richards “Remote Sensing Digital Image Analysis: An Introduction”, Second Revised Edition, 1993.
2. John R. Jensen, “Remote Sensing Of The Environment – An Earth Resource Perspective”, Pearson Education Series, 2003.
3. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing” (3rd Edition), Prentice Hall, 2007.
4. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011.

COURSE OUTCOMES

Upon completion of the course, the students will gain knowledge on

CO1	Able to understand electromagnetic remote sensing process and the data capturing mechanisms of satellite data.
CO2	Analyse the performance of different image enhancement techniques.
CO3	Analyse the performance of different feature extraction and classification techniques.
CO4	Able to understand the different satellite data fusion and compression techniques.
CO5	Able to understand the principles of microwave remote sensing techniques.

MAPPING OF COs WITH POs AND PSOs

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

EC1027 **COGNITIVE RADIO** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities
- To study the basic architecture and standard for cognitive radio
- To understand and design different algorithms for spectrum sensing and dynamic spectrum access
- To understand the physical, MAC and Network layer design of cognitive radio
- To expose the student to evolving applications and advanced features of cognitive radio

UNIT I: INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO **9**

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations. **CO1**

UNIT II: COGNITIVE RADIO ARCHITECTURE **9**

Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands. **CO2**

UNIT III: SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS **9**

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.. **CO3**

UNIT IV: MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO **9**

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques. **CO4**

UNIT V: ADVANCED TOPICS IN COGNITIVE RADIO **9**

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, —Cognitive Radio Communications and Networksǁ, Academic Press, Elsevier, 2010. (Unit I to IV)
2. Huseyin Arslan (Ed.), —Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. (Unit V)

REFERENCES:

1. Bruce Fette, —Cognitive Radio Technologyǁ, Newnes, 2006.
2. Kwang-Cheng Chen, Ramjee Prasad, — Cognitive Radio Networksǁ, John Wiley and Sons, 2009.
3. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, —Principles of Cognitive Radioǁ, Cambridge University Press, 2012.

COURSE OUTCOMES

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

CO1 Gain knowledge on the design principles on software defined radio and cognitive radio.

CO2 Explain the basic standards of cognitive radio.

CO3 Develop the ability to design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access.

CO4 Build experiments and projects with real time wireless applications.

CO5 Apply the knowledge of advanced features of cognitive radio for real world applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1028	INDUSTRIAL IOT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To attain knowledge about IoT Nodes & Sensors
- To provide depth of knowledge of IoT Gateways
- To understand and analyse the concepts of IoT Cloud Systems
- To identify and study IoT Cloud Dashboards
- To implement real field problem by gained knowledge of Industrial applications with IoT capability

UNIT I: UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM **9**

IOT Definition, Importance of IoT - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics. **CO1**

UNIT II: ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM **9**

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow. **CO2**

UNIT III: IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING HARDWARE AND SENSORS **9**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python- IoT Physical Devices and Endpoints - Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor. **CO3**

UNIT IV: CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM **9**

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; IoT Cloud Storage Models & Communication APIs - Exploring the web services like mail, Messaging (SMS) and Twitter etc.; Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; - Amazon Web Services for IoT. **CO4**

UNIT V: CHALLENGES AND REAL - WORLD APPLICATIONS OF IOT **9**

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation. Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCES:

1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications

CO2 Use processors & peripherals to design & build IoT hardware

CO3 Assess, select, and customize technologies for IoT application

CO4 Connect numerous IOT applications with the physical world of humans and reallife problem solving

CO5 Design and implement IOT applications that manage big data

MAPPING OF COs WITH POs AND PSOs

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

EC1029	THERAPEUTIC EQUIPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the principles of cardiac assist devices and the Types of Ventilators
- To comprehend the working of different Methods of Diathermy
- To understand the principle and working of Body Care Equipment
- To Understand the principle of Biomedical lasers and their Applications
- To enable the students to gain knowledge on the working of therapeutic clinical equipment

UNIT I: CARDIAC AND RESPIRATORY THERAPY EQUIPMENT **9**

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators. Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators. **CO1**

UNIT II: BIOMECHANICAL THERAPEUTIC EQUIPMENT **9**

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table. **CO2**

UNIT III: BODY CARE EQUIPMENT **9**

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Principle and operation of endoscopy- Parts of an endoscope - Types of endoscopy with applications. **CO3**

UNIT IV: DENTAL CARE EQUIPMENT **9**

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine. **CO4**

UNIT V: HEAT & PHOTON THERAPY EQUIPMENT **9**

Principle, working and modes of operation of Short wave diathermy, Microwave diathermy, Ultrasonic diathermy, Lithotripsy - Principle and operation of extra corporeal shock wave lithotripter and ultrasonic lithotripter. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2 laser, He-Ne laser, Nd-YAG and Ruby laser. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.
2. John.G.Webster. “Medical Instrumentation, Application and Design”. Fourth Edition.Wiley &s ons, Inc., NewYork. 2009.

REFERENCES:

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.P feiffer. “Biomedical Instrumentation and Measurements”. Second Edition. Prentice Hall Inc.2000.
2. John Low & Ann Reed. “Electrotherapy Explained, Principles and Practice”. Second Edition. Butterworth Heinemann Ltd. 2000.
3. Joseph. J. Carr, John Michael Brown, “Introduction to Biomedical Equipment Technology”, Prentice Hall and Technology, 2008.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1	Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc.,
CO2	Comprehend the principles of body care equipment.
CO3	Understand the operation of dental care equipment.
CO4	Analyze the different types of therapies for suitable applications.
CO5	Appreciate the application of lasers in biomedical applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	3	3	3	3	3	3	2	3
CO2	3	3	3	2	3	3	2	3	3	3	3	3	3	3	2
CO3	3	3	3	2	3	3	2	3	3	3	3	3	3	3	2
CO4	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	3	3	3	3	3	3

EC1030	ASIC & FPGA BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.
- To learn the architecture of different types of FPGA.
- To understand the applications of FPGA and SoC Design.

UNIT I: OVERVIEW OF ASIC AND PLD **9**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs. **CO1**

UNIT II: ASIC PHYSICAL DESIGN **9**

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing – circuit extraction – DRC **CO2**

UNIT III: LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry. Verilog and logic synthesis - VHDL and logic synthesis - types of simulation –DFT-boundary scan test - fault simulation - automatic test pattern generation. **CO3**

UNIT IV: FIELD PROGRAMMABLE GATE ARRAYS **9**

FPGA Design: FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization. FPGA Applications- Embedded system design using FPGAs, DSP using FPGAs. **CO4**

UNIT V: SOC DESIGN **9**

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies: Canonical Signed Digit Arithmetic, Knowledge Crunching Machine, Distributed Arithmetic, High performance digital filters for sigma-delta ADC. **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan. M. Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, New york.
6. P.K.Chan & S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall.
7. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
8. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Pub.
9. S.Brown, R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray, Kluwer Pub.
10. Richard FJinder, “Engineering Digital Design,” Academic press

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Understand architectures of ASIC and programmable logic devices

CO2 Understand various ASIC Physical Design

CO3 To analyse the Synthesis, Simulation and Testing of systems using VHDL and Verilog HDL

CO4 Develop the FPGA based system for various applications

CO5 Discuss the design issues of SOC.

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

EC1031 **BODY AREA NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the BAN architecture and sensors for wearable devices.
- To know the hardware requirement of BAN.
- To understand the BAN communication and networking technologies.
- To study the interference and security aspects of BAN.
- To know the implementation of UWB WBAN and applications.

UNIT I: INTRODUCTION **9**

BAN architecture-Technical challenges- sensor design, biocompatibility, energy supply, optimal node placement, number of nodes, system security and reliability, sensors for wearable devices - implementation issues. **CO1**

UNIT II: HARDWARE FOR BAN **9**

Processor-Low Power MCUs, Mobile Computing MCUs, Integrated processor with radio transceiver, Memory, Antenna - PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes. **CO2**

UNIT III: WIRELESS COMMUNICATION AND NETWORK **9**

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-stand alone BAN, Wireless personal area network technologies-IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee. **CO3**

UNIT IV: COEXISTENCE ISSUES WITH BAN **9**

Interferences – Intrinsic - Extrinsic, Effect on transmission, Countermeasures on physical layer and data link layer, Regulatory issues - Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection. **CO4**

UNIT V: ULTRA WIDEBAND FOR WBAN **9**

UWB hardware development – PHY layer – advantages and limitations - Design and Implementation – UWB WBAN applications **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCES:

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
4. Huan-Bang Li, Kamya Yekeh Yazdandoost, Bin Zhen, “Wireless body area networks”, River Publishers, 2010.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2 Design a BAN for appropriate application in medicine.

CO3 Assess the efficiency of communication and the security parameters.

CO4 Understand the need for medical device regulation and regulations followed in various regions.

CO5 Understand the UWB WBAN implementation.

MAPPING OF COs WITH POs AND PSOs

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

EI1851	FUNDAMENTALS OF SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Develop the skills to gain a basic understanding of neural network theory.
- Understand the advanced neural networks and its applications.
- Understand fuzzy logic and reasoning to handle and solve engineering problem.
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- Introduce Genetic algorithms from an engineering perspective.

UNIT I: ARCHITECTURES – ANN **9**

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network. **CO1**

UNIT II: NEURAL NETWORKS FOR CONTROL **9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network – Process identification – Neuro controller for inverted pendulum. **CO2**

UNIT III: FUZZY SYSTEMS **9**

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules – Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system. **CO3**

UNIT IV: APPLICATION OF FUZZY LOGIC SYSTEMS **9**

Fuzzy logic control: Home heating system – liquid level control – aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control. **CO4**

UNIT V: GENETIC ALGORITHMS **9**

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding – constraint handling methods – applications to economic dispatch and unit commitment problems. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Laurance Fausett, Englewood cliffs, N.J., ‘Fundamentals of Neural Networks’,Pearson Education, 1992.
2. Timothy J. Ross, ‘Fuzzy Logic with Engineering Applications’, Tata McGraw Hill, 1997.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, ‘Neural Networks’, Pearson Education, 2003.
2. John Yen & Reza Langari, ‘Fuzzy Logic – Intelligence Control & Information’, Pearson Education, New Delhi, 2003
3. M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, “ Neural Network Design”, Cengage Learning, 2012.
5. N.P.Padhy, “ Artificial Intelligence and Intelligent Systems”, Oxford, 2013.
6. William S.Levine, “Control System Advanced Methods,” The Control Handbook CRC Press, 2011.

COURSE OUTCOMES

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

CO1	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
CO2	To understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
CO3	To comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
CO4	To apply Fuzzy logic concepts to engineering problems
CO5	To understand basics of Evolution algorithm and swarm intelligence

MAPPING OF COs WITH POs AND PSOs

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

EC1033 **SPEECH AND AUDIO SIGNAL PROCESSING** **L T P C**

3 0 0 3

OBJECTIVES:

- To study basic concepts of processing speech and audio signals
- To study and analyze various M-band filter-banks for audio coding
- To understand audio coding based on transform coders.
- To study time and frequency domain speech processing methods
- To study predictive analysis of speech

UNIT I: MECHANICS OF SPEECH AND AUDIO **9**

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Nonsimultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality. **CO1**

UNIT II: TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS **9**

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies **CO2**

UNIT III: AUDIO CODING AND TRANSFORM CODERS **9**

Lossless Audio Coding – Lossy Audio Coding - ISO-MPEG-1A, 2A, 2A-Advaned, 4A Audio Coding -Optimum Coding in the Frequency Domain - Perceptual Transform Coder –Brandenburg – Johnston Hybrid Coder - CNET Coders Adaptive Spectral Entropy Coding –Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization **CO3**

UNIT IV: TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING **9**

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders **CO4**

UNIT V: PREDICTIVE ANALYSIS OF SPEECH **9**

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP **CO5**

TOTAL PERIODS: 45

REFERENCES:

1. B.Gold and N.Morgan, "Speech and Audio Signal Processing", Wiley and Sons, 2000
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech Signals", Prentice Hall,1978.
3. Mark Kahrs, Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio And Acoustic", Kluwer Academic Publishers
4. UdoZölzer, "Digital Audio Signal Processing", Second Edition, A John Wiley& sons Ltd
5. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana "Fundamentals of Speech Recognition", Pearson Education, 2009
6. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons,1999
7. Donglos O shanhnessy "Speech Communication: Human and Machine ", 2nd Ed. University press 2001.

COURSE OUTCOMES

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

CO1 To understand basic mechanics of speech and audio

CO2 To explain different filter bank and transform analysis in time-frequency domain

CO3 To evaluate audio coding and transform coders

CO4 To discuss about time and frequency domain methods for speech processing

CO5 To explain predictive analysis of speech

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

CS1827 **CLOUD ESSENTIALS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the concept of cloud computing.
- To learn about the concepts of virtualization and virtual machines.
- To understand the principles of cloud architecture, models and storage.
- To learn about the resource provisioning and security issues in the cloud environment.
- To understand the emergence of cloud as the next generation computing paradigm.

UNIT I: INTRODUCTION **9**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics –Benefits and Disadvantages of Cloud Computing- Elasticity in Cloud – On-demand Provisioning **CO1**

UNIT II: VIRTUALIZATION BASICS **9**

Virtual Machine Basics –Taxonomy of Virtual Machines-Hypervisor-Key Concepts- Virtualization Structure--Implementation Levels of Virtualization -Virtualization Types: Full Virtualization-Para Virtualization– Hardware Virtualization— Virtualization of CPU, Memory and I/O Devices. **CO2**

UNIT III: CLOUD ARCHITECTURE, SERVICES AND STORAGE **9**

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud Deployment Models – Cloud Service Models– Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3. **CO3**

UNIT IV: RESOURCE MANAGEMENT AND SECURITY IN CLOUD **9**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards. **CO4**

UNIT V: CLOUD ADVANCEMENT TECHNOLOGIES **9**

Hadoop – Map Reduce – Virtual Box –Google App Engine –Amazon AWS--Microsoft Azure- Cloud Software Environments - Eucalyptus – Open Stack. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. James E. Smith,Ravi Nair,"Virtual Machines:Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann,2005.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.
4. https://docs.openstack.org/train/install/
5. https://aws.amazon.com/documentdb/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2 Apply the concept of virtualization and its types.

CO3 Understand the architecture of compute and storage cloud, service and delivery models.

CO4 Explain the core issues of cloud computing such as resource management and security.

CO5 Install and use current cloud technologies and choose the appropriate technologies, approaches for implementation.

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee
- To have an adequate knowledge about global issues in multi-national companies

UNIT I: HUMAN VALUES **9**

Morals, values and Ethics; Integrity; Work ethics; Service learning; Civic virtue; Respect for others; Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character; Spirituality; Introduction to Yoga and meditation for professional excellence and stress management. **CO1**

UNIT II: ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg's theory; Gilligan's theory; Consensus and Controversy; Models of professional roles; Theories about right action; Self–interest; Customs and Religion; Uses of Ethical Theories. **CO2**

UNIT III: ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law. **CO3**

UNIT IV: SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk; Respect for Authority; Collective Bargaining; Confidentiality; Conflicts of Interest; Occupational Crime; Professional Rights; Employee Rights; Intellectual Property Rights (IPR), Discrimination. **CO4**

UNIT V: GLOBAL ISSUES **9**

Multinational Corporations; Environmental Ethics; Computer Ethics; Weapons Development; Engineers as Managers – Consulting Engineers, Engineers as Expert Witnesses and Advisors; Moral Leadership; Code of Conduct; Corporate Social Responsibility. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2012.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition, 2017.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd, New Delhi, 2013.

COURSE OUTCOMES

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

CO1 To define the dimensions or senses of engineering ethics and describe the various theories of moral development.

CO2 To describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.

CO3 To understand significance of safety and risk assessment when developing engineering products.

CO4 To understand the social responsibilities and intellectual property rights of engineers.

CO5 To understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development.

MAPPING OF COs WITH POs AND PSOs

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

GE1004 FUNDAMENTALS OF NANOSCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about basis of nanomaterial science, preparation method, types and application.

UNIT I: INTRODUCTION **9**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only). **CO1**

UNIT II: GENERAL METHODS OF PREPARATION **9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE. **CO2**

UNIT III: NANOMATERIALS **9**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications-Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications. **CO3**

UNIT IV: CHARACTERIZATION TECHNIQUES **9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nano indentation **CO4**

UNIT V: APPLICATIONS **9**

Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES

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

CO1	Ability to understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Ability to acquire knowledge in general methods of preparation of nano materials.
CO3	Ability to understand the Nano forms of Carbon and methods of synthesis
CO4	Ability to acquire knowledge in characteristic nanomaterial on various technique.
CO5	Ability to gain knowledge on various application of nano materials.

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

EC1034 **VIDEO ANALYTICS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the need for video Analytics
- To understand the basic configuration of video analytics
- To understand the functional blocks of a video analytic system
- To understand how video analytics is used for security
- To get exposed to the various applications of video analytics

UNIT I: **VIDEO ANALYTIC COMPONENTS** **9**

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction classifier - Pre-processing- edge detection- smoothening- Feature space-PCA-FLD-SIFT features **CO1**

UNIT II: **FOREGROUND EXTRACTION** **9**

Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation Tracking in a multiple camera environment **CO2**

UNIT III: **CLASSIFIERS** **9**

Neural networks (back propagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier **CO3**

UNIT IV: **VIDEO ANALYTICS FOR SECURITY** **9**

Abandoned object detection- human behavioral analysis -human action recognition- perimeter security crowd analysis and prediction of crowd congestion **CO4**

UNIT V: **VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE & TRAFFIC MONITIRING AND ASSISTANCE** **9**

Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestionidentification for route planning- driver assistance- lane change warning **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing, Kluwer academic publisher, 2001
2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016
3. Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014
4. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012

COURSE OUTCOMES

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

CO1 To understand the components used for video analytics

CO2 To analyze the classifiers used for video analytics design

CO3 To study the design of video analytic algorithms for security applications

CO4 To study the design of video analytic algorithms for business intelligence

CO5 To analyze the design of custom made video analytics system for the given target application

MAPPING OF COs WITH POs AND PSOs

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

EC1035	COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING **9**

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighbourhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization. **CO1**

UNIT II: FEATURE DETECTION, MATCHING AND SEGMENTATION **9**

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods- Medical Image Segmentation. **CO2**

UNIT III: FEATURE-BASED ALIGNMENT & MOTION ESTIMATION **9**

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion. **CO3**

UNIT IV: 3D RECONSTRUCTION **9**

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos. **CO4**

UNIT V: IMAGE-BASED RENDERING AND RECOGNITION **9**

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering- Video based animation – Video textures-Object detection - Face recognition – Eigen faces – Active appearance and 3D shape model- Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012

COURSE OUTCOMES

At the end of this course, the students will be able to:

CO1 understand basic knowledge about image formation and processing.

CO2 understand about feature detection, matching and detection algorithms.

CO3 describe a feature-based based image alignment, segmentation and motion estimations.

CO4 describe 3D image reconstruction techniques

CO5 design and develop image-based rendering and recognition applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1036 BRAIN COMPUTER INTERFACE AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface
- To Learn the various electrophysiological sources
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI
- To Learn the various applications of BCI

UNIT I: INTRODUCTION TO BCI **9**

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI, EEG, ECoG, MEG, fMRI. EEG signal acquisition - Signal Pre-processing – Artifacts removal. **CO1**

UNIT II: ELECTROPHYSIOLOGICAL SOURCES **9**

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms. **CO2**

UNIT III: FEATURE EXTRACTION METHODS **9**

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA,ARMA models – Principal Component Analysis (PCA), Independent Component Analysis (ICA), – Linear and Non-Linear Features. **CO3**

UNIT IV: FEATURE TRANSLATION METHODS **9**

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks. **CO4**

UNIT V: APPLICATIONS OF BCI **9**

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot, Emotion detection, P300 Mind Speller. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces:
2. Revolutionizing Human-Computer Interaction”, Springer, 2010.
3. Rajesh.P.N.Rao, Brain-Computer Interfacing: An Introduction, Cambridge University Press, First edition, 2013
4. Jonathan Wolpaw, Elizabeth Winter Wolpaw, Brain Computer Interfaces: Principles and practice, Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Describe BCI system and its major categorization

CO2 Analyze event related potentials and sensory motor rhythms.

CO3 Compute features suitable for BCI.

CO4 Design classifier modelling for a BCI system.

CO5 Apply BCI across diverse applications.

MAPPING OF COs WITH POs AND PSOs

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

EC1037	SENSORS, ACTUATORS & INTERFACE ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the purpose and techniques of signal conditioning
- Sensors based on the variation of the electric resistance
- Gain knowledge in self-generating sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and other sensing methods

UNIT I: INTRODUCTION TO MEASUREMENT SYSTEMS **9**

Introduction to measurement systems: general concepts and terminology, Classification of sensor, general input-output configuration, methods of correction. Analog signal conditioning: Principles, passive circuits, Operational Amplifier circuits, Digital signal conditioning: Digital fundamentals, converters, Data-Acquisition Systems. **CO1**

UNIT II: RESISTIVE AND REACTIVE SENSORS **9**

Resistive sensors: potentiometers, strain gauges, resistive temperature detectors, magneto resistors, Light-Dependent Resistors (LDRs), Signal conditioning for resistive sensors, capacitive sensors, inductive sensors, Electromagnetic sensors, Signal conditioning for reactance-based sensors. **CO2**

UNIT III: SELF-GENERATING SENSORS **9**

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer and transimpedance amplifiers, charge amplifiers, noise in amplifiers. **CO3**

UNIT IV: ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS **9**

Final control operation, Signal conversions: Analog electrical signals, Digital electrical signals, Pneumatic signals, Industrial electronics: SCR, TRIAC, Actuators: Electrical actuators, Pneumatic actuators, Hydraulic actuators. Control Elements: Mechanical, Electrical and Fluid Valves. **CO4**

UNIT V: DIGITAL SENSORS AND OTHER SENSING METHODS **9**

Digital sensors: position encoders, variable frequency sensors – quartz digital thermometer, vibrating wire strain gages, vibrating cylinder sensors, saw sensors, digital flow meters. Direct sensor – Microcontroller Interfacing, Communication Systems for Sensors. Sensors based on semiconductor junctions, MOSFET, CCD imaging sensors, ultrasonic sensors, fiber-optic sensors, Biosensors. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. D. Johnson, “Process Control Instrumentation Technology”, John Wiley and Sons.6th Edition, 2000.
2. Ramon Pallas-Areny, John G. Webster, Sensors and signal conditioning, John Wiley & Sons, INC, 2nd Edition, 2001
3. Nathan Ida, Sensors, Actuators, and their Interfaces-A Multidisciplinary Introduction, SciTech publishing, Edison, NJ, 2014

REFERENCES:

1. Graham Brooker, Introduction to Sensors for ranging and imaging, Yesdee, 2009.
2. Kevin James, PC Interfacing and Data acquisition, Elsevier, 2011.
3. D.Patranabis, “Sensors and Transducers”, TMH 2003.
4. E.O. Doeblin, “Measurement System : Applications and Design”, McGraw Hill Publications
5. Andrzej M. Pawlak Sensors and Actuators in Mechatronics Design and Applications, 2006.
6. Sensors and Actuators: Control System Instrumentation, Clarence W. de Silva CRC Press, 2007.

COURSE OUTCOMES

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

CO1 Design signal conditioning system to convert a given input variation into a required output.

CO2 Classify sensors by the physical quantity being measured and develop signal conditioning circuits.

CO3 Implement signal conditioning system using self-generating sensors for various applications.

CO4 Select suitable actuators for various applications.

CO5 Develop Microcontroller based interfacing systems and communication systems.

MAPPING OF COs WITH POs AND PSOs

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

EC1038	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Radar and Radar equation
- To study the types of Radar
- To understand the tracking of Radar
- To understand the various signal processing in Radar
- To understand the Subsystems in Radar and Navigational aids

UNIT I: INTRODUCTION TO RADAR EQUATION **9**

The Origins of Radar, Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses. **CO1**

UNIT II: CW, MTI AND PULSE DOPPLER RADAR **9**

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target 163 Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar. **CO2**

UNIT III: TRACKING RADAR **9**

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering. **CO3**

UNIT IV: RADAR SIGNAL PROCESSING **9**

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non- fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar. **CO4**

UNIT V: RADAR TRANSMITTERS AND RECEIVERS, NAVIGATIONAL AIDS **9**

Aspects of radar transmitters & receivers, linear beam power tubes solid state RF power sources. Receiver noise figure, super heterodyne receiver duplexers and receiver protectors, radar displays. Navigational Aids Introduction, Four Methods of Navigation, Radio Direction Findings, Radio Ranges, Hyperbolic Systems of Navigation, Aids to approach and Landing. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors “Principles of Modern Radar, Basic Principles”, SciTech Publishing, 2012

REFERENCES:

1. Nathansan, “Radar design principles-Signal processing and environment”, PHI, 2nd Edition,2007.
2. M.I.Skolnik, “Introduction to Radar Systems”, Tata McGraw Hill 2006.
3. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw-Hill, 2005.
4. Sen & Bhattacharya, “Radar Systems and Radio Aids to Navigation”, Publisher: Khanna publishers.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Identify the Radar parameters
CO2 Differentiate various radar types
CO3 Evaluate different tracking and filtering schemes
CO4 Apply signal processing in target detection
CO5 Design Radar transmitter and receiver blocks

MAPPING OF COs WITH POs AND PSOs

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

OMB104 **QUALITY FOR MANAGEMENT SCIENCE** **L T P C**
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I: INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, customer retention. **CO1**

UNIT II: TQM PRINCIPLES **9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, **CO2**

Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III: TQM TOOLS AND TECHNIQUES – I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to benchmark, Bench marking process - FMEA - Stages, Types. **CO3**

UNIT IV: TQM TOOLS AND TECHNIQUES – II **9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. **CO4**

UNIT V: QUALITY MANAGEMENT SYSTEM **9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector- Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements — Implementation—Documentation—Internal Audits—Registration-- ENVIRONMENTAL MANAGEMENTSYSTEM: Introduction— ISO 14000 Series Standards — Concepts of ISO 14001— Requirements of ISO 14001— Benefits of EMS. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Dale H. Besterfiled, Carol B. Michna,Glen H. Besterfield,Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal. R.K., "Total Quality Management - Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt.Ltd., 2006.
4. ISO 9001-2015 standardsZ

COURSE OUTCOMES

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

CO1 The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.

CO2 Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.

CO3 Students can understand the organisational, communication and teamwork requirements for effective quality management.

CO4 Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans.

CO5 The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

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

OEE102 **RENEWABLE ENERGY SOURCES** **L T P C**

(Common to ECE,CHEMICAL & CIVIL) **3 0 0 3**

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources

UNIT I: BASICS OF SOLAR RADIATION **9**

Environmental aspects of energy utilization- importance of renewable energy sources - physics of the sun - solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on tilted surface; Instruments for measuring solar radiation and sun shine - solar radiation data. **CO1**

UNIT II: SOLAR ENERGY COLLECTORS **9**

Non-Concentrating and concentrating collectors - classification - orientation and thermal analysis- advanced collectors. **CO2**

UNIT III: SOLAR ENERGY STORAGE AND APPLICATIONS **9**

Storage methods- Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying. Photovoltaic energy conversion. **CO3**

UNIT IV: WIND ENERGY AND BIOMASS **9**

Wind: Sources and potentials- horizontal and vertical axis windmills- performance characteristics- Types of wind Turbine generators- Betz criteria; BIO-MASS: Principles of Bio-Conversion- Anaerobic/aerobic digestion- types of Bio-gas digesters- gas yield- combustion characteristics of bio-gas- utilization for cooking. **CO4**

UNIT V: GEOTHERMAL AND OCEAN ENERGY **9**

Geothermal: Geothermal Resources- types of wells- methods of harnessing the energy- potential in India. OCEAN ENERGY: OTEC- Principles utilization- setting of OTEC plants- thermodynamic **CO5**

cycles. Tidal and wave energy: Potential and conversion techniques- mini-hydel power plants and their economics.

TOTAL PERIODS: 45

TEXT BOOKS:

1. Rai G.D, “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U, “Renewable Energy Technologies”,Narosa Publishing House, 2004.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi, 2010.

COURSE OUTCOMES

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

CO1 Ability to understand the physics of solar radiation and possible energy conversion.

CO2 Ability to understand the operation of various solar energy collectors.

CO3 Ability to learn the methodologies of storing solar energy.

CO4 Acquire Knowledge in wind and biomass energy conversion techniques.

CO5 Acquire Knowledge in geothermal and ocean energy conversion techniques.

MAPPING OF COs WITH POs AND PSOs

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

OEI103	BASICS OF BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements

UNIT I: BIO POTENTIAL GENERATION AND ELECTRODES TYPES **9**

Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes **CO1**

UNIT II: BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS **9**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven‟s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. **CO2**

UNIT III: SIGNAL CONDITIONING CIRCUITS **9**

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering **CO3**

UNIT IV: MEASUREMENT OF NON-ELECTRICALPARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement. **CO4**

UNIT V: BIO-CHEMICAL MEASUREMENT **9**

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description). **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:

1. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw Hill, 2003.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”,Pearson Education, 2004.

COURSE OUTCOMES

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

CO1 To Learn the different bio potential and its propagation.

CO2 To get Familiarize the different electrode placement for various physiological recording

CO3 Students will be able design bio amplifier for various physiological recording

CO4 Students will understand various technique non electrical physiogical measurements

CO5 Understand the different biochemical measurements

MAPPING OF COs WITH POs AND PSOs

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

OEE106 **ENERGY CONSERVATION AND MANAGEMENT** **L T P C**

(Common to Chemical Engineering, ECE) **3 0 0 3**

OBJECTIVES:

- To understand and analyse the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings
- To utilise the available resources in optimal ways

UNIT I: **ENERGY SCENARIO** **9**

Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future **CO1**

UNIT II: **FINANCIAL MANAGEMENT AND ENERGY MONITORING AND TARGETING** **9**

Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) **CO2**

UNIT III: **ENERGY MANAGEMENT & AUDIT** **9**

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to **CO3**

requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

UNIT IV: ENERGY EFFICIENCY IN THERMAL UTILITIES AND SYSTEMS **9**

Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation, Thermic fluid heaters, super critical boilers. **CO4**

UNIT V: ENERGY AND ENVIRONMENT, AIR POLLUTION, CLIMATE CHANGE **9**

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF). **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press Bureau of Energy Efficiency
3. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication

REFERENCES:

1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press Bureau of Energy Efficiency
3. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication

COURSE OUTCOMES

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

CO1 To understand the Classification of Energy, Indian energy scenario

CO2 To understand the energy pricing, energy

CO3 To understand the Introduction internal rate of return, cash

CO4 To understand the performances evaluation, analysis of losses

CO5 To understand the United Nations Framework Convention on Climate Change

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM 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	3	3	2	1	2	2	3	1	2	1
CO2	3	3	3	2	2	2	2	1	1	2	2	3	2	3	2
CO3	3	3	3	2	3	2	2	1	1	2	1	3	1	2	2
CO4	3	3	3	3	3	3	3	2	3	3	2	3	3	3	2
CO5	3	2	2	3	2	3	3	3	2	3	3	3	2	2	3

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM (COMMON TO AIDS, AIML, CSE, ECE AND IT)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

UNIT I: FUNDAMENTALS OF GIS **9**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements. **CO1**

UNIT II: SPATIAL DATA MODELS **9**

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality. **CO2**

UNIT III: DATA INPUT AND TOPOLOGY **9**

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser –Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping. **CO3**

UNIT IV: DATA ANALYSIS **9**

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation. **CO4**

UNIT V: APPLICATIONS **9**

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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, the 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	3	2	2	1	2	1	2	1	2	2	1	2	2	1	2
CO2	3	3	3	2	3	2	2	1	2	1	1	3	3	2	2
CO3	3	3	3	3	3	2	3	2	3	3	2	3	2	3	3
CO4	3	2	3	3	3	2	3	2	2	2	1	3	3	3	2
CO5	3	3	3	3	3	2	3	1	3	3	1	3	2	3	3

OBT105 INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

OBJECTIVES:

The course is aimed to

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

UNIT I: BASICS OF NANOTECHNOLOGY **9**

Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties. **CO1**

UNIT II: DIFFERENT CLASSES OF NANOMATERIALS **9**

Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon based nano materials (buckyballs, nanotubes, graphene)- Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials. **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 PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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, the 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	3	3	3	2	3	2	2	1	2	1	-	3	2	3	3
CO2	3	2	3	2	3	1	2	1	2	1	-	3	2	3	3
CO3	2	3	3	3	3	1	2	1	2	2	-	3	3	2	2
CO4	3	3	2	2	3	2	2	2	3	2	1	2	3	2	2
CO5	3	3	2	3	3	2	3	1	2	3	1	3	2	3	2

OEI110	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of drone concepts.
- To learn and understand the fundaments of design, fabrication and programming of drone.
- To impart the knowledge of a flying and operation of drone.
- To know about the various applications of drone.
- To understand the safety risks and guidelines of fly safely.

UNIT I: INTRODUCTION TO DRONE TECHNOLOGY **9**

Drone Concept -Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses -Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability. **CO1**

UNIT II: DRONE DESIGN, FABRICATION AND PROGRAMMING **9**

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection. **CO2**

UNIT III: DRONE FLYING AND OPERATION **9**

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity - Removable storage devices- Linked mobile devices and applications. **CO3**

UNIT IV: DRONE COMMERCIAL APPLICATIONS **9**

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing. **CO4**

UNIT V: FUTURE DRONES AND SAFETY **9**

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016.

REFERENCES:

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018.

COURSE OUTCOMES

On successful completion of this course, the student will be able to

CO1 Know about a various type of drone technology, drone fabrication and programming.

CO2 Execute the suitable operating procedures for functioning a drone.

CO3 Select appropriate sensors and actuators for Drones.

CO4 Develop a drone mechanism for specific applications.

CO5 Create the programs for various drones.

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

OME104 **INDUSTRIAL SAFETY ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I: INTRODUCTION **9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure. **CO1**

UNIT II: CHEMICAL HAZARDS **9**

Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology. **CO2**

UNIT III: ENVIRONMENTAL CONTROL **9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection. **CO3**

UNIT IV: HAZARD ANALYSIS **9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment. **CO4**

UNIT V: SAFETY REGULATIONS **9**

Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety regulations Product safety – case studies. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

REFERENCES:

1. Safety Manual, “EDEL Engineering Consultancy”, 2000.
2. David L.Goetsch, “Occupational Safety and Health for Technologists”, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

COURSE OUTCOMES

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

CO1 understand the basic safety concepts in Industrial boilers, pressure vessels

CO2 understand the hazardous effects caused and prevention methods of chemicals used in industry

CO3 understand the environmental measures and controls towards safety

CO4 understand the analysis of safety preventions and hazards in industry

CO5 understand the safety regulations and safety management.

MAPPING OF COs WITH POs AND PSOs

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

OEI101	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development

UNIT I: INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types. **CO1**

UNIT II: MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **CO2**

UNIT III: FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers. **CO3**

UNIT IV: OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors. **CO4**

UNIT V: SIGNAL CONDITIONING AND DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES:

1. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.
3. Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015

COURSE OUTCOMES

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

CO1 Expertise in various calibration techniques and signal types for sensors.

CO2 Apply the proximity and ranging sensors in the automotive and mechatronics applications.

CO3 Understand the principles of various magnetic and heading sensors.

CO4 Understand the functioning of optical, pressure, temperature and smart sensors.

CO5 Implement the DAQ systems with different sensors for real time applications.

MAPPING OF COs WITH POs AND PSOs

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

OCS104 **FUNDAMENTALS OF DATABASE DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

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

UNIT I: INTRODUCTION **9**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL **CO1**

UNIT II: DATABASE DESIGN **9**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **CO2**

UNIT III: TRANSACTION CONCEPTS AND CONCURRENCY CONTROL **9**

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms-Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery **CO3**

UNIT IV: IMPLEMENTATION TECHNIQUES **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation **CO4**

UNIT V: ADVANCED TOPICS AND DATABASE PROGRAMMING **9**

Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1 To understand relational data model, evolve conceptual model of a given problem and SQL
CO2 To understand Relational model and normalization to perform database design effectively
CO3 Apply and relate the concept of transaction, concurrency control and recovery in database
CO4 To understand the implementation technique and query processing
CO5 To understand the concepts of database security and database programming

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

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

UNIT I: INTRODUCTION TO DATA ANALYSIS **9**

Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics **CO1**

UNIT II: R PROGRAMMING BASICS **9**

Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages **CO2**

UNIT III: DATA VISUALIZATION USING R **9**

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.

Working with R Charts and Graphs: Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts **CO3**

UNIT IV: STATISTICS WITH R **9**

Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression **CO4**

UNIT V: PRESCRIPTIVE ANALYTICS **9**

Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.

COURSE OUTCOMES

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

CO1 Understand the basics of data analytics

CO2 Understand and apply the R-Programming concepts

CO3 Apply R-Programming for data visualization

CO4 Implement various classification techniques using R

CO5 Apply R programming to perform perspective analytics on data

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

OEI105 **SCADA SYSTEM AND APPLICATIONS MANAGEMENT** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applications in power system

UNIT I: INTRODUCTION TO SCADA **9**

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits **CO1**

UNIT II: SCADA SYSTEM COMPONENTS **9**

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels. **CO2**

UNIT III: SCADA COMMUNICATION **9**

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC. **CO3**

UNIT IV: SCADA MONITORING AND CONTROL **9**

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control. **CO4**

UNIT V: SCADA APPLICATIONS IN POWER SYSTEM **9**

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning. **CASE STUDIES:** SCADA Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar," Distributed computer control for industrial Automation" Marcel Dekker, Inc., Newyork,1990.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

COURSE OUTCOMES

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

CO1 Ability to understand the basics of SCADA and various components.
CO2 To understand various system components of SCADA
CO3 Ability to develop communications and interface of SCADA
CO4 Able to select and use most appropriate automation technologies for a given application.
CO5 Ability to gain knowledge on the recent developments in industrial automation.

MAPPING OF COs WITH POs AND PSOs

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

OBT107	INTRODUCTION TO CELL BIOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge on cell structure and its function.

UNIT I: CELL STRUCTURE **9**

Cell organization, structure of organelles, extra cellular matrix and cell junctions. **CO1**

UNIT II: CELL ORGANELLE AND FUNCTION **9**

Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall. **CO2**

UNIT III: CELL DIVISION **9**

Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis. **CO3**

UNIT IV: BIO-MOLECULES **9**

DNA, RNA and Proteins – basic units, architectural hierarchy and organization, functions **CO4**

UNIT V: ENZYMES **9**

Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Enzymes of plant and Animal origin used in industries, Biosensors and its applications. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Lodish, Harvey etal., “Molecular Cell Biology”, 5 th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman “The Cell : A Molecular Approach”, 4 th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., “Molecular Biology of the Cell”, 4 th Edition, Garland Science (Taylors Francis), 2002.

REFERENCES:

1. McDonald, F etal., “ Molecular Biology of Cancer” 2nd Edition, Taylor & Francis, 2004.
2. King, Roger J.B. “Cancer Biology” Addison Wesley Longman, 1996

COURSE OUTCOMES

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

CO1 Would have deeper understanding of cell at structural and functional level.

CO2 Would have broad knowledge on cell division mechanisms

CO3 Would demonstrate a clear understanding of Biomolecules such DNA, RNA and Protein

CO4 Would develop skill on employing enzymes for various applications

CO5 Would have deeper understanding of cell at structural and functional level.

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

AD1001 CONSTITUTION OF INDIA

L	**T**	**P**	**C**
2	**0**	**0**	**0**

OBJECTIVES:

Students will be able to :

- Understand the premises informing the twin themes of liberty and freedom from a civil Rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism Let the should know about the importance of character
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I: HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working) **CO1**

UNIT II: PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features **CO2**

UNIT III: CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. **CO3**

UNIT IV: ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions. **CO4**

UNIT V: LOCAL ADMINISTRATION

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. **CO5**

UNIT VI: ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women. **CO6**

TOTAL PERIODS: 30

REFERENCES:

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES

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

CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualizationof social reforms leading to revolution in India.

CO3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4 Discuss the passage of the Hindu Code Bill of 1956.

MAPPING OF COs WITH POs AND PSOs

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

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

Students will be able to

- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I:

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements **CO1**

UNIT II:

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline **CO2**

UNIT III:

Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature **CO3**

UNIT IV:

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively. **CO4**

TOTAL PERIODS: 30

REFERENCES:

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

COURSE OUTCOMES

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

CO1	Knowledge of self-development.
CO2	Learn the importance of Human values.
CO3	Developing the overall personality Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models
CO4	Using discrete time Markov chains to model computer systems
CO5	Knowledge of self-development.

MAPPING OF COs WITH POs AND PSOs															
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	-	3	-	-	-
CO2	-	-	1	-	-	3	2	1	3	2	-	-	-	-	-
CO3	2	3	3	3	3	2	-	-	2	3	-	-	3	3	-
CO4	3	2	3	3	3	2	-	-	2	2	3	3	3	2	-
CO5	-	-	2	-	1	3	-	-	2	1	-	3	-	-	-

AD1003 **PEDAGOGY STUDIES** **L T P C**

2 0 0 0

OBJECTIVES:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DFLD, other agencies and researchers
- Identify critical evidence gaps to guide the development

UNIT I: INTRODUCTION AND METHODOLOGY **5**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching **CO1**

UNIT II: INTRODUCTION AND METHODOLOGY **5**

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions **-** Overview of methodology and Searching **CO2**

UNIT III: THEMATIC OVERVIEW **5**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education **CO3**

UNIT IV: EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES **5**

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies **CO4**

UNIT V: PROFESSIONAL DEVELOPMENT **5**

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes **CO5**

TOTAL PERIODS: 25

REFERENCES:

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

COURSE OUTCOMES

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

CO1 Understand What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2 Understand What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3 Understand How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

MAPPING OF COs WITH POs AND PSOs

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

AD1004 **STRESS MANAGEMENT BY YOGA**

L	T	P	C
2	0	0	0

OBJECTIVES:

- To achieve overall health of body and mind
- To overcome stress

UNIT I:

Definitions of Eight parts of yoga.(Ashtanga) **CO1**

UNIT II:

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha. **CO2**

UNIT III:

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayama **CO3**

TOTAL PERIODS: 30

REFERENCES:

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

COURSE OUTCOMES

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

CO1 Develop healthy mind in a healthy body thus improving social health alsoImprove efficiency

CO2 Apply various yoga postures (asanas) and breathing exercises (pranayama) to manage stress and improve physical health.

CO3 Develop mindfulness and relaxation techniques through meditation and yoga to enhance emotional stability and self-awareness.

MAPPING OF COs WITH POs AND PSOs

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

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTNMENT SKILL	L	T	P	C
		2	0	0	0

OBJECTIVES:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I:

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's) **CO1**

UNIT II:

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48. **CO2**

UNIT III:

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63 **CO3**

TOTAL PERIODS: 30

REFERENCES:

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

COURSE OUTCOMES

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

CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

MAPPING OF COs WITH POs AND PSOs

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

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

OBJECTIVES:

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

UNIT I: QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN **9**

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **CO1**

Assignment: Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT II: RURAL ECONOMY AND LIVELIHOOD **9**

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **CO2**

Assignment: Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.

UNIT III: RURAL INSTITUTIONS **9**

History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **CO3**

Assignment: Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.

UNIT IV: RURAL DEVELOPMENT PROGRAMMES **9**

National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **CO4**

Written Assignment: Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.

UNIT V: FIELD WORK **9**

Each student selects one programme for field visit Field based practical activities:

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities **CO5**
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site

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

TOTAL PERIODS: 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1 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	-	-	-	-	-	3	3	3	-	2	1	3	2	-	-
CO2	3	3	2	2	2	-	-	-	1	1	1	-	2	2	1
CO3	-	-	-	-	-	3	3	3	-	2	1	3	2	-	-
CO4	-	-	-	-	-	3	3	3	-	2	1	3	2	-	-
CO5	-	-	-	-	-	3	3	3	-	2	1	3	2	-	-

AD1007 **ESSENCE OF INDIAN KNOWLEDGE TRADITION** **L T P C**
3 0 0 3

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: **INTRODUCTIONTOCULTURE** **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 LANGUAGESANDLITERATURE** **9**

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages &Literature **CO2**

UNIT III: **RELIGIONANDPHILOSOPHY** **9**

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only) **CO3**

UNIT IV: **FINE ARTS IN INDIA (ART, TECHNOLOGY & ENGINEERING)** **9**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India **CO4**

UNIT V: **EDUCATION SYSTEM IN INDIA** **9**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375,2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333,2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X,200

4. Narain, “Examinations in ancient India”, Arya Book Depot,1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher,1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990,2014.

COURSE OUTCOMES

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

CO1 Understand philosophy of Indian culture.

CO2 Distinguish the Indian languages and literature.

CO3 Learn the philosophy of ancient, medieval and modern India.

CO4 Acquire the information about the fine arts in India.

CO5 Know the contribution of scientists of differ enters.

MAPPING OF COs WITH POs AND PSOs

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

OEC101 **INTRODUCTION TO SIGNALS AND SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic properties of signal and systems
- To know the methods of characterization of LTI systems in the time domain
- To analyze continuous-time signals and system in the Fourier and Laplace domain
- To analyze discrete-time signals and system in the Fourier and Z transform domain

UNIT I: CLASSIFICATION OF SIGNALS AND SYSTEM **9**

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals – Continuous-time (CT) and Discrete-time (DT) signals, Periodic and Aperiodic signals, Deterministic and Random signals, Energy and Power signals - Classification of systems- CT systems and DT systems- — Linear and Nonlinear, Time-variant and Time-invariant, Causal and Non- causal, Stable and Unstable. **CO1**

UNIT II: ANALYSIS OF CONTINUOUS TIME SIGNALS **9**

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties. **CO2**

UNIT III: LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS **99**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series and parallel **CO3**

UNIT IV: ANALYSIS OF DISCRETE TIME SIGNALS **99**

Baseband signal Sampling – Fourier Transform of discrete-time signals (DTFT) – Properties of DTFT - Z Transform and Properties **CO4**

UNIT V: LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS **9**

Impulse response – Difference equations-Convolution sum- Discrete-time Fourier Transform and Z Transform analysis of Recursive and Non-Recursive systems-DT systems connected in series and parallel **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.
2. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford,2009.
3. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson,2007.
4. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson,2007.

COURSE OUTCOMES

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

CO1 To be able to determine if a given system is linear/causal/stable

CO2 Capable of determining the frequency components present in a deterministic signal

CO3 Capable of characterizing LTI systems in the time domain and frequency domain

CO4 Understand the process of sampling and able to analyze the discrete-time signals in the frequency domain

CO5 To be able to compute the output of an LTI system in the time and frequency domains

MAPPING OF COs WITH POs AND PSOs

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

OEC102	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio–economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I: ANALOG MODULATION **9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Super heterodyne receivers **CO1**

UNIT II: PULSE MODULATION **9**

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder – Time Division Multiplexing, Frequency Division Multiplexing **CO2**

UNIT III: DIGITAL MODULATION AND TRANSMISSION **9**

Phase shift keying – BPSK, DPSK, QPSK – Principles of M–array signalling, PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers **CO3**

UNIT IV: INFORMATION THEORY AND CODING **9**

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon–Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding **CO4**

UNIT V: SPREAD SPECTRUM AND MULTIPLE ACCESS **9**

PN sequences – properties – m–sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, ‘Principles of Communication Systems’ 3/e, TMH 2007
2. S. Haykin ‘Digital Communications’ John Wiley 2005

REFERENCES:

1. B. P. Lathi, ‘Modern Digital and Analog Communication Systems’, 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – ‘Analog and Digital Communications’ TMH 2006
3. B. Sklar, Digital Communications Fundamentals and Applications’ 2/e Pearson Education 2007.

COURSE OUTCOMES

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

CO1	Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2	Apply analog and digital communication techniques.
CO3	Use data and pulse communication techniques.
CO4	Analyze Source and Error control coding.
CO5	Understand concepts of spread spectrum and multiple access

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

OEC103 **BASICS OF EMBEDDED SYSTEMS AND IoT** **L T P C**

3 0 0 3

OBJECTIVES:

- Understand the concepts of embedded processor
- Learn the Interfacing and Embedded C programming
- Be exposed to the basic concepts of IOT and its programming
- Learn the concepts of IOT communications and IOT applications

UNIT I: **8-BIT EMBEDDED PROCESSOR** **9**

8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling. **CO1**

UNIT II: **EMBEDDED C PROGRAMMING** **9**

Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need for RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies. **CO2**

UNIT III: **IOT AND ARDUINO PROGRAMMING** **9**

Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output from Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino. **CO3**

UNIT IV: **IOT COMMUNICATION AND OPEN PLATFORMS** **9**

IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud. **CO4**

UNIT V: APPLICATIONS DEVELOPMENT **9**

Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2. 2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

REFERENCES:

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3. Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", MorganKauffman/Elsevier,2006.
4. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

COURSE OUTCOMES

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

CO1 Understand the concepts of embedded processor

CO2 Learn the Interfacing and Embedded C programming

CO3 Expose the basic concepts of IOT and its programming

CO4 Learn the concepts of IOT communications

CO5 Study the design of embedded system and IOT applications

MAPPING OF COs WITH POs AND PSOs

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

OEC104	BIOMEDICAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental of Digital Images
- To study about the different modalities of Biomedical Images.
- To learn the basic Image Enhancement and Segmentation techniques needed to processes Biomedical Images.
- To study different feature extraction techniques.
- To learn about the role of pattern recognition in different diagnostic methods using biomedical images using a case study.

UNIT I: FUNDAMENTALS OF DIGITAL IMAGE **9**

Introduction to Digital Image Fundamentals, Human visual system, Image as a 2D data, Image representation – Gray scale and Color images, image sampling and quantization, Objectives of biomedical image analysis. **CO1**

UNIT II: IMAGING MODALITIES **9**

Nature of medical images: X-ray imaging – Tomography – Nuclear medicine imaging – SPECT imaging – Positron imaging tomography – Ultrasonography – Magnetic resonance imaging. **CO2**

UNIT III: IMAGE ENHANCEMENT AND SEGMENTATION **9**

Image enhancement – Gray level transforms – Contrast enhancement, Histogram Equalization, Filtering in the Frequency Domain, Spatial filtering – Optimal filtering – Adaptive filters, Homomorphic filtering, Removal of artifacts in medical images. Segmentation- Thresholding and binarization, – Region growing and Edge detection **CO3**

UNIT IV: FEATURE EXTRACTION **9**

Analysis of shape and texture – Representation of shapes and contours – Shape factors – Models for generation of texture – Statistical analysis of texture – Fractal analysis – Fourier domain analysis of texture – Structural analysis of texture. **CO4**

UNIT V: PATTERN RECOGNITION **9**

Computer aided diagnosis, Pattern classification and diagnostic decision – Measures of diagnostic accuracy – Case Study: Contrast enhancement of mammograms – Detection of calcifications by region growing – Shape and texture analysis of calcifications- Classification. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. Sinha G. R, Patel, B. C., “Medical Image Processing: Concepts And Applications”, Prentice Hall, 2014.
2. Gonzalez R C, Woods R E, “Digital Image Processing”, Third Edition, Prentice Hall, 2007

REFERENCES:

1. Rangayyan R M, “Biomedical Image Analysis”, Fifth Edition, CRC Press, 2005
2. KayvanNajarian, Robert Splinter, “Biomedical Signal and Image Processing”, Second Edition, CRC Press, 2014.
3. Deserno T M, “Biomedical Image Processing”, Springer, 2011

COURSE OUTCOMES

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

CO1 To understand the fundamental of Digital Images

CO2 To study about the different modalities of Biomedical Images.

CO3 To learn the basic Image Enhancement and Segmentation techniques needed to processes Biomedical Images.

CO4 To study different feature extraction techniques.

CO5 To learn about the role of pattern recognition in different diagnostic methods using biomedical images using a case study.

MAPPING OF COs WITH POs AND PSOs

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

OEC105 WIRELESS COMMUNICATION AND NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To identify different types of personal, local, wide, and metropolitan area wireless networks.
- To explain the necessity of physical and wireless MAC layer alternatives and their mechanisms.
- To describe the advancements in wireless networks.

UNIT I: CHALLENGES IN WIRELESS NETWORKS **9**

Medium Access Alternatives – Fixed Assignment for Voice Oriented Networks Random Access for Data Oriented Networks – Handoff and Roaming Support – Security and Privacy **CO1**

UNIT II: WIRELESS LANS **9**

Wireless LANs – IEEE 802.11b WLAN – Architecture and Services – Installation of WLAN – Other IEEE 802.11 standards – a,g,n, HIPERLAN, Wi–Fi and WiMax standards **CO2**

UNIT III: WIRELESS WANS **9**

First Generation Analog – Second Generation TDMA – GSM – GPRS – Second Generation CDMA – IS-95 – Third Generation Systems WCDMA & CDMA 2000. **CO3**

UNIT IV: ADHOC AND SENSOR NETWORKS **9**

Characteristics of MANETs – Table–driven and Source initiated On Demand routing protocols, Hybrid protocols – Wireless Sensor networks – Classification – Routing protocols – Sensor Network Architecture – Data Dissemination – Data Gathering – MAC Protocols for Sensor Networks – Location Discovery and quality of a Sensor Network. **CO4**

UNIT V: ADVANCES IN WIRELESS NETWORKS **9**

Bluetooth – Zig Bee – Ultra wide Band Radio communication – Optical wireless Networks – Software Defined Radio– Cognitive Radio – WBAN. **CO5**

TOTAL PERIODS: 45

TEXT BOOKS:

1. KavehPahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks: A unified approach", Pearson, 2002.
2. William Stallings, Cory Beard, "Wireless Communications and Networks", Global Edition, Pearson Education, 2015.

REFERENCES:

1. Dharma PrakashQing–An Zeng&Agrawal, “Introduction to Wireless and Mobile Systems”, 4th Edition, Cengage learning, 2015.
3. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
4. Clint Smith, P.E. & Daniel Collins, “3G Wireless Networks”, 3rd Edition, Tata McGraw Hill, 2014.
5. Gary. S. Rogers & John Edwards, “An Introduction to Wireless Technology”, Pearson, 2012.
6. P.MuthuChidambara Nathan, “Wireless Communications", Kindle edition, PHI Learning Pvt. Ltd., 2013.

COURSE OUTCOMES

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

CO1 Explain the Challenges in Wireless Networks.

CO2 Compare the performance of various LAN standards

CO3 Analyze the performance of WAN standards

CO4 Apply network protocol concepts associated with adhoc and sensor networks, wireless MANs, LANs and PANs. Analyze the advancements in different wireless networking standards

CO5 Explain the Challenges in Wireless Networks.

MAPPING OF COs WITH POs AND PSOs

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

OEC106	PCB DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain the basics of PCB design.
- To understand the basic design rules of PCB design.
- To apply the modern tools for designing and fabrication of PCBs.
- To gain the knowledge of production techniques of PCB design.
- To understand the effects of EMI/EMC in PCB design

UNIT I: INTRODUCTION TO PRINTED CIRCUIT BOARD **9**

Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. **CO1**

UNIT II: DESIGN RULES FOR PCB **9**

Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications. **CO2**

UNIT III: INTRODUCTION TO ELECTRONIC DESIGN AUTOMATION (EDA) TOOLS FOR PCB DESIGNING **9**

Brief Introduction of various simulators, SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design. **CO3**

UNIT IV: INTRODUCTION PRINTED CIRCUIT BOARD PRODUCTION TECHNIQUES **9**

Photo printing, film master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations. **CO4**

UNIT V: PCB DESIGN FOR EMI/EMC AND TECHNOLOGY TRENDS **9**

DESIGN FOR EMI/EMC: Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques. Multilayer PCBs. **CO5**

RECENT TRENDS: Multi wire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.

TOTAL PERIODS: 45

TEXT BOOKS:

1. R. S. Khandpur, “Printed circuit board design, fabrication, assembly and testing” Tata McGraw Hill 2006.

REFERENCES:

1. Walter C. Bosshart, “Printed circuit Board Design and technology” 1st Edition, McGraw Hill Education.
2. Clyde F. Coombs, Jr, Happy T. Holden, ”Printed Circuits Handbook”, Sixth Edition, McGraw-Hill Education, 2016

3. Kraig Mitzner, Bob Doe, Alexander Akulin, Anton Suponin, Dirk Müller, “Complete PCB Design Using OrCAD Capture and PCB Editor” 2nd Edition, 2009.
4. Rao R Tummala, Madhavan Swaminathan, “Introduction to System-on-Package” McGraw Hill, 2008.

COURSE OUTCOMES

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

CO1 Understand the basics of PCB design.

CO2 Understand the design rules of PCB design.

CO3 Apply advance techniques, skills and modern tools for designing and fabrication of PCBs

CO4 Understand the production techniques of PCB design.

CO5 Understand the effects of EMI/EMC in PCB design.

MAPPING OF COs WITH POs AND PSOs

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