B.E. Degree

in

ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM & SYLLABUS (CBCS)

(For students admitted from the Academic Year 2022-2023)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

CHUNKANKADAI, NAGERCOIL – 629 003.

KANYAKUMARI DISTRICT, TAMIL NADU, INDIA

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

Chunkankadai, Nagercoil – 629 003

AUTONOMOUS COLLEGE AFFILIATED TO ANNA UNIVERSITY

ACADEMIC REGULATIONS 2022

B. E. ELECTRONICS AND COMMUNICATION ENGINEERING CURRICULUM

CHOICE BASED CREDIT SYSTEM

Inconsonance to the vision of our College,

An engineering graduate we form would be a person with optimal human development, i.e. physical, mental, emotional, social and spiritual spheres of personality.

He/she would be also a person mature in relationships, especially knowing how to treat everyonewith respect, including persons of complementary gender with equality and gender sensitivity guidedby clear and pro-social values.

He would be patriotic and would hold the Indian Constitution and all the precepts it outlays close to his heart and would have a secular spirit committed to safeguard and cherish the multi-cultural, multi- religious and multi-linguistic ethos of Indian Society.

Academically, he/she would be a graduate with a strong engineering foundation with proficient technical knowledge and skills. He would have enough exposure and experience into the ethos of relevant industry and be industry ready to construct a successful career for himself and for the benefit of the society.

He would have been well trained in research methodology and would have established himself as a researcher having taken up many research projects, with sound ethical standards and social relevance. He would be a person with a passion for technical innovations committed to lifelong learning and research.

He would be well prepared and confident to develop ingenuous solutions to the problems people face as an individual and as a team and work for the emancipation of our society with leadership and courage.

Electronics and Communication Engineering is a demanding course trending over along period since it plays a vibrant role in improving the productivity and efficiency of all Electronic and Communication equipment. It aims at developing technically competent Engineers with academic excellence, ethical values and international outlook to serve the society.

Electronics and Communication engineers_ expertise in managing large scale research, conceptualizing, designing, developing and testing of the electronic equipment used in latest communication devices and other handy technological equipment, and smart devices.

I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I.	To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.
II.	To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.
III.	To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

II. PROGRAMME OUTCOMES (POs)

PO#	Graduate Attribute
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 knowledgeand 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 consequentresponsibilities relevant to the professional engineering practice.
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of,and need for sustainable development.
8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

III. PROGRAMME SPECIFIC OUTCOMES (PSOs)

1.	Analyze, design and develop solutions by applying foundational concepts of electronics and communication engineering.
2.	Apply design principles and best practices for developing quality products for scientific and business applications.
3.	Adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
II.	2	1	2	2	3	1	1	1	1	1	1	2	2	1	1
III.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

PROGRAMME ARTICULATION MATRIX

Year	Semester	Course name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	MA22101	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
		PH22101	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
		CH22101	3	2	2	1	-	-	2	-	-	-	-	1	-	-	-
		CS22101	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
		GE3152	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
		EN22101	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-
		BS22101	3	1	-	-	-	2	2	-	2	1	-	1	-	-	-
		CS22102	3	3	3	3	2	-	-	-	-	-	-	1	-	-	2
		HS22101	3	2	2	1	-	-	1	-	1	-	1	1	-	-	-
		HS22102	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2
I	II	MA22201	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
		EE22201	2	1	-	-	-	-	-	-	2	1	-	1	-	-	-
		EC22201	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-
		ME22201	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-
		GE3252	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
		EN22201	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
		PH22202	2	1	-	-	-	-	-	-	2	1	-	1	-	-	-
		CH22201	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
		EC22202	2	2	1	-	-	-	-	-	2	1	1	2	2	-	-
		ES22203	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-
II	III	MA22303	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
		EC22301	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
		EC22302	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
		EC22303	3	3	3	1	-	-	-	-	-	-	-	-	3	3	3
		EC22304	2	2	2	1	-	1	-	-	-	-	1	2	2	2	2
		EC22305	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
		EC22306	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
		SD22302	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
		AC22301	-	1	1	1	1	1	1	1	1	1	1	1	-	-	-
		HS22301	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
II	IV	EC22401	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
		EC22402	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
		EC22403	3	3	2	3	-	2	-	-	-	-	-	2	2	1	-
		EC22404	2	2	2	1	2	2	-	-	2	2	2	2	2	1	-
		EC22405	2	2	1	1	1	-	-	-	-	-	-	-	1	-	2
		EC22406	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
		EC22407	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
		SD22402	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
		AC22401	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1

III	V	**EC22501**	2	2	1	1	2	1	-	-	1	-	2	2	2	1	1
		EC22502	2	2	2	2	1	-	-	-	1	-	-	2	2	2	1
		EC22503	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
		EC22504	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2
		EC22505	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2
		SD22502	2	2	2	-	1	1	1	1	2	2	1	2	-	1	2
		AC22501	1	1	1	1	1	2	1	2	1	1	1	1	-	-	-
		HS22501	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
III	VI	**HS22601**	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-
		EC22601	2	2	2	2	2	2	-	-	-	-	2	2	3	-	-
		EC22602	2	2	2	2	2	2	-	-	-	-	-	2	2	1	1
		SD22602	2	2	2	-	2	-	-	-	1	-	-	2	-	-	1
IV	VII	**MS22701**	2	1	1	2	2	1	1	1	2	3	1	1	2	1	1
		EC22701	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
		SD22702	2	2	2	-	2	-	-	-	1	-	-	2	-	-	1
		EC22702	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
IV	VIII	**EC22801**	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3

SEMESTER I

SL.NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	MA22101	Matrices and Calculus	BSC	3	1	0	4	4
2.	PH22101	Engineering Physics	BSC	3	0	0	3	3
3.	CH22101	Engineering Chemistry	BSC	3	0	0	3	3
4.	CS22101	Problem Solving and Python Programming	ESC	3	0	0	3	3
5.	GE3152	Heritage of Tamil	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
6.	EN22101	Communicative English	HSMC	2	0	2	4	3
PRACTICAL COURSES								
7.	BS22101	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
8.	CS22102	Python Programming Laboratory	ESC	0	0	4	4	2
MANDATORY COURSES								
9.	IP22101	Induction Programme	-	-	-	-	-	0
10.	HS22101	Higher Order Thinking	MC	1	0	0	1	1
11.	HS22102	Universal Human Values: Understanding Harmony and Ethical Human Conduct	HSMC	2	0	0	2	2
TOTAL				**18**	**1**	**10**	**29**	**24**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	MA22201	Statistics and Numerical Methods	BSC	3	1	0	4	4
2.	EE22201	Basic Electrical and Instrumentation Engineering	ESC	3	0	0	3	3
3.	EC22201	Electric Circuits and Electron Devices	ESC	3	0	0	3	3
4.	ME22201	Engineering Graphics	ESC	2	0	2	4	3
5.	GE3252	Tamils and Technology	HSMC	1	0	0	1	1
THEORY COURSES WITH PRACTICAL COMPONENT								
6.	EN22201	Technical English	HSMC	2	0	2	4	3
7.	PH22202	Physics for Electronics Engineering	BSC	2	0	2	4	3
8.	CH22201	Environment and Sustainability	BSC	2	0	2	4	3
PRACTICAL COURSES								
9.	EC22202	Circuits and Devices Laboratory	ESC	0	0	4	4	2
10.	ES22203	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				**18**	**1**	**16**	**35**	**27**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	MA22303	Linear Algebra and Transforms	BSC	3	1	0	4	4
2.	EC22301	Electronic Circuits	PCC	3	0	0	3	3
3.	EC22302	Signals and Systems	PCC	3	0	0	3	3
4.	EC22303	C Programming and Data Structures	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
5.	EC22304	Digital Principles and System Design	PCC	3	0	2	5	4
PRACTICAL COURSES								
6.	EC22305	Electronic Circuits Laboratory	PCC	0	0	4	4	2
7.	EC22306	C Programming and Data Structures Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8.	SD22302	Coding Skills and Soft Skills Training – Phase I	EEC	0	0	4	4	2
MANDATORY COURSES								
9.	AC22301	Constitution of India	MC	2	0	0	2	0
10.	HS22301	Value Education-I	MC	1	0	0	1	0
TOTAL				**18**	**1**	**14**	**33**	**23**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22401	Analog Communication	PCC	3	0	0	3	3
2.	EC22402	Electromagnetic Fields	PCC	3	0	0	3	3
3.	EC22403	Control Systems Engineering	PCC	3	0	0	3	3
4.	EC22404	Linear Integrated Circuits	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
5.	EC22405	Digital Signal Processing	PCC	3	0	2	5	4
PRACTICAL COURSES								
6.	EC22406	Analog Communication Laboratory	PCC	0	0	4	4	2
7.	EC22407	Linear Integrated Circuits Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8.	SD22402	Coding Skills and Soft Skills Training – Phase II	EEC	0	0	4	4	2
MANDATORY COURSES								
9.	AC22401	Industrial Safety Engineering	MC	2	0	0	2	0
TOTAL				**17**	**0**	**14**	**31**	**22**

SEMESTER V

SL.NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.		Professional Elective I	PEC	3	0	0	3	3
2.		Professional Elective II	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
3.	EC22501	Networks and Security	PCC	2	0	2	4	3
4.	EC22502	VLSI Design	PCC	2	0	2	4	3
5.	EC22503	Microprocessor and Microcontroller	PCC	2	0	2	4	3
EMPLOYABILITY ENHANCEMENT COURSES								
6.	EC22504	Technical Seminar	EEC	0	0	2	2	1
7.	EC22505	In plant / Industrial Training	EEC	-	-	-	-	1
8.	SD22502	Coding Skills and Soft Skills Training – Phase III	EEC	0	0	4	4	2
MANDATORY COURSES								
9.	AC22501	Entrepreneurship Development	MC	2	0	0	2	0
10.	HS22501	Value Education-II	MC	1	0	0	1	0
TOTAL				**15**	**0**	**12**	**27**	**19**

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	HS22601	Professional Ethics	HSMC	3	0	0	3	3
2.		Open Elective – I	OEC	3	0	0	3	3
3.		Professional Elective III	PEC	3	0	0	3	3
4.		Professional Elective IV	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
5.	EC22601	Digital Communication	PCC	3	0	2	5	4
6.	EC22602	Embedded Systems and IoT Design	PCC	2	0	2	4	3
EMPLOYABILITY ENHANCEMENT COURSES								
7.	SD22602	Coding Skills and Quantitative Aptitude – Phase I	EEC	0	0	4	4	2
TOTAL				**17**	**0**	**8**	**25**	**21**

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	MS22701	Principles of Management	HSMC	3	0	0	3	3
2.		Professional Elective V	PEC	3	0	0	3	3
3.		Professional Elective VI	PEC	3	0	0	3	3
4.		Open Elective – II	OEC	3	0	0	3	3
5.		Open Elective – III	OEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
6.	EC22701	Antenna and RF Communication	PCC	2	0	2	4	3
EMPLOYABILITY ENHANCEMENT COURSES								
7.	SD22702	Coding Skills and Quantitative Aptitude – Phase II	EEC	0	0	4	4	2
8.	EC22702	Mini Project	EEC	0	0	6	6	3
TOTAL				**17**	**0**	**12**	**29**	**23**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
EMPLOYABILITY ENHANCEMENT COURSES								
1.	EC22801	Project Work	EEC	0	0	16	16	8
TOTAL				**0**	**0**	**16**	**16**	**8**

TOTAL CREDITS: 167

SUMMARY

B.E. Electronics and Communication Engineering											
S.No	Subject Area	Credits per Semester								Total Credits	AICTE
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	6	4				3	3		16	15
2	BSC	12	10	4						26	25
3	ESC	5	13							18	24
4	PCC			17	20	9	7	3		56	48
5	PEC					6	6	6		18	18
6	OEC						3	6		9	18
7	EEC			2	2	4	2	5	8	23	15
8	MC	1		0	0	0				1	-
9	AC			0	0	0				0	0
Total		24	27	23	22	19	21	23	8	167	163

PROFESSIONAL ELECTIVE COURSES: VERTICALS

LIST OF IDENTIFIED VERTICALS	
Vertical 1	VLSI DESIGN AND TECHNOLOGY
Vertical 2	IMAGE AND SIGNAL PROCESSING
Vertical 3	HEALTHCARE DEVICES AND TECHNOLOGY
Vertical 4	IoT AND ITS APPLICATIONS
Vertical 5	WIRELESS AND SPACE TECHNOLOGIES

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5
VLSI DESIGN AND TECHNOLOGY	IMAGE AND SIGNAL PROCESSING	HEALTHCARE DEVICES AND TECHNOLOGY	IoT AND ITS APPLICATIONS	WIRELESS AND SPACE TECHNOLOGIES
VLSI Technology	Statistical Signal Processing	Biomedical Sensors and Instrumentation	Sensors and Actuators	4G/5G Communication Networks
Digital System Design with FPGA	Audio and Speech Processing	Diagnostic and Therapeutic Equipment	Programming Embedded System with C	Avionics Systems
VLSI Testing and Design for Testability	Bio Signal Processing	Medical Imaging Technology	IoT System Architecture	Optical Communication and Networks
Analog IC Design	Image and Video Processing	Wearable Devices	IoT Protocols and Networking	Radar and Navigational Aids
ASIC Design	DSP Processors	Human Assist Devices and Implant Technology	Smart IoT Applications	Satellite Communication and Broadcasting
Low Power IC Design	Machine Learning Techniques	Brain Computer Interface and Applications	Mobile Application Development for IoT	Wireless Communication
VLSI Signal Processing	Biometric Systems	Environmental Radiation and Safety	AI and IoT in Robotics	Air Balun Application in Communication Technology

VERTICAL 1: VLSI DESIGN AND TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22511	VLSI Technology	PEC	3	0	0	3	3
2.	EC22512	Digital System Design with FPGA	PEC	2	0	2	4	3
3,	EC22613	VLSI Testing and Design for Testability	PEC	3	0	0	3	3
4.	EC22614	Analog IC Design	PEC	2	0	2	4	3
5.	EC22715	ASIC Design	PEC	3	0	0	3	3
6.	EC22716	Low Power IC Design	PEC	2	0	2	4	3
7.	EC22717	VLSI Signal Processing	PEC	2	0	2	4	3

VERTICAL 2: IMAGE AND SIGNAL PROCESSING

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22521	Statistical Signal Processing	PEC	3	0	0	3	3
2.	EC22522	Audio and Speech Processing	PEC	3	0	0	3	3
3,	EC22623	Bio Signal Processing	PEC	3	0	0	3	3
4.	EC22624	Image and Video Processing	PEC	3	0	0	3	3
5.	EC22725	DSP Processors	PEC	3	0	0	3	3
6.	EC22726	Machine Learning Techniques	PEC	3	0	0	3	3
7.	EC22727	Biometric Systems	PEC	3	0	0	3	3

VERTICAL 3: HEALTHCARE DEVICES AND TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22531	Biomedical Sensors and Instrumentation	PEC	3	0	0	3	3
2.	EC22532	Diagnostic and Therapeutic Equipment	PEC	3	0	0	3	3
3,	EC22633	Medical Imaging Technology	PEC	3	0	0	3	3
4.	EC22634	Wearable Devices	PEC	3	0	0	3	3
5.	EC22735	Human Assist Devices and Implant Technology	PEC	3	0	0	3	3
6.	EC22736	Brain Computer Interface and Applications	PEC	3	0	0	3	3
7.	EC22737	Environmental Radiation and Safety	PEC	3	0	0	3	3

VERTICAL 4: IoT AND ITS APPLICATIONS

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22541	Sensors and Actuators	PEC	3	0	0	3	3
2.	EC22542	Programming Embedded System with C	PEC	3	0	0	3	3
3,	EC22643	IoT System Architecture	PEC	3	0	0	3	3
4.	EC22644	IoT Protocols and Networking	PEC	3	0	0	3	3
5.	EC22745	Smart IoT Applications	PEC	3	0	0	3	3
6.	EC22746	Mobile Application Development for IoT	PEC	3	0	0	3	3
7.	EC22747	AI and IoT in Robotics	PEC	2	0	2	4	3

VERTICAL 5: WIRELESS AND SPACE TECHNOLOGIES

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1.	EC22551	4G/5G Communication Networks	PEC	3	0	0	3	3
2.	EC22552	Avionics Systems	PEC	3	0	0	3	3
3,	EC22653	Optical Communication and Networks	PEC	3	0	0	3	3
4.	EC22654	Radar and Navigational Aids	PEC	3	0	0	3	3
5.	EC22755	Satellite Communication and Broadcasting	PEC	3	0	0	3	3
6.	EC22756	Wireless Communication	PEC	3	0	0	3	3
7.	EC22757	Air Balun Application in Communication Technology	PEC	3	0	0	3	3

OPEN ELECTIVES

(List of Subjects offered by ECE to other department students)

OPEN ELECTIVES – I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	EC22681	Robotic Process Automation	OEC	3	0	0	3	3
2.	EC22682	Medical Instrumentation	OEC	3	0	0	3	3
3.	EC22683	Fundamentals of Embedded and IoT	OEC	2	0	2	4	3

OPEN ELECTIVES – II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	EC22781	Biometric Technology	OEC	3	0	0	3	3
2.	EC22782	Mobile App Development	OEC	3	0	0	3	3

OPEN ELECTIVES – III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	EC22783	PCB Design and Fabrication	OEC	3	0	0	3	3
2.	EC22784	Consumer Electronics	OEC	3	0	0	3	3
3.	EC22785	Machine Learning	OEC	3	0	0	3	3

SEMESTER – I

MA22101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications
- To familiarize the students with differential calculus
- To familiarize the student with functions of several variables. This is needed in many branches of engineering
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications
- To make the students understand various techniques ODE

UNIT I MATRICES **12**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Problem solving using Cayley-Hamilton method – Orthogonal transformation of a symmetric matrix to Diagonal form – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature, rank, index.

UNIT II DIFFERENTIAL CALCULUS **12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiationrules: sum, product, quotient, chain rules - Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES **12**

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

UNIT IV MULTIPLE INTEGRALS **12**

Double integrals – Double integrals in Cartesian and polar coordinates –Area enclosed by planecurves - Change of order of integration – Triple integrals – Volume of solids: cube, rectangular parallelopiped.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **12**

Linear differential equations of second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n , sin ax, cos ax, $e^{ax}\,x^n$, e^{ax} sinbx, e^{ax} cosbx – Linear differential equations ofsecond and third order with variable coefficients: Cauchy‘s and Legendre‘s linear equations – Method of variation of parameter

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Define the basic concepts of matrices, limit and continuity of a function, differentiation, ODE and integration
CO2:	Explain the properties of matrices and nature of the quadratic form

CO3:	Interpret the techniques of differentiation, partial differentiation, ODE and integration
CO4:	Apply diagonalization of matrices in quadratic form and apply Cayley Hamilton theorem to find the inverse of matrices
CO5:	Solve problems on differentiation, partial differentiation, integration and ODE using different methods
TEXT BOOKS:	
1.	Narayanan, S. and Manicavachagom Pillai, T. K., Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, Reprint 2017.
2.	Grewal B.S., –Higher Engineering Mathematics'', Khanna Publishers, New Delhi,43rd Edition, 2014
REFERENCES:	
1.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2.	Anton, H, Bivens, I and Davis, S, "Calculus", Tenth Edition , Wiley, 2016.
3.	Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics'', Third Edition, Narosa Publications, New Delhi, 2007.
4.	Kreyszig. E, "Advanced Engineering Mathematics", Tenth Edition, John Wiley and Sons, New Delhi, 2016.
5.	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Seventh Edition Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	1	-

PH22101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology
- To help the students to interrelate the topics such as properties of matter, thermal physics, ultrasonics, quantum theory and crystals, learned in the course
- To motivate students to compare and contrast the available equipment in the respective fields
- To induce the students to design new devices that serve humanity by applying the knowledge gained during the course

UNIT I	PROPERTIES OF MATTER	9

Elasticity – Types of Elastic moduli – Factors affecting elasticity - Stress-strain diagram and its uses - beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: determination of young‘s modulus – I shaped Girders - twisting couple - torsion pendulum: determination of rigidity modulus and moment of inertia – torsion springs - other states of matter

UNIT II	THERMAL PHYSICS	9

Modes of Heat transfer – Thermal conductivity – Newton‘s law of cooling – Linear heat flow – Thermal conductivity in compound media - Lee‘s Disc method – Radial heat flow – Rubber tubemethod – Solar water heater - Thermodynamics – Isothermal and adiabatic process – Otto cycle – Diesel cycle

UNIT III	ULTRASONICS	9

Sound waves – ultrasonics – properties - production: magnetostriction method - piezoelectric method – cavitation - acoustic grating: wavelength and velocity of ultrasonic waves in liquids – applications: welding, machining, cleaning, soldering and mixing (qualitative) - SONAR – ultrasonic flaw detector - ultrasonography.

UNIT IV	QUANTUM PHYSICS	9

Black body radiation – Planck‘s radiation law – Deduction of Wien‘s displacement law and Rayleigh Jean‘s law - Compton effect, Photoelectric effect (qualitative) – matter waves – 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 – scanning tunneling microscope

UNIT V	CRYSTAL PHYSICS	9

Crystalline and amorphous materials – unit cell, crystal systems, Bravais lattices, Crystal planes, directions and Miller indices – Characteristics of crystal structures: SC, BCC, FCC and HCP structures - crystal imperfections: point, line and surface defects – crystal growth: epitaxial and lithography techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Recall the basics of properties of matter, thermal physics and ultrasonics, to improve their engineering knowledge.
CO2:	Define the advanced physics concepts of quantum theory and the characteristics of crystalline materials.
CO3:	Illustrate Bending of beams, thermal behavior and ultrasonic devices to assess societal and safety issues.
CO4:	Summarize the dual aspects of matter, crystal structures and imperfections of crystals.
CO5:	Apply the moduli of elasticity of different materials, thermal energy, ultrasonics, scanning tunneling microscope and crystal growth techniques in engineering fields.

TEXT BOOKS:

1.	Gaur, R.K & Gupta.S.L, “Engineering Physics”, Dhanpat Rai Publishers, 2016.
2.	Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”, Pearson India Pvt Ltd., 2018

REFERENCES:

1.	Halliday.D, Resnick, R. & Walker. J, “Principles of Physics”, Wiley, 2015.
2.	Bhattacharya, D.K. & Poonam.T., “Engineering Physics”, Oxford University Press, 2015.

3.	Pandey.B. K, & Chaturvedi.S, "Engineering Physics", Cengage Learning India. 2012.
4.	Malik H K & Singh A K,"Engineering Physics'', Second Edition, McGraw Hill Education (India Pvt. Ltd.),2018.
5.	Serway.R.A. & Jewett, J.W, "Physics for Scientists and Engineers'', Cengage Learning India. 2010.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-

CH22101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with water treatment methods and electrochemistry concept
- To gain basic knowledge of corrosion and protection methods
- To understand the basic concepts and synthesis of various engineering materials, nano materials and fuels
- To familiarise the students with the principles, working process and application of energy storage devices

UNIT I **WATER TREATMENT** **9**

Water: Sources, impurities - Hardness of water: Types - Estimation of hardness (EDTA method) - Disadvantages of hard water in boilers (Scale, Sludge) – Softening methods: Internal treatment (Calgon, Sodium Aluminate) and External treatment (Demineralisation process). Domestic water treatment – Desalination of brackish water: RO and Solar desalination method.

UNIT II **ELECTROCHEMISTRY AND CORROSION** **12**

Electrochemical cell – Free energy and emf – Nernst equation and applications – Oxidationand reduction potential – Standard electrodes: Standard Hydrogen electrode, Saturated calomelelectrode, Glass electrode – pH measurement – Conductometric titration (acid-base, precipitation) and Potentiometric titrations: Redox titration (Fe^{2+} x $Cr_2O_7^{2-}$).

Corrosion – Types: Chemical corrosion and Electrochemical corrosion – Corrosion control methods: Sacrificial anodic and Impressed current Cathodic protection method

UNIT III **FUELS AND COMBUSTION** **8**

Fuels - classification of fuels – Comparison of solid, liquid and gaseous fuel - Solid fuel – coal - analysis of coal (proximate only) – Liquid fuel - Petroleum – Refining of petroleum - manufacture of synthetic petrol (Bergius process) – Biodiesel – preparation, properties and uses. Gaseous fuel – CNG, LPG.

Combustion – Calorific value – Types (Gross and Net calorific value) – Dulong's formula – GCV and LCV calculation using Dulong's formula. Flue gas – Analysis of flue gas by Orsat method.

UNIT IV **ENERGY STORAGE DEVICES** **8**

Batteries – Types (Primary and Secondary) - Lead acid battery, Lithium ion battery - Super capacitors – Storage principle, types and examples – Electric vehicle – working principle - Fuel cells – microbial fuel cell and polymer membrane fuel cell.

Nanomaterials in energy storage – CNT –Types, properties and applications.

UNIT V **ENGINEERING MATERIALS** **8**

Abrasives – Types: Natural and Artificial – SiC – preparation, properties and uses. Refractories –Types Acidic, Basic, Neutral – Refractoriness, RUL. Cement – Manufacture – Special cement – white cement and water proof cement. Glass – Manufacture, properties and uses

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Recall the basic concepts of water softening, nano materials and batteries
CO2:	Summarize the types of corrosion, fuels and energy storage devices
CO3:	Explain the basic principles of electrochemistry and engineering materials
CO4:	Identify suitable methods for water treatment, fuel and corrosion control
CO5:	Apply the knowledge of engineering materials, fuels and energy storage devices for material selection and also in energy sectors

TEXT BOOKS:

1.	P. C. Jain and Monika Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2.	S. S. Dara, S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company Ltd, New Delhi, 2015.

REFERENCES:

1.	Friedrich Emich, "Engineering Chemistry", Scientific International Pvt, Ltd, New Delhi, 2014.
2.	Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi 2015.
3.	Sivasankar B. "Engineering Chemistry', Tata McGraw Hill Publishing company Ltd, New Delhi, 2008.
4.	B.S.Murty, P.Shankar, Baldev Raj, B B Rath and James Murday,"Text book of nanoscience and technology'', Universities press.
5.	O.G. Palanna,"Engineering Chemistry", Second Edition, McGraw Hill Education (India) Private Limited, 2017.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	2	1	-	-	1	-	-	-	-	1	-	-	-
CO4	3	2	2	1	-	-	2	-	-	-	-	1	-	-	-
CO5	3	2	2	1	-	-	2	-	-	-	-	1	-	-	-
CO	3	2	2	1	-	-	2	-	-	-	-	1	-	-	-

CS22101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving
- To learn to solve problems using Python conditionals and loops
- To define Python functions and use function calls to solve problems
- To use Python data structures - lists, tuples, and dictionaries to represent complex data

UNIT I	**INTRODUCTION TO COMPUTERS AND PROBLEM SOLVING STRATEGIES**	**9**

Introduction- Components and functions of a computer system- Hardware and Software. Problem solving strategies- Program design tools: Algorithms, Flow charts, Pseudo code

UNIT II	**DATA TYPES, EXPRESSIONS, STATEMENTS AND CONTROL FLOW**	**9**

Features of Python -Variables and Identifiers – Data types: Numbers, Strings, Boolean, Tuples, List, Dictionary, Sets - Input operation - Comments, Reserved words, Indentation - Operators and Expressions – Type Conversion - Selection / Conditional Branching Statements - Basic Loop Structures / Iterative Statements - Nested Loops – break statement – continue statement – pass statement

UNIT III	**FUNCTIONS AND STRINGS**	**9**

Functions: Function Definition, function call- variable scope and lifetime – return statements. Strings: Definition, operations (concatenation, appending, multiply, slicing) - immutability, comparison, iterations, string methods

UNIT IV	**LIST, TUPLES AND DICTIONARIES**	**9**

Lists: Access, updating values- nested, cloning- list operations- list methods- looping in list. Tuples: Tuple operations- nested tuple; Dictionaries- Creating, Accessing, adding, modifying, deleting items

UNIT V	FILES, EXCEPTIONS AND PACKAGES	9
Files: Types of files, Opening and closing Files, Reading and writing files, File positions, Renaming and deleting files. Exceptions: Errors and exceptions, Handling exceptions, Packages		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the basics of computer system and problem solving approaches.
CO2:	Describe the usage of Python selection and looping statements.
CO3:	Solve simple problems using Python functions and strings.
CO4:	Make use of Python data structures - lists, tuples, and dictionaries to represent compound data.
CO5:	Illustrate the basic concepts of files, exceptions and packages.

TEXT BOOKS:	
1.	Reema Thareja, "Python Programming Using Problem Solving Approach", Thirteenth Edition, Oxford University Press, 2022.
2.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", Second Edition, O'Reilly Publishers, 2016.

REFERENCES:	
1.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", BCS Learning & Development Limited, 2017.
2.	Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 2021.
3.	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", Third Edition, MIT Press, 2021.
4.	Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", Second Edition, No Starch Press, 2019.
5.	Martin C. Brown, "Python: The Complete Reference", Fourth Edition, Mc-Graw Hill, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO4	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO5	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3
CO	3	3	3	3	-	-	-	-	-	-	-	1	-	-	3

GE3152	HERITAGE OF TAMIL	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:
• To help students understand the values of Tamil Language, basic language families in India and types of Tamil literature.
• To facilitate the students to understand Tamil heritage of rock arts, paintings and musical instruments in their economic life.
• To facilitate the students in understanding the harmony existing in Tamils martial arts.
• To create an awareness on concept of Thinai Tamils and its values.
• To understand the contribution and Influence of Tamils in Indian culture.

UNIT I	LANGUAGE AND LITERATURE	3
Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –. Biodiversity – Types – Values, threats and conservation of biodiversity – Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.		
UNIT II	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**	**3**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
UNIT III	**FOLK AND MARTIAL ARTS**	**3**
Therukoothu, Karagattam - Villu Pattu - Kaniyan Koothu – Oyillattam - Leather puppetry- Silambattam – Valari - Tiger dance - Sports and Games of Tamils.		
UNIT IV	**THINAI CONCEPT OF TAMILS**	**3**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
TOTAL: 15 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the importance of Tamil Language and types of Tamil literature.
CO2:	Illustrate their knowledge in rock art paintings to modern art.
CO3:	Demonstrate a strong foundational knowledge in martial arts.
CO4:	Explain the concept of Thinai Tamils and its values
CO5:	Describe the contribution of Tamils in Indian culture.

TEXT & REFERENCE BOOKS:	
1.	jkpof tuyhW – kf;fSk; gz;ghLk; Nf. Nf. gps;is (ntspaPL : jkpo;ehL ghlE}y; kw;Wk; fy;tpay; gzpfs; fofk;.
2.	Dr.K.K.Pillay, “Social Life of Tamils”, A joint publication of TNTB & ESC and RMRL.
3.	Dr.S.Singaravelu, “Social Life of the Tamils - The Classical Period”, International Institute of Tamil Studies.
4.	Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, “Historical Heritage of the Tamils”, International Institute of Tamil Studies.
5.	Dr.M.Valarmathi, “ The Contributions of the Tamils to Indian Culture”, International Institute of Tamil Studies.
6.	Dr.K.K.Pillay, “Studies in the History of India with Special Reference to Tamil Nadu”.

GE3152	**jkpou; kuG**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OBJECTIVES:	
• jkpo; nkhopapd; kjpg;Gfs;> ,e;jpahtpy; cs;s mbg;gil nkhopf;FLk;gq;fs; kw;Wk; jkpo; ,yf;fpa tiffis khzth;fs; Ghpe;Jnfhs;s cjTjy;.	
• khzth;fs; ghiw Xtpaq;fs;> rpw;gf;fiyfs; kw;Wk; ,irf;fUtpfspd; top jkpo; ghuk;ghpaj;ijg; Ghpe;Jnfhs;s trjp nra;jy;	
• jkpoh;fspd; fiy kw;Wk; tPu tpisahl;Lfisg; Ghpe;J nfhs;tjw;F khzth;fSf;F cjTjy;.	
• jkpoh;fspd; jpizf; fUj;Jf;fs; kw;Wk; mth;fspd; tho;f;if newpfisg; gw;wp khzth;fSf;F tpopg;Gzh;it Vw;gLj;Jjy;	
• ,e;jpa fyhr;rhuj;jpy; jkpoh;fspd; gq;fspg;igAk; mjd; jhf;fj;ijAk; khzth;fs; Ghpe;Jnfhs;s nra;jy;.	
myF I	**nkhop kw;Wk; ,yf;fpak;** **8**
,e;jpa nkhopf; FLk;gq;fs; – jpuhtpl nkhopfs; – jkpo; xU nrk;nkhop – jkpo; nrt;tpyf;fpaq;fs; – rq;f ,yf;fpaj;jpd; rkar;rhu;gw;w jd;ik – rq;f ,yf;fpaj;jpy; gfpu;jy; mwk; – jpUf;Fwspy; Nkyhz;ikf; fUj;Jf;fs; – jkpo;f; fhg;gpaq;fs;> jkpofj;jpy; rkz ngsj;j rkaq;fspd; jhf;fk; – gf;jp ,yf;fpak;> Mo;thu;fs; kw;Wk; ehad;khu;fs; – rpw;wpyf;fpaq;fs; – jkpopy; etPd ,yf;fpaj;jpd; tsu;r;rp – jkpo; ,yf;fpa tsu;r;rpapy; ghujpahu; kw;Wk; ghujpjhrd; MfpNahupd; gq;fspg;G.	
myF II	**kuG – ghiw Xtpaq;fs; Kjy; etPd Xtpaq;fs; tiu – rpw;gf;fiy.** **8**

eLfy; Kjy; etPd rpw;gq;fs; tiu – [k;nghd; rpiyfs; – goq;Fbapdu; kw;Wk; mtu;fs; jahupf;Fk; iftpidg; nghUl;fs;> nghk;ikfs; – Nju; nra;Ak; fiy – RLkz; rpw;gq;fs; – ehl;Lg;Gwj; nja;tq;fs; – FkupKidapy; jpUts;Stu; rpiy – ,irf; fUtpfs; – kpUjq;fk;> giw> tPiz> aho;> ehj];tuk; – jkpou;fspd; r%f nghUshjhu tho;tpy; Nfhtpy;fspd; gq;F		
myF III	**ehl;Lg;Gwf; fiyfs; kw;Wk; tPu tpisahl;Lfs;**	**3**
njUf;$j;J> fufhl;lk;> tpy;Yg;ghl;L> fzpahd; $j;J> xapyhl;lk;> Njhy;ghitf; $j;J> rpyk;ghl;lk;> tsup> Gypahl;lk;> jkpou;fspd; tpisahl;Lf;fs;.		
myF IV	**jkpou;fspd; jpizf; Nfhl;ghLfs;.**	**3**
Jkpofj;jpd; jhtuq;fSk;> tpyq;FfSk; – njhy;fhg;gpak; kw;Wk; rq;f ,yf;fpaj;jpy; mfk; kw;Wk; Gwf;Nfhl;ghLfs; – jkpou;fs; Nghw;wpa mwf;Nfhl;ghL – rq;ffhyj;jpy; jkpofj;jpy; vOj;jwpTk;> fy;tpAk; – rq;ffhy efuq;fSk; Jiw Kfq;fSk; – rq;f fhyj;jpy; Vw;Wkjp kw;Wk; ,wf;Fkjp – fly; fle;j ehLfspy; Nrhou;fspd; ntw;wp.		
myF V	**,e;jpa Njrpa ,af;fk; kw;Wk; ,e;jpa gz;ghl;bw;F jkpou;fspd; gq;fspg;G**	**3**
,e;jpa tpLjiyg;Nghupy; jkpou;fspd; gq;F – ,e;jpahtpd; gpwg;gFjpfspy; jkpo;g; gz;ghl;bd; jhf;fk; – Rakupahij ,af;fk; – ,e;jpa kUj;Jtj;jpy; rpj;j kUj;Jtj;jpd; gq;F – fy;ntl;Lfs;> ifnaOj;Jg;gbfs; – jkpo;g; Gj;jfq;fspd; mr;R tuyhW.		
TOTAL: 15 PERIODS		

COURSE OUTCOMES:	
,g;ghlj; jpl;lj;jpd; %yk; khzth;fs; ngWk; gad;fs;:	
CO1:	jkpo; nkhopapd; Kf;fpaj;Jtk; kw;Wk; ,yf;fpa tiffis tpthpf;f KbAk;.
CO2:	ghiw Xtpaq;fs; Kjy; etPd fiyfs; tiu mth;fspd; mwpit tpthpf;f KbAk;.
CO3:	jw;fhg;Gf; fiyfspd; tYthd mbj;js mwpit tpthpf;f KbAk;.
CO4:	jkpoh;fspd; jpizf; fUj;Jf;fs; kw;Wk; mjd; kjpg;Gfis tpsf;f KbAk;.
CO5:	,e;jpa fyhr;rhuj;jpy; jkpoh;fspd; gq;fspg;ig tpthpf;f ,aYk;.

TEXT & REFERENCE BOOKS:	
1.	jkpof tuyhW – kf;fSk; gz;ghLk; – Nf. Nf. gps;is (ntspaPL : jkpo;ehL ghlE}y; kw;Wk; fy;tpay; gzpfs; fofk;.
2.	Dr.K.K.Pillay, “Social Life of Tamils”, A joint publication of TNTB & ESC and RMRL.
3.	Dr.S.Singaravelu, “Social Life of the Tamils - The Classical Period”, International Institute of Tamil Studies.
4.	Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, “Historical Heritage of the Tamils”, International Institute of Tamil Studies.
5.	Dr.M.Valarmathi, “ The Contributions of the Tamils to Indian Culture”, International Institute of Tamil Studies.
6.	Dr.K.K.Pillay, “Studies in the History of India with Special Reference to Tamil Nadu”.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

EN22101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**

		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To guide the learners on the basics of language including vocabulary and grammar
- To develop the receptive skills of the learners: Reading and Listening
- To develop the productive skills of the learners: Writing and Speaking
- To make the learners realize the importance of accuracy and fluency
- To help the learners use the language in real situations

UNIT I	**VOCABULARY AND LANGUAGE STUDY**	**6**

Vocabulary – Synonyms and Antonyms, Word building – Prefixes and Suffixes – Word formation- Definitions - One word substitutes - Reading for vocabulary and languagedevelopment- Note making and Summarising - Developing Hints.

UNIT II	**READING AND LANGUAGE DEVELOPMENT**	**6**

Parts of speech, Types of sentences – Statement, Interrogative, Imperative, Exclamatory, Wh- questions, **Yes** or **No** questions and tag questions, Formal Letters – Academic, Official, andBusiness Letters

UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**6**

Tense and Voice, Auxiliary verbs (be, do, have), Modal verbs - Types of Reading : Intensive Reading and Extensive Reading- *Strategies*: Predicting- Skimming and Scanning -Reading for facts - Understanding the parts of paragraph- Learning the transitional signals used in the passage to classify the text

UNIT IV	**FUNDAMENTALS OF WRITING**	**6**

Punctuation and Capitalization- **Sentence formation**: Word order-Completion of sentences- Conjunctions-Transitional signals- sentence and sentence structures- Informal Letters.

UNIT V	**EXTENDED WRITING**	**6**

Degrees of Comparison – Reported speech **-Paragraph writing**-Topic sentence, supportingsentences and concluding sentence-Informal and Formal expressions

TOTAL : 30 PERIODS

PRACTICAL EXERCISES

Listening (Receptive skill**)** Intensive Listening: Effective and Attentive Listening

Exercises

1.	Listening for gist from recorded speeches
2.	Listening for specific information from recorded conversations
3.	Listening for strengthening vocabulary skills.
4.	Listening to variety of situations and voices- Listening for language development
5.	Listening for pronunciation: syllables, stress and intonation.

Speaking (Productive Skill)

Exercises

1.	Introducing oneself and others
2.	Asking for / giving personal information
3.	Practicing dialogues in pairs
4.	Giving directions-Informal and formal dialogues
5.	Speaking in connected speech
6.	Responding to questions
7.	Short presentations
8.	Speaking in small and big groups
9.	Learning and practicing the essential qualities of a good speaker

TOTAL: 30 PERIODS

TOTAL(T+P): 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Apply and practice the correct usages of language
CO2:	Receive the language effectively and meaningfully through receptive skills
CO3:	Produce the language appropriate to the needs and situations exercising productive skills
CO4:	Transfer or interpret any piece of information with accuracy and fluency
CO5:	Apply the language intellectually and confidently

TEXT BOOKS:

1.	Shobha. K.N, Rayen, Joavani, Lourdes, ”Communicative English”, Cambridge University Press, 2018.
2.	Sudharshana.N. P, Saveetha. C, “English for Technical Communication”, Cambridge University Press: New Delhi, 2016.
REFERENCES:	
1.	Kumar, Suresh. E.,”Engineering English”, Orient Blackswan, Hyderabad, 2015.
2.	Means, L. Thomas and Elaine Langlois,” English & Communication for Colleges”, Cengage Learning, USA: 2007.
3.	Greendaum, Sydney and Quirk, Randolph, “A Student ‘s Grammar of the English Language”, Pearson Education.
4.	Wood F.T,”Remedial English Grammar”, Macmillan, 2007.
5.	Kumar, Sanjay and Pushp Lata,”Communication Skills: A Workbook”, New Delhi: OUP, 2018.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-	1	1	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-

BS22101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation ofexperimental data.
- To determine error in experimental measurements and techniques used to minimize sucherror.
- To make the student an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS

1	Non-uniform bending – Determination of Young‘s modulus.
2	SHM of Cantilever – Determination of Young‘s modulus.
3	Poiseuille‘s flow – Coefficient of viscosity of liquid
4	Torsional pendulum - Determination of Rigidity modulus.
5	Newton‘s ring – Radius of curvature of convex lens.
6	Lee‘s Disc – Determination of coefficient of thermal conductivity of bad conductor.

TOTAL: 30 PERIODS

CHEMISTRY LABORATORY

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters suchas, acidity, alkalinity and hardness.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1	Determination of total hardness of water by EDTA method.
2	Conductometric titration of strong acid and strong base.
3	Determination of strength of given hydrochloric acid using pH meter.
4	Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
5	Determination of alkalinity in water sample.
6	Estimation of iron content of the given solution using potentiometer.

TOTAL: 30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Determine different moduli of elasticity used in day to day engineering applications.
CO2:	Calculate the viscosity of liquids and radius of curvature of convex lens
CO3:	Estimate the coefficient of thermal conductivity of bad conductors
CO4:	Determine the water quality parameters of the given water sample.
CO5:	Analyze quantitatively the metals (Fe, Ni,) in the any sample volumetrically as well as by using spectroanalytical methods.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO2	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO3	3	1	-	-	-	-	-	-	2	1	-	1	-	-	-
CO4	3	1	-	-	-	2	2	-	1	-	-	-	-	-	-
CO5	3	1	-	-	-	2	2	-	1	-	-	-	-	-	-
CO	3	1	-	-	-	2	2	-	2	1	-	1	-	-	-

CS22102	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES
• To understand the problem solving approaches
• To learn the basic programming constructs in Python
• To practice various computing strategies for Python-based solutions to real world problems
• To use Python data structures - lists, tuples, dictionaries
• To do input/output with files in Python
LIST OF EXPERIMENTS
1. Identification and solving of simple real life or scientific or technical problems, and developing algorithms and flow charts for the same
2. Python programming using simple statements and expressions
3. Scientific problems using Conditionals and Iterative loops
4. Implementing real-time/technical applications using Lists, Tuples
5. Implementing real-time/technical applications using Sets, Dictionaries
6. Implementing programs using Functions
7. Implementing programs using Strings
8. Implementing real-time/technical applications using File handling
9. Implementing real-time/technical applications using Exception handling
10. Exploring Pygame tool
11. Developing a game activity using Pygame like bouncing ball
TOTAL: 60 PERIODS
COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs
CO3: Implement programs in Python using conditionals, loops and functions for solving problems
CO4: Process compound data using Python data structures
CO5: Utilize Python packages in developing software applications

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	2

CO2	3	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	1	-	-	2
CO5	3	3	3	3	2	-	-	-	-	-	-	1	-	-	2
CO	3	3	3	3	2	-	-	-	-	-	-	1	-	-	2

HS22101	**HIGHER ORDER THINKING**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OBJECTIVES:

- Teaching the students the sources and dynamics of thinking.
- Teaching the students the basics of systematic and scientific thinking.
- Initiating the students into critical thinking and to use critical thinking in practical life
- Initiating students into creative thinking

UNIT I	**INTRODUCTION TO COGNITION, KNOWLEDGE AND THINKING**	**3**

Cognition - Different Cognitive functions - Cognition and intelligence - Cognitive development: till adolescence and post adolescence - possibility of true knowledge - The sources of Knowledge.Sensation, perception. Reality of perception - Concept formation, abstraction. Memory and retrieving - Introduction to thinking and types of thinking. Systematic thinking

UNIT II	**LOGIC AND REASONING**	**3**

Commonsense and scientific knowledge. Pursuit of truth- Syllogistic Logic. Greek and Indian. –Exercises

UNIT III	**CRITICAL THINKING SKILLS AND DISPOSITIONS**	**3**

Critical Thinking Skills & Dispositions. Critical Thinking Exercises

UNIT IV	**ANALYSIS OF ARGUMENTS**	**3**

Propositions and fallacies. - Analyzing arguments. - Exercises.

UNIT V	**CREATIVE THINKING AND INNOVATIVE THINKING**	**3**

Evolution of Scientific Thinking and Paradigm Shift. - Dynamics of Thoughts: Hegel - Convergent thinking and divergent thinking (out of the box thinking). - Problem solving and Planning.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Demonstrate the sources of knowledge and the process of thinking
CO2:	Demonstrate critical thinking skills and dispositions of critical thinking
CO3:	Confidently engage in creative thinking and problem solving

REFERENCES:

1	Introduction to Logic, Irving M. Copi, Carl Cohen and Kenneth McMahon, Fourteenth Edition, Pearson Education Limited, 2014.
2	Teaching Thinking Skills: Theory and Practice, Joan Boykoff Baron and Robert J. Sternberg, W.H. Freeman and Company, New York.
3	Cognitive Psychology, Robert J. Sternberg, Third Edition, Thomson Wadsworth, UK

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	**Programme Outcomes**												**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	2	1	-	-	1	-	1	-	1	1	-	-	-
CO	3	2	2	1	-	-	1	-	1	-	1	1	-	-	-

HS22102	**UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY AND ETHICAL HUMAN CONDUCT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.

• To facilitate the students to understand harmony at all the levels of human living, and live accordingly.		
• To create an awareness on Engineering Ethics and Human Values.		
• To understand social responsibility of an engineer.		
UNIT I	**INTRODUCTION TO VALUE EDUCATION**	**6**
Value Education - Definition, Concept and Need for Value Education, Basic Guidelines - The Content and Process of Value Education - Basic Guidelines for Value Education - Self exploration as a means of Value Education - Happiness and Prosperity as parts of Value Education.		
UNIT II	**HARMONY IN THE HUMAN BEING**	**6**
Human Being is more than just the Body- Harmony of the Self (_I') with the Body -Understanding Myself as Co-existence of the Self and the Body - Understanding Needs of the Self and the needs of the Body - Understanding the activities in the Self and the activities in theBody.		
UNIT III	**HARMONY IN THE FAMILY, SOCIETY AND HARMONY INTHE NATURE**	**6**
Family as a basic unit of Human Interaction and Values in Relationships - The Basics for Respectand today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love - Comprehensive Human Goal: The Five Dimensions of Human Endeavour - Harmony in Nature: The Four Orders in Nature - The Holistic Perception of Harmony in Existence.		
UNIT IV	**SOCIAL ETHICS**	**6**
The Basics for Ethical Human Conduct - Defects in Ethical Human Conduct - HolisticAlternative and Universal Order - Universal Human Order and Ethical Conduct - Human Rights violation and Social Disparities.		
UNIT V	**PROFESSIONAL ETHICS**	**6**
Universal Human Values - Value based Life and Profession - Professional Ethics and Right Understanding - Competence in Professional Ethics - Issues in Professional Ethics – The Current Scenario - Vision for Holistic Technologies - Production System and Management Models.		
TOTAL: 30 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Illustrate the significance of value inputs in a classroom and start applying them in their life and profession.	
CO2:	Explain the role of a human being in ensuring harmony in society and nature.	
CO3:	Demonstrate the value of harmonious relationship based on trust and respect in their life and profession.	
CO4:	Compare values, skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	
CO5:	Classify ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	
TEXT BOOKS:		
1.	R R Gaur, R Sangal, G P Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010.	
2.	A.N. Tripathy, " Human Values", New Age International Publishers, New Delhi, 2004.	
REFERENCES:		
1,	Gaur. R.R., Sangal. R, Bagaria. G.P," A Foundation Course in Value Education", Excel Books, 2009.	
2.	Gaur. R.R., Sangal. R, Bagaria. G.P," Teachers Manual Excel Books", 2009.	
3.	Gaur R R, R Sangal, G P Bagaria,"A Foundation Course in Human Values and Professional Ethics", 2009.	
4.	William Lilly, "Introduction to Ethics", Allied Publisher.	
5.	Nagarajan, R.S., " Professional Ethics and Human Values", New Age International Publishers, 2006.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2
CO2	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2
CO3	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2
CO4	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2

CO5	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2
CO	1	-	-	-	-	2	2	3	1	1	-	1	3	1	2

SEMESTER II

MA22201	**STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a few statistical and numerical methods andgive procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples whichplays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various numerical methods of solving ordinary differential equations.

UNIT I	**TESTING OF HYPOTHESIS**	**12**

Statistical hypothesis -Type I and Type II errors - Large sample tests based on Normal distributionfor single mean and difference of means -Tests based on t distribution for single mean and equality of means - Test based on F distribution for equality of variances - Chi square test for single varianceand goodness of fit - Independence of attributes - Contingency table : Analysis of r c tables.

UNIT II	**DESIGN OF EXPERIMENTS**	**12**

General principles – Analysis of variance (ANOVA) - One way classification - Completelyrandomized design (CRD) – Two way classification - Randomized block design (RBD) – Three way classification - Latin square design (LSD) – Two factor experiments: 2^2 factorial design

UNIT III	**NUMERICAL SOLUTION OF EQUATIONS**	**12**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphsonmethod - Solution of linear system of equations - Gauss elimination method - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel

UNIT IV	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**12**

Newton‘s forward and backward interpolation – Interpolation with unequal intervals - Lagrange‘s interpolation- Divided differences - Newton‘s divided difference - Approximation of derivates using interpolation polynomials – Numerical integration using Trapezoidal and Simpson‘s 1/3, 3/8 rules- Numerical double integration: Trapezoidal and Simpson‘s rules.

UNIT V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Single step methods : Taylor‘s series method - Euler‘s method - Modified Euler‘s method - Fourthorder Runge-Kutta method for solving first order equations - Multi step methods : Milne‘s and Adams - Bash forth predictor corrector methods for solving first order equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1:	Define the basic concepts of statistical tests, ANOVA, iterative methods, interpolations
CO2:	Discuss the techniques of statistical tests and design of experiments.
CO3:	Explain the solution of equations, ODE, single and multistep methods, interpolations,
CO4:	Apply the concept of testing of hypothesis and design of experiment in real life.
CO5:	Apply numerical techniques in system of equations, differential equations

TEXTBOOKS:

1	Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", Tenth Edition, Khanna Publishers, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J.,"Miller and Freund‘s Probability and Statistics for Engineers", Ninth Edition, Pearson Education, Asia, 2016.

REFERENCES:	
1	Burden, R.L and Faires, J.D, "Numerical Analysis", Ninth Edition, Cengage Learning, 2016.
2	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, Eighth Edition, 2014.
3	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis", Pearson Education, Asia, New Delhi, 2006.
4	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Fourth Edition, Tata McGraw Hill Edition, 2012.
5	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Ninth Edition, Pearson Education, Asia, 2012.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-

EE22201	BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on construction and working of Transformer
- To explain the construction and working of different DC machines
- To explain the construction and working of AC rotating machines
- To impart knowledge on basics of power system.
- To introduce the functional elements and working of measuring instruments.

UNIT I TRANSFORMER **9**

Introduction - Ideal and Practical Transformer – Construction and working of Single phase and Three Phase Transformers - EMF equation of Transformer –Auto Transformers- Applications.

UNIT II DC MACHINES **9**

Introduction – Construction and working of DC Generator and Motor -EMF and Torque equation –Types of DC Machines – Applications.

UNIT III AC ROTATING MACHINES **12**

Construction and working of AC rotating machines-single phase and three phase Induction motor-Alternators -Synchronous motors- Stepper motor-BLDC motor-Applications.

UNIT IV POWER SYSTEM **6**

Components of a power system – Generation Subsystem, Transmission Subsystem, Distribution Subsystem- Domestic Wiring- Earthing.

UNIT V MEASUREMENTS AND INSTRUMENTATION **9**

Functional elements of an instrument –Static and dynamic characteristics of instruments, Errors, Principles of electrical indicating instruments- Types of indicating instruments -Moving Coil andMoving Iron instruments - DSO - Transducers- Resistive Transducers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the construction and working of Transformer.
CO2:	Explain the construction, working and applications of DC machines.
CO3:	Interpret the construction and working of AC machines.
CO4:	Explain the basics of power system.
CO5:	Interpret the operating principles of measuring instruments.

TEXT BOOKS:

1.	M .S.Sukhja ,T.K.Nagsarkar,"Basic Electrical and Electronics Engineering'', Oxford Higher Education, 2018.
2.	S. Salivahanan, R.Rengaraj,"Basic Electrical and Instrumentation Engineering", McGraw Hill Education ,2019.
REFERENCES:	
1.	Kothari DP and I.J Nagrath,"Basic Electrical Engineering'', Fourth Edition, McGraw Hill Education, 2019.
2.	S. K, Bhattacharya, "Basic Electrical and Electronics Engineering", Second Edition, Pearson Education, 2017.
3.	B.L Theraja, "Fundamentals of Electrical Engineering and Electronics", Chand & Co, 2008.
4.	S.K.Sahdev, "Basic of Electrical Engineering", Pearson, 2015.
5.	H.S. Kalsi,"Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	3	-	-	-	-	-	-	2	1	-	1	-	-	-
CO	2	1	-	-	-	-	-	-	2	1	-	1	-	-	-

EC22201	ELECTRIC CIRCUITS AND ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the basic concepts and behaviour of DC and AC circuits
- To understand various methods of circuit/ network analysis using network theorems
- To understand the transient and steady state response of the circuits subjected to DC excitations and AC with sinusoidal excitations
- To learn the semiconductor devices
- To learn the basic concepts and behaviour of DC and AC circuits

UNIT I	DC CIRCUIT ANALYSIS	10

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchoff's Current Law, Kirchoff's voltage law, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis, Delta-Wye Conversion

UNIT II	NETWORK THEOREM AND TWO PORT NETWORK	10

Useful Circuit Analysis techniques - Linearity and Superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Reciprocity Theorem. Analysis using dependent current sourcesand voltage sources, linear two port Network parameters.

UNIT – III	SINUSOIDAL STEADY STATE ANALYSIS	9

Sinusoidal Steady – State analysis, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power**.**

UNIT – IV	TRANSIENTS AND RESONANCE IN RLC CIRCUITS	9
Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor**.**		
UNIT – V	**SEMICONDUCTOR DEVICES**	**7**
PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator, MOS capacitor**.**		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1:	Explain the basic concepts of electric circuits and electron devices.
CO2:	Use suitable network theorems on DC circuits
CO3:	Calculate the two port network parameters and steady state response of any R, L, C
CO4:	Calculate the transient response for any RC, RL and RLC circuits and frequencyresponse of parallel and series resonance circuits
CO5:	Illustrate the structure and operation of basic electronic devices

TEXTBOOKS:

1	Hayt Jack Kemmerly, Steven Durbin, "Engineering Circuit Analysis", Mc Graw Hill education, Ninth Edition, 2018.
2	Joseph Edminister and Mahmood Nahvi," Electric Circuits", Schaum 's Outline Series, Fifth Edition Reprint, Tata McGraw Hill Publishing Company, New Delhi.
3	David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford Higher Education Press, 2010.

REFERENCES:

1	Robert.L. Boylestead, "Introductory Circuit Analysis", Twelveth Edition, Pearson Education India, 2014.
2	John O Mallay, Schaum"s Outlines "Basic Circuit Analysis", Second Edition, Tata Mc Graw Hill companies, 2011.
3	Charles K. Alexander & Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, Mc Graw- Hill, 2003.
4	Robert L. Boylestead and Louis Nasheresky," Electronic Devices and Circuit Theory", Tenth Edition, Pearson Education / PHI, 2008.
5	Adel. S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Seventh Edition, Oxford University Press, 2014**.**

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	-	-	-	-	-	-	-	1	-	2	2	-	-
CO2	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO3	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO4	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO5	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-
CO	2	2	-	-	-	-	-	-	-	1	-	2	2	-	-

ME22201	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To draw the engineering curves.
- To draw orthographic projection of points and lines
- To draw orthographic projection of solids and section of solids.
- To draw the development of surfaces
- To draw the isometric projections of simple solids and freehand sketch of simple objects.

CONCEPTS AND CONVENTIONS

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

UNIT – I	PLANE CURVES	12

Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.		
UNIT – II	**PROJECTION OF POINTS, LINES AND PLANES**	**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 any one principal plane.		
UNIT – III	**PROJECTION OF SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to any one of the principal planes by rotating object method.		
UNIT – IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**12**
Sectioning of solids (Prisms, pyramids cylinders and cones) in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.		
UNIT – V	**ISOMETRIC PROJECTIONS AND FREEHAND SKETCHING**	**12**
Principles of isometric projection — isometric scale - isometric projections of simple solids andtruncated solids - Prisms, pyramids & cylinders, in simple vertical positions. Representation of Three Dimensional objects — Layout of views- Freehand sketching of multipleviews from pictorial views of objects. Practicing three-dimensional modeling of projection of simple objects by CAD Software (Demonstration purpose only).		
		TOTAL: 60 PERIODS
COURSE OUTCOMES: At the end of the course the students would be able to		
CO1:	Recall the existing national standards and interpret a given three-dimensionaldrawing.	
CO2:	Interpret graphics as the basic communication and methodology of the design	
CO3:	Acquire visualization skills through the concept of projection	
CO4:	Develop the sectioned solids and discover its true shape	
CO5:	Develop imagination of physical objects to be represented on paper for engineering communication.	
TEXTBOOKS:		
1.	Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.	
2.	Jeyapoovan T.," Engineering Graphics using AutoCAD", Seventh Edition, Vikas Publishing House, 2015.	
REFERENCES:		
1.	Venugopal K. and Prabhu Raja V.," Engineering Graphics", New Age International (P) Limited, 2008.	
2.	Julyes Jai Singh S.," Engineering Graphics", Seventh edition, SRM tri sea publishers, Nagercoil, 2015.	
3.	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Fifty third Edition, Charotar Publishing House, 2019.	
4.	Gopalakrishna K.R.,"Engineering Drawing", (Vol. I&II combined), Twenty seventh Edition, Subhas Publications, Bangalore, 2017.	
5.	Luzzader, Warren.J. and Duff,John M.,"Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production".	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-
CO2	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-

CO5	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-
CO	3	1	-	-	-	-	-	-	-	2	-	-	2	-	-

GE3252	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To facilitate the students to understand weaving and ceramic technology of sangam Age.k2
- To create an awareness on structural design of Tamils during sangam age.
- To help students to distinguish between all the levels of manufacturing technology in ancient period.
- To understand the ancient Knowledge of agriculture and irrigation technology.
- To enable the students to understand the digitalization of Tamil language.

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III	MANUFACTURING TECHNOLOGY	3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING	3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Describe the importance of weaving and ceramic technology of sangam Age.
CO2:	Illustrate the knowledge on structural design of Tamils during sangam age.
CO3:	Demonstrate a strong foundational knowledge in manufacturing technology of ancient Tamils.
CO4:	Desck8ribe the importance of ancient agriculture and irrigation technology of Tamils.
CO5:	Explain the concept of digitalization of Tamil language.

TEXT & REFERENCE BOOKS:

1.	fzpzpj;jkpo; – Kidtu; ,y. Re;juk;. (tpfld; gpuRuk;)
2.	fPob – itif ejpf;fuapy; rq;ffhy efu ehfuPfk; (njhy;ypay; Jiw ntspaPL) / Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
3.	nghUie – Mw;wq;fiu ehfuPfk;. (njhy;ypay; Jiw ntspaPL) / “Porunai Civilization”, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
4.	Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
5.	Dr.S.Singaravelu, “Social Life of the Tamils - The Classical Period”, International Institute of Tamil Studies.
6.	R.Balakrishnan, “Journey of Civilization Indus to Vaigai”, RMRL.

GE3252	jkpoUk; njhopy; El;gKk;	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- rq;f fhyj;jpd; nerT kw;Wk; gPq;fhd; njhopy; El;gj;ij khzth;fs; Ghpe;Jnfhs;s trjp nra;jy;.
- rq;f fhyj; jkpoh;fspd; tbtikg;G njhopy;El;gk; gw;wpa tpopg;Gzh;it Vw;gLj;Jjy;.
- gz;ila fhy cw;gj;jp njhopy;El;gj;jpd; midj;J epiyfisAk; NtWgLj;jp mwpa khzth;fSf;F cjTjy;.
- tptrhak; kw;Wk; ePh;g;ghrd njhopy;El;gj;jpd; gz;ila mwpitg; Ghpe;Jf; nfhs;s nra;jy;.
- jkpo; nkhopapd; b[pl;ly; kakhf;fy; gw;wpg; Ghpe;Jf; nfhs;s nra;jy;.

myF I	nerT kw;Wk; ghidj; njhopy;El;gk	3

rq;f fhyj;jpy; nerTj; njhopy; – ghidj; njhopy;El;gk; – fUg;G rptg;G ghz;lq;fs; – ghz;lq;fspy; fPwy; FwpaPLfs;

myF II	tbtikg;G kw;Wk; fl;blj; njhopy;El;gk	3

rq;f fhyj;jpy; tbtikg;G kw;Wk; fl;Lkhdq;fs; & rq;f fhyj;jpy; tPl;Lg; nghUl;fspy; tbtikg;G – rq;f fhyj;jpy; fl;Lkhd nghUl;fSk; eLfy;Yk; – rpyg;gjpfhuj;jpy; Nkil mikg;G gw;wpa tptuq;fs; – khky;yGur; rpw;gq;fSk;> Nfhtpy;fSk; – Nrhou; fhyj;J ngUq;Nfhapy;fs; kw;Wk; gpw topghl;Lj; jyq;fs; – ehaf;fu; fhyf; Nfhtpy;fs; – khjpup fl;likg;Gfs; fw;wp mwpjy;> kJiu kPdhl;rp mk;kd; Myak; kw;Wk; jpUkiy ehaf;fu; k`hy; – nrl;behl;L tPLfs; – gpupl;b\;; fhyj;jpy; nrd;idapy; ,e;Njh – rhNuhnrdpf; fl;blf; fiy.

myF III	cw;gj;jpj; njhopy; El;gk;	3

fg;gy; fl;Lk; fiy – cNyhftpay; – ,Uk;Gj; njhopw;rhiy – ,Uk;ig cUf;Fjy;> v/F – tuyhw;Wr; rhd;Wfshf nrk;G kw;Wk; jq;f ehzaq;fs; – ehzaq;fs; mr;rbj;jy; – kzp cUthf;Fk; njhopw;rhiyfs; – fy;kzpfs;- fz;zhb kzpfs; – RLkz; kzpfs; – rq;F kzpfs; - vYk;Gj;Jz;Lfs; – njhy;ypay; rhd;Wfs; – rpyg;gjpfhuj;jpy; kzpfspd; tiffs;.

myF IV	Ntshz;ik kw;Wk; ePu;ghrdj; njhopy;El;gk	3

miz> Vup> Fsq;fs;> kjF – Nrhou;fhyf; FKopj; J}k;gpd; Kf;fpaj;Jtk; – fhy;eil guhkupg;G – fhy;eilfSf;fhd tbtikf;fgl;l fpzWfs; – Ntshz;ik kw;Wk; Ntshz;ikr; rhu;e;j nray;ghLfs; – fly;rhu; mwpT – kPd;tsk; – Kj;J kw;Wk; Kj;Jf;Fspj;jy; – ngUq;fly; Fwpj;j gz;ila mwpT – mwpTrhu; r%fk;.

myF V	mwptpay; jkpo; kw;Wk; fzpdpj;jkpo;	3

mwptpay; jkpopd; tsu;r;rp – fzpdpj;jkpo; tsu;r;rp – jkpo; E}y;fis kpd;gjpg;G nra;jy; – jkpo; nkd;nghUl;fs; cUthf;fk; – jkpo; ,izaf; fy;tpf;fofk; – jkpo; kpd; E}yfk; – ,izaj;jpy; jkpo; mfuhjpfs; – nrhw;Fitj; jpl;lk;.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

,g;ghlj; jpl;lj;jpd; %yk; khzth;fs; ngWk; gad;fs;:

CO1:	rq;f fhyj;jpd; nerT kw;Wk; gPq;fhd; njhopy; El;gj;jpd; Kf;fpaj;Jtj;ij tpthpf;f KbAk;.
CO2:	rq;f fhyj; jkpoh;fspd; tbtikg;G njhopy;El;gk; gw;wpa mwpit tpsf;f KbAk;.
CO3:	gz;ila jkpoh;fspd; cw;gj;jp njhopy;El;gk; gw;wpa tYthd mbj;js mwpit ntspg;gLj;j KbAk;.
CO4:	jkpoh;fspd; tptrhak; kw;Wk; ePh;g;ghrd njhopy;El;gj;jpd; gz;ila mwpit tpthpf;f KbAk;.
CO5:	jkpo; nkhopapd; b[pl;ly; kakhf;fy; gw;wpa fUj;ij tpsf;f KbAk;.

TEXT & REFERENCE BOOKS:

1.	fzpzpj;jkpo; – Kidtu; ,y. Re;juk;. (tpfld; gpuRuk;)
2.	fPob – itif ejpf;fuapy; rq;ffhy efu ehfuPfk; (njhy;ypay; Jiw ntspaPL) / Keeladi - 'Sangam City Civilization on the banks of river Vaigai', Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
3.	nghUie – Mw;wq;fiu ehfuPfk;. (njhy;ypay; Jiw ntspaPL) / "Porunai Civilization", Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu.
4.	Dr.K.K.Pillay, Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
5.	Dr.S.Singaravelu, "Social Life of the Tamils - The Classical Period", International Institute of Tamil Studies.
6.	R.Balakrishnan, "Journey of Civilization Indus to Vaigai", RMRL.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

CO4	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
CO	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-

EN22201	TECHNICAL ENGLISH	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To widen strategies and skills to augment ability to read and comprehend engineering and technology texts.
- To develop writing skill to make technical presentations.
- To draft convincing job applications and effective reports.
- To strengthen listening skills to comprehend technical lectures and talks in their areas of specialization.
- To cultivate speaking skills both technical and general.

UNIT I	LANGUAGE STUDY	6

Technical Vocabulary- synonyms, antonyms, prefix and suffix, word formation, Homonyms andHomophones - puzzles,- Reading: skimming a reading passage – scanning for specific information- Instruction- Interpreting – Writing: Recommendation- Checklist.

UNIT II	READING AND STUDY SKILLS	6

Active and Passive voice- Extended Definitions- Imperatives- Numerical Adjectives- Purpose Statement – Reading: Critical reading- Newspaper articles- journal reports- editorials and opinion blogs - Report Writing: Fire Accident, Industrial visit, Project report, feasibility report,
survey report, business report.

UNIT III	WRITING SKILLS- INTRODUCTION TO PROFESSIONAL WRITING	6

Error Spotting/Common Errors- Concord-Compound words- Abbreviations and Acronyms- Discourse Markers - Finding key information – shifting facts from opinion- interpreting visual material- making inference from the reading passage - Interpretation of charts- - Minutes of the meeting- Paraphrasing- Proposal writing.

UNIT IV	TECHNICAL WRITING AND GRAMMAR	6

If Conditional Clauses- Prepositional Phrases- Fixed and semi fixed expressions- -e-mailcommunication- reading the attachment files having a poem /joke / proverb/sending their responses through e-mail.- Job application letter and Resume/CV/ Bio-data.

UNIT V	EXTENDED WRITING AND LANGUAGE STUDY	6

Articles- Cause and Effect expressions- Collocations- Sequencing words- Reading longer technical texts and taking down notes- Structure of Essay- Types of Essay: Narrative essay-Descriptive Essay- Analytical Essay- Cause and Effect Essay – Compare and contrast essays.

TOTAL :30 PERIODS

PRACTICAL EXERCISES

Listening Skills – Listening for professional Development

Listening to UPSC Toppers Mock Interviews- Listening to debates/discussions/differentviewpoints / scientific lectures/event narrations/documentaries/telephonic conversations

Speaking Skills –emphasizing communicative establishment

Seeking Information -asking and giving directions- narrating personal experiences/ events- answering interview questions- picture description- presenting a product and giving instructionto use a product – mini presentations-role plays- speaking in formal and informal situations- speaking about one‘s locations - speaking about great personalities –describing a simple process- telephone skills and etiquette

TOTAL: 30 PERIODS

TOTAL (T+P) = 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Infer advanced technical texts from varied technical genres to expand engineering knowledge and explore more ideas.

CO2:	Analyze technical contents written on par with international standards and rewritecontents using the right vocabulary without grammatical errors to make their articles published in reputed journals.
CO3:	Present reports and job letters utilizing the required format prescribed on par with international standards using the exact vocabulary to make their works worthy to be read
CO4:	Employ the language tones and styles appropriately in interviews and Group Discussions effortlessly following the strategies expected by the corporate world
CO5:	Appraise the need for new products and write feasibility and survey reports followingthe format prescribed in a way to create awareness.
TEXT BOOKS:	
1.	Mike Markrl, "Technical Communication", Palgrave Macmillan, London, 2012.
2.	Sumant,S and Joyce Pereira,"Technical English II‖", Chennai: Vijay Nicole Imprints Private Limited, 2014.
REFERENCES:	
1.	Raman, Meenakshi & Sangeetha Sharma,"Communication Skills", New Delhi: OUP, 2018.
2.	Rizvi M, Ashraf, "Effective Technical Communication", New Delhi: Tata McGraw- Hill Publishing Company Limited, 2007.
3.	Kumar, Sanjay and Pushp Lata, "Communication Skills: A Workbook", New Delhi: OUP, 2018.
4.	Means, L. Thomas and Elaine Langlois,"English & Communication for Colleges", Cengage Learning, USA: 2007.
5.	Greendaum, Sydney and Quirk, Randolph, "A Student's Grammar of the English Language", Pearson Education.

Mapping of Course Outcomes to Program Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

PH22202	**PHYSICS FOR ELECTRONICS ENGINEERING (Common to ECE & EEE)**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To understand the concepts of light, electron transport properties and the essential principles of semiconductors.
- To become proficient in magnetic properties of materials and the functioning of opticaldevices.
- To know the basics of quantum structures and Single electron transistor.
- To induce the students to design new devices that serve humanity by applying the knowledge gained during the course.

UNIT I	**PHOTONICS**	**6**

Interference – Air wedge – LASER – population inversion - Einstein coefficient – NdYAGLaser - CO2 laser – semiconductor laser – Optical fibre – Total internal reflection – propagation oflight – Numerical Aperture and Acceptance angle – Fiber optic communication system – Endoscopy.

UNIT II	**ELECTRICAL PROPERTIES OF MATERIALS**	**6**

Classical free electron theory - Expression for electrical conductivity and Thermal conductivity, Wiedemann-Franz law – Success and failures - Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Band theory of solids - Electron effective mass – concept of hole.

UNIT III	**SEMICONDUCTING MATERIALS**	**6**

Semiconductors –direct and indirect band gap semiconductors – Intrinsic semiconductors Carrier concentration, band gap in intrinsic semiconductors – extrinsic semiconductors - N-type & P-type semiconductors – Variation of carrier concentration and Fermi level with temperature - Hall effect - measurement of Hall coefficient – applications		
UNIT IV	**MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS**	**6**
Magnetic dipole moment – permeability, susceptibility - Magnetic material classification:diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism – B-H curve – Hard and soft magnetic materials - Magnetic recording - Dielectrics - Types of polarization - Internal field and Clausius- Mossoti equation		
UNIT V	**OPTOELECTRONIC AND NANODEVICES**	**6**
Carrier generation and recombination processes - Photo diode – solar cell - Organic LED – Optical data storage - Quantum confinement – Quantum structures - single electron phenomena and singleelectron transistor - Quantum dot laser		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Recall the basic concepts of light, electron transport properties of conductors andbasic principles of semiconductors
CO2:	Define the magnetic properties of materials and the principles of optoelectronic andnano devices.
CO3:	Illustrate laser and fibre optics, classical and quantum concepts of conductingmaterials, physics of semiconducting materials
CO4:	Summarize the functioning of various magnetic, optoelectronic and nano devices.
CO5:	Demonstrate the concepts of optics, fibre optics, moduli of elasticity and thermal energy, behavior of conductors, semiconductors, magnetic and dielectric materials and also the functioning of optical and nano devices in various engineering applications
TEXT BOOKS:	
1	Gaur, R.K & Gupta.S.L, "Engineering Physics", Dhanpat Rai Publishers, 2016.
2	Kasap,S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2017.
REFERENCES:	
1	Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley 2012.
2	Kittel, C. "Introduction to Solid State Physics". Wiley, 2017.
3	Garcia,N. & Damask, A. "Physics for Computer Science Students", Springer-Verlag,2012.
4	Hanson, G.W. "Fundamentals of Nanoelectronics", Pearson Education, 2009.
5	Rogers, B., Adams, J. & Pennathur, S., "Nanotechnology: Understanding SmallSystems", CRC Press, 2014.
LIST OF EXPERIMENTS	
1	Uniform bending – Determination of Young's modulus
2	Air-wedge – Thickness of thin wire
3	Spectrometer – Grating
4	LASER – Wavelength and particle size determination
5	Optical fibre – Acceptance angle and Numerical aperture
6	Band gap determination
	TOTAL: 30 PERIODS
	TOTAL (T+P) = 60 PERIODS

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	3	-	-	-	-	-	-	2	1	-	1	-	-	-
CO	2	1	-	-	-	-	-	-	2	1	-	1	-	-	-

CH22201	ENVIRONMENT AND SUSTAINABILITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES

- To understand the concept of ecosystem and biodiversity.
- To conversant with various types of pollution and its effects.
- To obtain knowledge on natural resources and its exploitation.
- To understand the social issues related to environment and methods to protect.
- To gain knowledge on sustainability and environment.

UNIT I	ECOSYSTEM AND BIODIVERSITY	6

Environment – Ecosytem – Structure and function of an ecosystem – Energy flow in an ecosystem – Food chain and food web –.Biodiversity – Types – Values, threats and conservation of biodiversity –Endangered and endemic species – Hot spot of biodiversity – Biodiversity at state level, national level and global level.

UNIT II	NATURAL RESOURCES	6

Introduction – Forest resources – Uses and Overexploitation - Deforestation – causes and consequences – Water resources – effect of over utilisation of water – Food resources – Impacts of modern agriculture (pesticides, fertilizers, water logging, salinity) – Sustainable Energy resources – Wind, Solar, hydroelectric power, geothermal – Land resources – Desertification, soil erosion – Roleof an individual in the conservation of natural resources. Case study – Deforestation, water conflicts, fertilizer and pesticide problem.

UNIT III	ENVIRONMENTAL POLLUTION AND MANAGEMENT	7

Definition, causes, effects and control measures of air pollution, water pollution, noise pollution,thermal pollution and marine pollution – Waste water treatment - Waste management – solid waste, bio waste, e-waste - Disaster management – Flood, cyclone, earthquake

UNIT IV	SOCIAL ISSUES AND HUMAN HEALTH	6

Population explosion and its effects on environment — variation of population among nations - Environmental issues and Human health – Food adulteration – Risk of food adulteration – Detectionand prevention of food adulteration - COVID-19 – Human rights – Value education

UNIT V	SUSTAINABLE DEVELOPMENT AND ENVIRONMENT	5

Sustainable development – needs and challenges — Goals – Aspects of sustainable development – Assessment of sustainability - Environmental ethics – Green chemistry – Eco mark, Eco products –EIA – Regional and local environmental issues and possible solutions - Role of engineering in environment and human health

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course the students would be able to

CO1:	Recall the basic concepts of environment and sustainable development.
CO2:	Summarize the types of pollution, various natural resources and food adulterants.
CO3:	Explain the methods for waste management and detection of adulterants.
CO4:	Apply the gained knowledge to overcome various issues related to health
CO5:	Identify suitable methods for local environmental issues and sustainability.

TEXTBOOKS:

1	Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, New Delhi, 2017.
2	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education, 2015.

REFERENCES:

1.	Erach Bharucha, "Text book of Environmental studies", Universities Press (I) Pvt Ltd, Hyderabad, 2015.
2.	Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2015
3.	Tyler Miller G and Scott E. Spoolman,"Environmental Science", Cengage LearningIndia Pvt Ltd, 2014.
4.	Ruth F. Weiner and Robin A. Matthews. Butterworth,"Environmental Engineering", Fourth Edition, Heineman Publications.
5.	Dash M.C, "Concepts of Environmental Management for Sustainable Development",

EXPERIMENTS	
1	Determination of DO content of waste water sample (Winkler‘s method).
2	Determination of chloride content of water sample by Argentometric method
3	Estimation of copper content in water by Iodometry.
4	Determination of Ca / Mg in waste water sample
5	Detection of adulterant in ghee/edible oil/coconut oil.
6	Detection of adulterant in sugar/honey/chilli powder.
	TOTAL:30 PERIODS
	TOTAL (T+P) = 60 PERIODS

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
CO2	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
CO3	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
CO4	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
CO5	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-
CO	3	-	-	-	-	-	3	-	1	1	-	1	-	-	-

EC22202	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 theorem, KVL & KCL, Super Positiontheorems

LIST OF EXPERIMENTS	
1.	Verification of KVL & KCL.
2.	Verification of Thevenin & Norton theorem.
3.	Verification of Super Position Theorem.
4.	Verification of Maximum power transfer.
5.	Determination of resonance frequency of Series & Parallel RLC Circuits
6.	Transient analysis of RL and RC circuits.
7.	Characteristics of PN Junction Diode and Zener diode.
8.	Full Wave Rectifier with Filters.
9.	Design of Zener diode Regulator.
10.	Common Emitter input-output characteristics.
11.	MOSFET Drain current and transfer characteristics
	TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Verify KVL & KCL and network theorems
CO2:	Demonstrate the characteristics of basic electronic devices
CO3:	Design series and parallel resonance circuits
CO4:	Design RL and RC transient circuits
CO5:	Design FWR circuit

LAB REQUIREMENTS

1. CRO/DSO (30 MHz) – 15 Nos.
2. Signal Generators / Function Generators (3 MHz) – 15 Nos.
3. Dual Regulated Power Supplies (0-30 v) - 15 Nos.

4. Bread Boards - 15 Nos.
5. BC107, BC547, BF195C, BFW10, IN4001, IN4007 – 25 each

REFERENCE

1. XYZ of Oscilloscope – Application note: Tektronix USA.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	-	-	-	-	-	-	2	1	1	2	2	-	-
CO2	2	2	-	-	-	-	-	-	2	1	1	2	2	-	-
CO3	2	2	2	-	-	-	-	-	2	1	1	2	2	-	-
CO4	2	2	1	-	-	-	-	-	2	1	1	2	2	-	-
CO5	2	2	1	-	-	-	-	-	2	1	1	2	2	-	-
CO	2	2	1	-	-	-	-	-	2	1	1	2	2	-	-

ES22203	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for

1	Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used incommon household wood work.
2	Wiring various electrical joints in common household electrical wire work.
3	Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet
4	Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & MECHANICAL)

PART I	**CIVIL ENGINEERING PRACTICES**	**15**
PLUMBING WORK:	Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household. Preparing plumbing line sketches. Laying pipe connection to the suction side of a pump Laying pipe connection to the delivery side of a pump. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.	
WOOD WORK:	Sawing, Planning and Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.	
PART II	**MECHANICAL ENGINEERING PRACTICES**	**15**
WELDING WORK:	Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. Practicing gas welding.	
BASIC MACHINING WORK:	Perform turning operation in the given work piece. Perform drilling operation in the given work piece. Performing tapping operation in the given work piece.	
ASSEMBLY WORK	Assembling a centrifugal pump. Assembling a household mixer.	

SHEET METAL WORK:	Making of a square tray

GROUP – B (ELECTRICAL AND ELECTRONICS)		
PART-I	**ELECTRICAL ENGINEERING PRACTICES**	**15**
Introduction to tools, switches, fuses, indicators and lamps.One lamp controlled by one switch. Series and parallel wiring.Staircase wiring. Fluorescent Lamp wiring.Residential wiring. Iron Box wiring and assembly.		
PART-II	**ELECTRONIC ENGINEERING PRACTICES**	**15**
Introduction to electronic components and equipments Calculation of resistance using colour coding Verify the logic gates AND, OR, EX-OR and NOT. Measurement of AC signal parameters using CRO Soldering simple electronic circuits on a small PCB and checking continuity.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1:	Prepare various pipe and furniture fittings used in common household.
CO2:	Perform the given metal joining and metal removal operation in the given work piece as per the dimensions.
CO3:	Apply the fundamental concepts involved in Electrical Engineering.
CO4:	Explain the basic electrical wiring procedures..
CO5:	Assemble basic electronic components.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-
CO2	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-
CO3	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-
CO4	2	-	-	-	-	-	-	-	3	1	-	1	1	-	-
CO5	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-
CO	3	-	-	-	-	-	-	-	3	1	-	1	1	-	-

SEMESTER III

MA22303	LINEAR ALGEBRA AND TRANSFORMS	L	T	P	C
		3	**1**	**0**	**4**

COURSE OBJECTIVES:

- To introduce the basic notions of vector spaces which will then be used to solve related problems
- To apply the concept of inner product space in orthogonalization
- To acquaint the student with Fourier transform techniques used in wide variety ofsituations
- To develop Fourier sine and cosine transforms technique to analyze continuous timesignals
- To develop Z-transform techniques for discrete time systems

UNIT I	**VECTOR SPACES**	**12**
Basic algebraic structures - Vector spaces – Cancellation law – Different types of vector spaces(R^n, P(R) and matrix only) - Linear combinations – Linear dependence and linear independence.		
UNIT II	**INNER PRODUCT SPACES**	**12**

Inner product - norms - Cauchy-Schwarz and triangle inequality – Orthonormal basis for R^3, C^3 and $P_2(R)$ using Gram Schmidt orthogonalization process – Fourier coefficient of vectors –Fit a straight line by least square approximation.		
UNIT III	**FOURIER TRANSFORMS**	**12**
Statement of Fourier integral theorem – Fourier transform – Properties of Fourier transform:Linear, Change of scale, Shifting and Modulation – Problems based on transforms of polynomial and constant functions – Inverse Fourier transform – Fourier transform pair – Problems usingConvolution theorem – Parseval"s identity(proof excluded).		
UNIT IV	**FOURIER SINE AND COSINE TRANSFORMS**	**12**
Fourier sine and cosine transforms – Properties: Linear, Change of scale and Modulation – Problems based on Fourier sine and cosine transforms of polynomial functions (n = 0 , 1, 2) and exponential function - Inverse Fourier sine and cosine transforms – Problems usingConvolution theorem – Parseval"s identity (Proof excluded).		
UNIT V	**Z – TRANSFORMS**	**12**
One sided Z-transform of sequence f(n) – Elementary properties: Linear, First shifting, Change of scale(statement only) - Problems based on properties – Z-transform of functions f(n) = n, n^2 using differentiation in Z-domain property – Initial and final value theorems(proof excluded) - Inverse Z-transform using partial fraction and convolution theorem.		
		TOTAL : 60 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Develop vector space and linear combination of functions	
CO2:	Construct orthonormal basis using Gram Schmidt process	
CO3:	Apply Fourier and inverse Fourier transforms in engineering field	
CO4:	Solve problems using Fourier sine and cosine transforms	
CO5:	Apply Z-transform techniques in communication field	
TEXT BOOKS:		
1.	Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Fourth Edition, Prentice Hall of India,New Delhi, 2004.	
2.	Grewal B.S.,"Higher Engineering Mathematics", Forty fourth Edition, Khanna Publishers, New Delhi,2015.	
REFERENCES:		
1.	Strang. G., "Linear Algebra and its applications", Fourth Edition, Thomson (Brooks/Cole), New Delhi,, 2018.	
2.	Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India,New Delhi, Reprint, 2018.	
3.	Veerarajan. T., "Transforms and Partial Differential Equations", Second reprint, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2012.	
4.	Sankara Rao. K , "Introduction to Partial Differential Equations", Prentice Hall ofIndia Pvt. Ltd, New Delhi, 1997.	
5.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd,New Delhi, 2018.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-

EC22301	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:		
• To explain the basics of Amplifiers and its biasing.		
• To analyze the feedback amplifier and frequency response of small signal amplifiers.		
• To analyse and classify power amplifiers and waveshaping circuits.		
• To design multivibrators and DC-DC converters		
• To design Oscillators and single stage and multistage amplifier circuits		
UNIT I	**AMPLIFIERS**	**9**
Load line, operating point, biasing methods for BJT and MOSFET, BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS, CG and Source follower – Gain and frequency response- High frequencyanalysis.		
UNIT II	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER**	**9**
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis -MOSFET input stages – tuned amplifiers – Gain and frequency response – Neutralization methods.		
UNIT III	**FEEDBACK AMPLIFIERS**	**9**
Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis ofseries- series, shunt-shunt and shunt-series feedback amplifiers.		
UNIT IV	**OSCILLATORS, WAVE SHAPING AND MULTIVIBRATOR CIRCUITS**	**9**
Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt‟s oscillators and crystal oscillators, RC integrator and differentiator circuits – diode clampers and clippers – Multivibrators		
UNIT V	**POWER AMPLIFIERS AND DC/DC CONVERTERS**	**9**
Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect-Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the basics of Amplifiers and its biasing.
CO2:	Demonstrate the frequency response of small signal and multistage amplifiers.
CO3:	Identify the topologies of feedback amplifier.
CO4:	Construct Oscillators, wave shaping and multivibrator circuits.
CO5:	Construct power amplifiers and DC-DC converters.

TEXT BOOKS:	
1.	David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford Higher Education press,2010.
2.	Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Seventh Edition , Oxford University Press, 2014.

REFERENCES:	
1.	Donald.A. Neamen, "Electronic Circuit Analysis and Design", Third Edition, Tata McGraw Hill, 2010.
2.	D.Schilling and C.Belove, "Electronic Circuits", Third Edition, McGraw Hill, 1989.
3.	Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI, 2004.
4.	Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and CircuitTheory”, Tenth Edition, Pearson Education / PHI, 2008.
5.	S.Salivahanan,N.Suresh Kumar,”Electronic Devices and Circuits”, Fifth Edition,McGraw Hill, 2022.

List of Open Source Software/ Learning website:

https://onlinecourses.nptel.ac.in/noc23_ee106/preview- Analog Electronic Circuit

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO2	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO3	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2

CO4	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO5	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2

EC22302	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the basic classification of signals and properties of systems.
- To examine continuous time signals in the Fourier and Laplace domain.
- To examine continuous time LTI systems in the Fourier and Laplace domain
- To determine the sampling process and sampling of discrete time signals.
- To analyze discrete time signals and DT-LTI systems in the Fourier and Z-domain.

UNIT I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**	**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 & Aperiodic signals, Deterministic & Random signals, Energy & Power signals -Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable systems.

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

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.

UNIT III	**LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS**	**9**

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transformsin Analysis of CT systems - Systems connected in series / parallel.

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

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT) – Properties ofDTFT.

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

Impulse response–Difference equations -Convolution sum- DTFT and Z- Transform Analysis of Recursive & Non-Recursive systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Classify the continuous time and discrete time signals and systems.
CO2:	Examine the continuous time signal in Fourier and Laplace domain.
CO3:	Examine the response of continuous time LTI system in Fourier and Laplace domain.
CO4:	Investigate the process of sampling and the effects of under sampling.
CO5:	Compute and the response of discrete time LTI systems in the Fourier and Z domain.

TEXT BOOKS:

1.	Oppenheim, Willsky and Hamid, “Signals and Systems”, Second Edition, PearsonEducation, New Delhi, 2015.(Units I - V)
2.	Simon Haykin, Barry Van Veen, “Signals and Systems”, Second Edition, Wiley, 2002.

REFERENCES:

1	B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2	M. J. Roberts, “Signals and Systems Analysis using Transform methods andMATLAB”, McGraw- Hill Education, 2018.
3	John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
4	R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems – Continuous and Discrete”, Pearson, 2007.
5	Edward W Kamen & Bonnie‟s Heck, “Fundamentals of Signals and Systems”,Pearson Education, 2007.

List of Open Source Software/ Learning website:

https://archive.nptel.ac.in/courses/108/104/108104100/ - Introduction - Principles of Signals and Systems

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
CO3	2	2	1	2	-	-	-	-	-	-	1	2	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
CO5	2	2	1	2	-	-	-	-	-	-	1	2	2	2	2
CO	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2

EC22303	C PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I	C PROGRAMMING FUNDAMENTALS	9

Introduction to programming paradigms – Storage classes - Operations Precedence and Associativity – Compilation process - Functions – Recursive Functions – Array – Stringprocessing.

UNIT II	C PROGRAMMING - ADVANCED FEATURES	9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays andFunctions – File Handling – Pre-processor Directives.

UNIT III	LINEAR DATA STRUCTURES	9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly-Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV	NON-LINEAR DATA STRUCTURES	9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing –Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT V	SORTING AND SEARCHING TECHNIQUES	9

Sorting - Insertion Sort – Quick Sort – Heap Sort – Merge Sort – Searching - Linear Search–Binary Search.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Describe the basics of C programming language.
CO2:	Explain the concepts of advanced features of C.
CO3:	Implement the concepts of linear data structures.
CO4:	Apply non-linear data structures.
CO5:	Explore sorting and searching techniques

TEXT BOOKS:

1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", SecondEdition ,Pearson Education, 1997.
2	ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C,Pearson Education, 2013.

2	Paul J. Deitel, Harvey Deitel,"C How to Program", Seventh Edition, Pearson Education, 2013.
3	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures andAlgorithms, Pearson Education, 2016.
4	Ellis Horowitz, Sartaj Sahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2018.
5	Kernighan, B.W and Ritchie, D.M," The C Programming language", SecondEdition, Pearson Education, 2015.
List of Open Source Software/ Learning website:	
	https://onlinecourses.nptel.ac.in/noc23_cs93/preview - C Programming and AssemblyLanguage **https://onlinecourses.nptel.ac.in/noc23_cs95/preview** - Programming, Data Structuresand Algorithms Using Python

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	1	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	1	-	-	-	-	-	-	-	-	3	3	3
CO	3	3	3	1	-	-	-	-	-	-	-	-	3	3	3

EC22304	**DIGITAL PRINCIPLES AND SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSE OBJECTIVES:

- To present the fundamentals of digital circuits and simplification methods
- To practice the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and Asynchronous Sequential circuits
- To learn integrated circuit families
- To introduce semiconductor memories and related technology

UNIT I	**DIGITAL FUNDAMENTALS**	**10**

Number Systems – Decimal, Binary, Octal, Hexadecimal, Conversions,1"s and 2"s complements – Boolean theorems, Sum of products and product of sums, Minterms and Maxterms , Logic gates, Universal gates, Simplification of Boolean expressions _ Karnaugh map Minimization and Quine -McCluskey method of minimization, Implementation of Boolean expressions using universalgates.

UNIT II	**COMBINATIONAL LOGIC CIRCUITS**	**9**

Problem formulation and design of combinational circuits - Code-Converters , Design of Half andFull Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder

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 - Moore/Mealy models, stateminimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

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 Hazardfree circuits.

UNIT V	**LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES**	**8**

Logic families _ propagation delay, power dissipation, fan-out and fan in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS, Comparison of Logic families_ Implementation of combinational logic/sequential logic design using standard ICs, Basic memorystructure – 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.	
TOTAL : 45 PERIODS	
PRACTICAL EXERCISES	
1.	Study of logic gates.
2.	Design and implementation of Adder and Subtractor using logic gates.
3.	Design and implementation of code converters using logic gates (i) BCD toExcess- 3 code and vice versa (ii) Binary to Gray and vice-versa.
4.	Design and implementation of Multiplexer and De-multiplexer using logicgates.
5.	Design and implementation of encoder and decoder using logic gates.
6.	Design of Magnitude Comparators.
7.	Design and implementation of counters using flip-flops.
8.	Design and implementation of shift registers.
TOTAL: 30 PERIODS	
TOTAL:75 PERIODS	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Apply Boolean Algebra and simplification procedure relevant to digital logic
CO2:	Design various combinational digital circuits using logic gates
CO3:	Design synchronous sequential circuits and realize using logic gates
CO4:	Design asynchronous sequential circuits and realize using logic gates and flipflop
CO5:	Design of programmable logic devices
TEXT BOOKS:	
1.	M. Morris Mano and Michael D. Ciletti," Digital Design", Sixth Edition, Pearson, 2018. (Unit - I -V)
2.	S Salivahanan & S Arivazhagan," Digital Circuits and Design", Fifth Edition Oxford University Press, 2019.
REFERENCES:	
1.	Charles H. Roth, Jr, "Fundamentals of Logic Design", Sixth Edition, Jaico Books, 2013.
2.	William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hallof India, 2015.
3.	Floyd T.L., "Digital Fundamentals", Eleventh Edition, Pearson Education Inc, 2021.
4.	John. F. Wakerly, "Digital Design Principles and Practices", Fifth Edition, Pearson Education, 2021.
5.	Kumar A.," Fundamentals of Digital Circuits", Fourth Edition, PHI, 2016.
List of Open Source Software/ Learning website:	
1. https://nptel.ac.in/courses/108106177 - Introduction Digital System Design 2. https://www.coursera.org/learn/digital-systems	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	-	1	-	-	-	-	1	2	2	2	2
CO2	2	2	2	2	-	1	-	-	-	-	1	2	2	2	2
CO3	2	2	2	2	-	1	-	-	-	-	1	2	2	2	2
CO4	2	2	2	1	-	1	-	-	-	-	1	2	2	2	2
CO5	2	2	2	1	-	1	-	-	-	-	1	2	2	2	2
CO	2	2	2	1	-	1	-	-	-	-	1	2	2	2	2

EC22305	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:
• To design and test BJT/MOSFET amplifier.
• To analyze the bandwidth of different amplifiers.
• To design the frequency of oscillation for different oscillators.
• To analyze wave shaping and multivibrators circuits.
• To explain the basics of Amplifiers and its biasing.
LIST OF EXPERIMENTS
1.Input and Output Characteristics of BJT in different Configurations.
2. Output and Transfer Characteristics of N- channel MOSFET.
3. Fixed Bias amplifier circuit using BJT
4. Design and construct BJT Common Emitter Amplifier using voltage divider bias (self–bias)with and without bypassed emitter resistor.
5. Frequency response of CE and CS amplifiers.
6. Frequency response of CB and CC amplifiers.
7. Frequency response of Cascode Amplifier.
8. CMRR measurement of Differential Amplifier
9. Voltage/Current series Feedback Amplifier.
10. RC Phase shift/Wein Bridge oscillator
11. Hartley/Colpitts Oscillator.
12. RC Integrator and Differentiator circuits.
13. Astable multivibrator.
14.Clippers and Clampers
TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course, the students will be able to:

CO1:	Construct and test BJT/MOSFET amplifier
CO2:	Analyse the bandwidth of different amplifiers
CO3:	Analyse the frequency of oscillation for different oscillators.
CO4:	Analyse waveshaping circuits
CO5:	Analyse multivibrators circuits

LAB REQUIREMENTS

1. CRO/DSO (30 MHz) – 15 Nos.
2. Signal Generators / Function Generators (3 MHz) – 15 Nos.
3. Dual Regulated Power Supplies (0-30 v) - 15 Nos.
4. Bread Boards - 15 Nos.
5. BC107, BC547, BF195C, BFW10, IN4001, IN4007 – 25 each

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO2	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO3	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO4	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO5	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2
CO	2	2	1	2	2	2	-	-	-	-	1	2	3	2	2

EC22306	**C PROGRAMMING AND DATA STRUCTURES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
COURSE OBJECTIVES:					

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1.Practice of C programming using statements, expressions, decision making and iterativestatements

2. Practice of C programming using Functions and Arrays

3. Implement C programs using Pointers and Structures

4. Implement C programs using Files

5. Development of real time C applications

6. Array implementation of List ADT

7. Array implementation of Stack and Queue ADTs

8. Linked list implementation of List, Stack and Queue ADTs

9. Applications of List, Stack and Queue ADTs

10..Implementation of Binary Trees and operations of Binary Trees

11. Implementation of Binary Search Trees

12. Implementation of searching techniques

13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort

14. Implementation of Hashing – any two collision techniques

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Develop applications by using C programming constructs.
CO2:	Write functions to implement linear and non-linear data structure operations.
CO3:	Apply linear/non–linear data structure operations for solving a problem.
CO4:	Apply hash functions for data storage and retrieval.
CO5:	Implement Sorting and Searching algorithms for a given application

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO	3	3	3	-	-	-	-	-	-	-	-	-	-	-	2

SD22302	**CODING SKILLS AND SOFT SKILLS TRAINING – PHASE I**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To make the students to solve basic programming logics.
- To help the students develop logics using decision control statements.
- To make them develop logics using looping statements and arrays and help them getstarted with embedded systems programming.
- To train the students for effective communication and identify the common errors informal writings
- To guide and motivate the students for setting their goals with positive thinking.

UNIT I	FUNDAMENTALS IN PROGRAMMING	6
Output of Programs: I/O Functions, Data types, Constants, Operators – Mathematical Problems – Debugging – Puzzles - Company Specific Programming Examples		
UNIT II	**DECISION CONTROL STATEMENTS**	**8**
Logic Building Using Conditional Control Statements – Output of Programs – Mathematical Problems - Puzzles – Company Specific Programming Examples		
UNIT III	**LOOPING STATEMENTS & C PROGRAMMING FOR EMBEDDED APPLICATIONS**	**14**
Looping Statements: Number Programs – Programs on Patterns – Array Programs – Programs on Sorting and Searching - Matrix Programs – Puzzles - Output of Programs - Company Specific Programming Examples **C Programming for Embedded Applications**: Getting Started in Embedded Systems – A quick analysis of memory usage with Keil – Bit Manipulation – A Bit Field Example with Keil		
UNIT IV	**COMMUNICATION IN GENERAL**	**15**
Introduction to communication-Types of communication – Effective Communication-Barriers to communication. Language Study: Vocabulary-Formation of sentences-Sentence and sentence structures-Common errors – Writing paragraphs & essays. Professional writing: Job application & Resume writing		
UNIT V	**PERSONALITY DEVELOPMENT**	**15**
Study of personality & ways to improve. Soft Skills: Self-evaluation / self-awareness – Goal setting and positive thinking – Self-esteem and confidence – Public speaking – Extempore – Bodylanguage and Observation skills		
		TOTAL : 60 PERIODS

Suggestive Assessment Methods:

- Pre Assessment Test – To check the student's previous knowledge in Programming skills
- Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20
- Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20
- Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20
- A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.
- For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
- The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Solve problems on basic I/O constructs
CO2:	Develop problem solving skills using control statements and arrays.
CO3:	Develop basic embedded system applications.
CO4	Avoid / fix the common errors they commit in academic and professional writings and prepare standard resumes and update the same for future career.
CO5	Recognize the value of self-evaluation and grow with self-confidence.

TEXT BOOKS:

1	Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.
2	Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCES

1.	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Pearson Education, 2013.
2.	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighthedition, Pearson Education, 2018.
3.	E Balagurusamy, "Programming in ANSI C", Eighth Edition, Mc Graw Hill Publications, 2019

4.	S.Sobana, R.Manivannan, G.Immanuel, ”Communication and Soft Skills“, VK Publications, 2016.
5.	Elecia White, “Making Embedded Systems: Design Patterns for Great Software”, O’R Publications, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO4	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO5	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2
CO	3	2	2	-	2	-	-	-	-	-	-	2	-	-	2

AC22301	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

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

UNIT I	INTRODUCTION	6

History of Making of the Indian Constitution - Drafting Committee - Philosophy of the IndianConstitution – Preamble - Salient Features

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES	6

Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right toFreedom of Religion - Cultural and Educational Rights - Fundamental Duties

UNIT III	ORGANISATIONS OF GOVERNANCE	7

Parliament – Composition - Qualifications and Disqualifications - Powers and Functions -ExecutivePresident – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges - Qualifications, Powers and Functions.

UNIT IV	EMERGENCY PROVISIONS	4

Emergency Provisions - National Emergency, President Rule, Financial Emergency.

UNIT V	LOCAL ADMINISTRATION	7

District‟s Administration head - Role and Importance –Municipalities - Introduction- Mayor and role of Elected Representative - CEO of Municipal Corporation -Pachayati raj – Introduction - PRI- Zila Pachayat- Elected officials and their roles.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Understand history and philosophy of Indian Constitution.
CO2:	Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
CO3:	Understand powers and functions of Indian government
CO4:	Understand emergency rule
CO5:	Understand structure and functions of local administration.

TEXT BOOKS:

1	Basu D D, “Introduction to the Constitution of India”, Lexis Nexis, 2015.
2	Busi S N, Ambedkar B R, “Framing of Indian Constitution”, 2015.
3	Jain M P, “Indian Constitution Law”, Seventh Edition., Lexis Nexis, 2014
4	The Constitution of India (Bare Act), Government Publication,1950

REFERENCES:	
1	M.V.Pylee, “Introduction to the Constitution of India”,Fourth Edition, Vikas publication, 2005.
2	Durga Das Basu (DD Basu), “Introduction to the constitution of India”, (StudentEdition),19th Edition, Prentice-Hall EEE, 2008.
3	Merunandan, “Multiple Choice Questions on Constitution of India”, Second Edition,Meraga publication, 2007.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	1	-	-	1	1	-	1	-	-	-	1	-	-	-
CO2	-	1	1	-	-	1	-	1	-	1	-	-	-	-	-
CO3	-	1	1	-	-	1	-	1	-	1	-	-	-	-	-
CO4	-	-	-	1	-	-	1	-	1	1	1	1	-	-	-
CO5	-	-	-	-	-	-	1	-	-	1	-	1	-	-	-
CO	-	1	1	1	1	1	1	1	1	1	1	1	-	-	-

HS22301	VALUE EDUCATION - I	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:		
• To give the students a deeper understanding about the purpose of life.		
• To animate the students to have a noble vision and a right value system for their life.		
• To help the students to set short term and long term goals in their life.		
UNIT I	**MY LIFE AND MY PLACE IN THE UNIVERSE**	**4**
Value of my life – My Uniqueness, strengths and weakness – My self-esteem and confidence –Myidentity in the universe		
UNIT II	**MY LIFE AND THE OTHER**	**4**
Realising the need to relate with other persons and nature – My refined manners and conductin relationships – Basic communication and relationship skills – Mature relationship attitudes.		
UNIT III	**MY LIFE IS MY RESPONSIBILITY**	**3**
Personal autonomy – developing a value system and moral reasoning skills – setting goals for life.		
UNIT IV	**UNDERSTANDING MY EDUCATION AND DEVELOPING MATURITY**	**4**
Importance of my Engineering education – Managing emotions - personal problem solving skills.		
		TOTAL : 15 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the importance of value based living.
CO2:	Set realistic goals and start working towards them.
CO3:	Apply the interpersonal skills in their personal and professional life.
CO4:	Emerge as responsible citizens with a clear conviction to be a role modelin the society

REFERENCES:	
1	David Brooks,” The Social Animal: The Hidden Sources of Love,Character and Achievement”, Random House, 2011.
2	Mani Jacob,” Resource Book for Value Education”, Institute of Value Education,2002.
3	Eddie de Jong,” Goal Setting for Success.”, CreateSpace Independent Publishing,2014.
4	Dr. Abdul Kalam,” My Journey-Transforming Dreams into Actions”, RupaPublications, 2013

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO2	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO3	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO4	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-

SEMESTER IV

EC22401	**ANALOG COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the concepts of various analog modulations and their spectral characteristics.
- To understand the properties of random process.
- To know the effect of noise on communication systems.
- To study the principles of sampling & quantization.

UNIT I	**AMPLITUDE MODULATION**	**9**

Amplitude Modulation - DSBSC, DSBFC, 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, Superheterodyne Receiver.

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, FMDemodulation - FM to AM conversion, FM Discriminator - PLL as FM Demodulator.

UNIT III	**RANDOM PROCESS**	**9**

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

UNIT IV	**NOISE CHARACTERIZATION**	**9**

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

UNIT V	**SAMPLING & QUANTIZATION**	**9**

Low pass sampling — Aliasing- Signal Reconstruction-Quantization — Uniform & non-uniformquantization — quantization noise — Logarithmic Companding –PAM, PPM, PWM, PCM — TDM, FDM.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the basic concepts and spectral characteristics of Amplitude Modulation.
CO2:	Describe the basic concepts and spectral characteristics of Angle Modulation.
CO3:	Apply the concepts of Random Process in Communication systems.
CO4:	Demonstrate the significance of noise in communication systems.
CO5:	Explain the sampling and quantization concepts in modulation systems.

TEXT BOOKS:

1.	J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems" Pearson Education 2014. (UNIT I-IV)
2.	Simon Haykin, "Communication Systems", Fourth Edition, Wiley, 2014. (UNIT I-V)

REFERENCES:

1.	Wayne Tomasi, "Electronic Communication Systems, Fundamentals through Advanced", Fifth Edition, Pearson Education, 2004.
2.	B.P.Lathi, "Modern Digital and Analog Communication Systems", Third Edition,Oxford University Press, 2007.
3.	D.Roody, J.Coolen, "Electronic Communications", Fourth edition PHI 2006.
4.	A.Papoulis, "Probability, Random variables and Stochastic Processes", Third Edition, McGraw Hill,1991.
List of Open Source Software/ Learning website:	
	https://onlinecourses.nptel.ac.in/noc23_ee117/preview - Analog Communication

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
CO2	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
CO3	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
CO4	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
CO5	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-
CO	1	2	2	1	2	2	-	-	-	-	1	2	2	-	-

EC22402	**ELECTROMAGNETIC FIELDS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behaviour of the propagation of EM waves
- To study the significance of Time varying fields.

UNIT I	**INTRODUCTION**	**9**

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

UNIT II	**ELECTROSTATICS**	**9**

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT III	**MAGNETOSTATICS**	**9**

Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magneticfield intensity for various current distributions, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques.

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

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potentialfunctions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields.

UNIT V	**PLANE ELECTROMAGNETIC WAVES**	**9**

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

	TOTAL : 45 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Illustrate the fundamentals of vector, coordinate system to electromagnetic concepts.
CO2:	Describe the characteristics of Electrostatic field.
CO3:	Explain the characteristics of magneto static field.
CO4:	Outline the significance of time varying field.
CO5:	Summarize the behaviour of the propagation of EM waves.
TEXT BOOKS:	
1.	D.K. Cheng, "Field and wave electromagnetics", Second Edition., Pearson (India), 2002
2.	M.N.O.Sadiku and S.V. Kulkarni, "Principles of electromagnetics", Sixth Edition , Oxford(Asian Edition), 2015
REFERENCES:	
1.	Edward C. Jordan & Keith G. Balmain, "Electromagnetic waves and RadiatingSystems", Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
2.	W.H. Hayt and J.A. Buck, "Engineering electromagnetics", Seventh Edition, McGraw-Hill (India), 2006
3.	B.M. Notaros, "Electromagnetics", Pearson: New Jersey, 2011
4.	D.J. Griffiths, "Introduction to electrodynamics", Fourth Edition, Pearson (India), 2013
5.	Nathan Ida, "Engineering Electromagnetics", Second Edition, Springer (India) Pvt. Ltd., New Delhi,2005.
List of Open Source Software/ Learning website:	
	https://onlinecourses.swayam2.ac.in/aic21_ge25/preview - Electromagnetic Fields in 3-D

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
CO2	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
CO3	2	2	2	2	1	1	-	-	-	-	1	2	2	1	1
CO4	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
CO5	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1
CO	2	2	2	2	2	1	-	-	-	-	1	2	2	1	1

EC22403	**CONTROL SYSTEMS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To introduce the components and their representation of control systems					
• To learn various methods for analyzing the time response, frequency response andstability of the systems.					
• To learn the various approach for the state variable analysis					
UNIT I	**SYSTEMS COMPONENTS AND THEIR REPRESENTATION**				**9**
Control System: Terminology and Basic Structure-Feed forward and Feedback control theory-Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system					
UNIT II	**TIME RESPONSE ANALYSIS**				**9**
Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constantandsystem- type number-PID control-Analytical design for PD, PI, PID control systems					
UNIT III	**FREQUENCY RESPONSE AND SYSTEM ANALYSIS**				**9**

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots -Design of compensators using Bode plots -Cascade lead compensation-Cascade lag compensation- Cascade lag-lead compensation.		
UNIT IV	**CONCEPTS OF STABILITY ANALYSIS**	**9**
Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion- Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stabilitycriterion.		
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-State transition matrix- Solution of state equations-Concepts of Controllability and Observability- control design using state feedback.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the control system components and their transfer function	
CO2:	Compute the time domain parameters of second order system	
CO3:	Apply the frequency response concept in closed loop control system.	
CO4:	Apply the concepts of system stability criterions.	
CO5:	Develop state feedback controller from state variable models	
TEXT BOOKS:		
1.	M.Gopal, "Control System – Principles and Design", Fourth Edition, Tata McGraw Hill, 2012	
2.	J.Nagrath and M.Gopal, "Control System Engineering", Seventh Edition, New Age International Publishers, 2021.	
REFERENCES:		
1	K. Ogata, "Modern Control Engineering', Fifth edition, PHI, 2012..	
2	S.K.Bhattacharya, "Control System Engineering", Third Edition, Pearson, 2013.	
3	Benjamin C. Kuo, "Automatic Control Systems", Seventh edition PHI Learning Private Ltd, 2010.	
4	Richard C.Dorf and Bishop, R.H.,"Modern Control Systems", Education Pearson, 3 Impression 2009.	
5	Norman S. Nise , "Control Systems Engineering", Eighth Edition, Wiley Publisher, 2019	
List of Open Source Software/ Learning website:		
	https://onlinecourses.nptel.ac.in/noc23_ee143/preview - Control Engineering https://onlinecourses.nptel.ac.in/noc23_de10/preview - Control Systems	
	NPTEL Video Lecture Notes on ―Control Engineering‖ by Prof.S.D.Agashe, IIT Bombay	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-
CO2	2	3	-	-	-	-	-	-	-	-	-	2	2	1	-
CO3	-	-	2	-	-	2	-	-	-	-	-	-	2	1	-
CO4	-	2	-	3	-	-	-	-	-	-	-	2	2	1	-
CO5	-	-	-	-	-	2	-	-	-	-	-	-	2	1	-
CO	3	3	2	3	-	2	-	-	-	-	-	2	2	1	-

EC22404	**LINEAR INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSEOBJECTIVES:					

• 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 analog multipliers and PLL.		
• To learn the theory of ADC and DAC.		
• To introduce the concepts of waveform generators and voltage regulators.		
UNITI	**BASICS OF OPERATIONAL AMPLIFIERS**	**9**
Advantages of ICs over discrete components, Classification, Basic information about Op-Amps, Ideal Operational Amplifier-Open and closed loop configurations, General Operational Amplifier stages-differential amplifier-transfer characteristics-CMRR-Circuits for improving CMRR-Current mirror and current sources, Current sources as active loads, DC characteristics, AC performance characteristics-frequency response, Slew Rate.		
UNIT II	**APPLICATIONS OF OPERATIONAL AMPLIFIERS**	**9**
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, Adder, Subtractor, V- to-Iand I-to-V Converters, Instrumentation Amplifier, Integrator, Differentiator, Logarithmic Amplifier, Antilogarithmic Amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-Pass, High-Pass and Band-Pass Butterworth Filters.		
UNIT III	**ANALOG MULTIPLIER AND PLL**	**9**
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, Analog Multiplier ICs and their applications, PLL: 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 demodulationand Frequency synthesizing and clock synchronization.		
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, inverted 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		
UNIT V	**WAVEFORM GENERATORS AND VOLTAGE REGULATORS**	**9**
Waveform generators: Sine-wave generators, Triangular wave generator, Saw-tooth wavegenerator,ICL8038 function generator, IC 555 Timer: Monostable operation, Astable operation,IC Voltage regulators: Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators.		
		TOTAL : 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Demonstrate the basic building blocks of linear integrated circuits.	
CO2:	Explain linear and non-linear applications of operational amplifiers.	
CO3:	Illustrate the applications of analog multiplier and PLL.	
CO4:	Construct ADC and DAC using OP – AMPS.	
CO5:	Construct waveform generators and voltage regulators using Special Function ICs.	
TEXT BOOKS:		
1.	Roy Choudhry, Shail Jain, "Linear Integrated Circuits", Fifth Edition, New Age International Pvt. Ltd., 2018. (Unit I – V)	
2.	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Fourth Edition, Tata McGraw-Hill, 2016 (Unit I – V)	
REFERENCES:		
1.	S. Salivahanan & V.S. Kanchana Bhaskaran," Linear Integrated Circuits", TMH, Second Edition, Fourth Reprint, 2016.	
2.	Ramakant A. Gayakwad, "OP-AMP and Linear ICs", Fourth Edition, Prentice Hall / Pearson Education, 2015	
3.	Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.	
4.	B.S. Sonde, "System design using Integrated Circuits", Second Edition, New Age Pub, 2001.	

5.	Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Fifth Edition, Wiley International, 2009.
6.	William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", Fourth Edition, Pearson Education,2001.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	1	2	-	-	1	1	2	2	2	1	-
CO2	2	1	-	2	1	2	-	-	2	3	2	2	2	1	-
CO3	2	1	2	1	2	2	-	-	1	1	2	2	2	1	-
CO4	2	2	2	1	-	2	-	-	2	2	2	2	2	1	-
CO5	2	2	2	1	2	2	-	-	2	3	2	2	2	1	-
CO	2	2	2	1	2	2	-	-	2	2	2	2	2	1	-

EC22405	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To learn discrete Fourier transform, properties of DFT and its application to linearfiltering.
- To understand the characteristics of digital filters and design digital IIR and FIR filters.
- To study the effects of finite precision representation on digital filters.
- To understand the fundamental concepts of multirate signal processing and itsapplications.
- To introduce the concepts of adaptive filters and its application to communicationengineering.

UNIT I	DISCRETE FOURIER TRANSFORM	9

Frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution, linearity, time reversal, multiplication, Linear filtering using DFT, Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT), Linear filteringusing FFT.

UNIT II	INFINITE IMPULSE RESPONSE FILTERS	9

Analog filter design Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters(LPF, HPF, BPF, BRF) Approximation of derivatives, Impulse invariance method, Bilinear transformation. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III	FINITE IMPULSE RESPONSE FILTERS	9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - cascade structure,
direct form realizations.

UNIT IV	FINITE WORD LENGTH EFFECTS	9

Fixed point and floating point number representation - ADC - quantization - truncation androunding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantizationandsummation - scaling to prevent overflow.

UNIT V	DSP APPLICATIONS	9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization- DSP Architecture – TMS320C50 architecture – Addressing modes – Instruction Set – Programming

TOTAL : 45 PERIODS

PRACTICAL EXERCISES

MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSORBASED IMPLEMENTATION

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 demonstrates the filtering operation.
6.	Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) anddemonstrate the filtering operations.
7.	Study of architecture of Digital Signal Processor.
8.	Perform MAC operation using various addressing modes in DSP processor.
9.	Generation of various signals using DSP processor.
10.	Design and demonstration of FIR Filter for Low pass and High passfilteringusing DSP processor.
11.	Design and demonstration of Butter worth and Chebyshev IIR Filters for Low passand High pass filtering using DSP processor.
12.	Sample an analog signal using DSP Processor.
	TOTAL: 30 PERIODS
	TOTAL(T+P): 75 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Apply DFT for the analysis of digital signals and systems.
CO2:	Design IIR filter.
CO3:	Design FIR filter.
CO4:	Outline the effects of finite precision representation on digital filters.
CO5:	Illustrate the concept of adaptive filters and DSP applications.
TEXT BOOKS:	
1	John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms and Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2	A. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing",Third Edition, Pearson, 2009.
REFERENCES:	
1	Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Fourth Edition, Tata McGrawHill, 2013.
3	Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006.
4	S.Salivahanan, "Digital Signal Processing", Fourth Edition Tata McGraw Hill,2019.
5	Venkataramani & M.Baskar, "Digital Signal Processors", Second edition, Tata Mc Graw Hill, 2017.
List of Open Source Software/ Learning website:	
	https://onlinecourses.nptel.ac.in/noc23_ee93/preview - Real Time Digital Signal Processing

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	-	-	-	-	-	-	-	1	-	2
CO2	2	2	2	1	1	-	-	-	-	-	-	-	1	-	2
CO3	2	2	2	1	1	-	-	-	-	-	-	-	1	-	2
CO4	2	2	2	1	1	-	-	-	-	-	-	-	1	-	2
CO5	2	2	1	1	1	-	-	-	-	-	-	-	1	-	2
CO	2	2	1	1	1	-	-	-	-	-	-	-	1	-	2

EC22406	**ANALOG COMMUNICATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To visualize the effects of sampling and Line Coding.

• To Implement AM and FM modulation & demodulation and TDM.	
• To implement PCM .	
• To simulate Analog Modulation schemes.	
PRACTICAL EXERCISES	
1.	AM Modulator and Demodulator.
2.	FM Modulator and Demodulator.
3.	Time Division Multiplexing.
4.	Signal Sampling and reconstruction.
5.	Pulse Code Modulation and Demodulation.
6.	Line coding schemes.
7.	Simulation of AM generation and detection schemes.
8.	Simulation of FM generation and detection schemes.
9.	Simulation of PM generation and detection schemes.
10	AM, FM and PM using SIMULINK.
	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Illustrate the sampling and Line coding schemes.
CO2:	Construct AM, FM modulators & Demodulators and TDM.
CO3:	Demonstrate PCM scheme.
CO4:	Simulate Analog modulation schemes.
CO5:	Develop modulators using Simulink.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO2	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO3	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO4	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO5	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-

EC22407	**LINEAR INTEGRATED CIRCUITS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
COURSE OBJECTIVES:					
• To analyze the performance of oscillators, amplifiers, Schmitt trigger and multivibrators.					
• To examine the frequency response of filters using op-amp.					
• To analyze the working of PLL and describe its application as a frequency multiplier.					
• To analyze D/A converters using op-amp.					
• To examine the performance of filters, multivibrators and A/D converter using SPICE.					
DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS					
LIST OF EXPERIMENTS					
1	Inverting and Non inverting amplifier.				
2	Schmitt Trigger using op-amp.				
3	Instrumentation amplifier.				
4	Active low-pass, High pass & Band pass filters				
5	PLL Characteristics and its use as frequency multiplier.				
6	R-2R ladder type D-A converter using Op-Amp				
7	Astable & Monostable multivibrators using Op-amp				
8	Astable and Monostable multivibrators using NE555 Timer.				
	SIMULATION USING SPICE (Using Transistor):				
9	Active low-pass, High-pass and band-pass filters using Op-amp.				
10	Wein Bridge Oscillator.				

11.	Astable and Monostable multivibrators using NE555 Timer
12.	A/ D converter.
	TOTAL: 60 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Analyze the performance of oscillators, amplifiers, Schmitt trigger and multivibrators.
CO2:	Examine the frequency response of filters using op-amp.
CO3:	Analyze the working of PLL and describe its application as a frequency multiplier.
CO4:	Analyze D/A converters using op-amp.
CO5:	Examine the performance of filters, multivibrators and A/D converter using SPICE.

LAB REQUIREMENTS

1. CRO/DSO (30 MHz) – 15 Nos.
2. Signal Generators / Function Generators (2 MHz) – 15 Nos.
3. Dual Regulated Power Supplies (0-30 v) - 15 Nos.
4. Digital Multimeter -- 15 Nos
5. IC Tester -- 5 Nos
6. Standalone desktops PC -- 15 Nos
7. Bread Boards - 15 Nos.
8. Components and Accessories – 50 Nos

Components and Accessories: Transistors, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, A/D convertors.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO2	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO3	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO4	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO5	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-
CO	1	1	2	2	2	2	-	-	-	-	2	2	2	-	-

SD22402	**CODING SKILLS AND SOFT SKILLS TRAINING – PHASE II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSEOBJECTIVES:

- To help students on developing modular applications in using functions.
- To help the students develop logics using Strings and Pointers.
- To make them use user defined datatypes in C and help them know more about Embedded systems programming.
- To train the students on speaking skills for group discussions
- To set them correctly on the track of presentation skills and management skills.

UNIT I	**FUNCTIONS**	**12**
Logic Building Using Functions – Programs on Recursion – Puzzles - Output of Programs -Company Specific Programming Example		
UNIT II	**STRINGS AND POINTERS**	**10**
Logic Building Using Strings – Programs on Strings - Logic Building Using Pointers –User Defined Datatypes – Puzzles - Output of Programs - Company Specific Examples		
UNIT III	**USER DEFINED DATATYPES & C PROGRAMMING FOR EMBEDDED APPLICATIONS**	**10**
User Defined Datatypes: Working with User Defined Datatypes – Puzzles - Output of Programs -Company Specific Examples C Programming for Embedded Applications: Lookup Tables-Functions – LUT vs Function Example using Keil – Float Point Unit Example in Keil		
UNIT IV	**COMMUNICATION SKILLS / LANGUAGE SKILLS**	**15**

Receptive Skills and productive skills - Skills together - Integration of skills - Input and output Receptive Skills: Listening and Reading - Lead-in - Pre-existent knowledge - General understanding of the audio or the written text - Discussion in pairs or small groups – feedback - Text-related task in detail - Focus on aspects of language in the text. Productive Skills: Speakingand Writing - lead-in - engaging students with the topic - setting the task - role-play - Monitoringthe task - Giving the feedback-positive- task-related follow up - repetition / re-setting of task. Activities: Pronunciation: syllable, stress, intonation - Writing memos, e-mails and formal letters
- Oral presentations / seminars - Written and Oral Descriptions Group discussions. .

UNIT V	**SOFT SKILLS: SEARCH AND FIND FOR CAREER DEVELOPMENTS**	**15**

Self-motivation: Interpersonal relationship - Attitudes and interpersonal integrity – Time management – prioritizing - Leadership quality – In the team: Team building and Team work - Memory technique Problem solving: – emotional intelligence – positive attitude towards life – taking up initiatives – developing mind set –openness to feed back – adaptability – active listening work ethics. Presentation of skills: creative thinking – critical thinking – logical thinking - decision making. Management ability: empathy – selflessness – humility – cultural respectfulness – versatility – generosity – trustworthiness – planning and executing – target achievement – listeningto others‘ views – friendliness - active participation – empowering healthy atmosphere – exchangeof ideas – mediation – negotiation – qualities – updating the knowledge – pre-work for performance respect for rules and regulations

TOTAL : 45 PERIODS

SUGGESTIVE ASSESSMENT METHODS:

1. Pre Assessment Test – To check the student‘s previous knowledge in Programming skills.
2. Internal Assessment I for coding skills will be conducted for 100 marks which are then calculated to 20.
3. Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.
4. Model Exam for coding skills will be conducted for 100 marks which are then reduced to 20
5. A test for Communication skills will be conducted for 100 marks which will be then calculated to 40.
6. For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
7. The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Develop and implement modular applications in functions.
CO2:	Design and implement applications using strings and user defined data types.
CO3:	Design and implement embedded system applications
CO4:	Practice both receptive skills (listening and reading) and productive skills (writing and speaking) and speak English with standard pronunciation using correct stress andintonation.
CO5:	Practice team building and team work procedures and develop memory techniques and Manage abilities like empathy, selflessness, cultural respectfulness and trustworthiness preparing themselves for target achievement

TEXT BOOKS:

1.	Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.
2.	Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015 .

REFERENCES:

1	Anita Goel and Ajay Mittal,"Computer Fundamentals and Programming in C", Pearson Education, 2013.
2	Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018
3	E Balagurusamy, "Programming in ANSI C", Eighth Edition, Mc GrawHill Publications, 2019.

4	Andrew J Dubrin, "Leadership – Research Findings', Houghton Mifflin Company,New York, 2008.
5	Elecia White, "Making Embedded Systems: Design Patterns for Great Software'', O'Reilly Publications, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 2	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 3	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 4	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 5	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1

AC22401	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		2	0	0	0

COURSEOBJECTIVES:

- Explaining the fundamental concept and principles of industrial safety
- Applying the principles of maintenance engineering.
- Analyzing the wear and its reduction.
- Evaluating faults in various tools, equipment and machines.
- Applying periodic maintenance procedures in preventive maintenance

UNITI INDUSTRIAL SAFETY ENGINEERING **9**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes andpreventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safetycolor codes. Fire prevention and firefighting, equipment and methods.

UNIT II MAINTENANCE ENGINEERING **9**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of toolsused for maintenance, Maintenance cost & its relation with replacement economy, Service lifeof equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION **9**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication
vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING **9**

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE **9**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling ofmechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the fundamental concept and principles of industrial safety
CO2:	Apply the principles of maintenance engineering
CO3:	Apply periodic maintenance procedures in preventive maintenance
CO4:	Analyze the wear and its reduction
CO5:	Evaluate faults in various tools, equipment and machines
TEXT BOOKS:	
1.	L M Deshmukh, "Industrial Safety Management", Tata McGraw-Hill Education, 2005.
2.	Charles D. Reese, " Occupational Health and Safety Management: A PracticalApproach"", CRC Press, 2003.
REFERENCES:	
1	Edward Ghali, V. S. Sastri, M. Elboujdaini, "Corrosion Prevention and Protection:Practical Solutions", John Wiley & Sons, 2007
2	Garg, HP, "Maintenance Engineering", S. Chand Publishing
3	J Maiti, Pradip Kumar Ray, "Industrial Safety Management: 21st CenturyPerspectives of Asia", Springer, 2017.
4	R. Keith Mobley, "Maintenance Fundamentals", Elsevier, 2011.
5	W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, "Create space Independent Pub",2014
List of Open Source Software/ Learning website:	
	https://onlinecourses.nptel.ac.in/noc23_mg98/preview - Industrial Safety Engineering

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 2	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 3	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 4	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO 5	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1
CO	2	1	2	-	-	2	1	-	-	-	-	1	1	2	1

SEMESTER V

EC22501	**NETWORKS AND SECURITY**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To learn the Network Models and datalink layer functions.
- To understand routing in the Network Layer.
- To explore methods of communication and congestion control by the Transport Layer.
- To study the Network Security Mechanisms.
- To learn various hardware security attacks and their countermeasures.

UNIT I	**NETWORK MODELS AND DATALINK LAYER**	**6**

Data Communications – Networks, Switching – Network Models – OSI, TCP/IP, Data link Layer – Link layer addressing, Framing, Data Link Layer Protocols- Error Detection: Parity, CRC – HDLC – Wired LANs – Ethernet (802.3): Standard Ethernet - Wireless LAN – IEEE 802.11: Architecture, MAC Sub layer, Addressing Mechanism.

UNIT II	**NETWORK LAYER PROTOCOLS**	**6**

Logical Addressing – IPv4, IPv6 Addresses – Network Layer Protocols: (IP, ICMP) - IPv6 – Datagram Format -Transition from IPv4 to IPv6- Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF, Multicast Routing: DVMRP.

UNIT III	**TRANSPORT AND APPLICATION LAYERS**	**6**

Transport Layer Protocols – User Datagram Protocols : Datagram, Services- Transmission Control Protocol: Datagram , Connection, State Transition Diagram - Congestion Control, Quality of services (QoS), Domain Name System (DNS) – World Wide Web, HTTP, Electronic Mail.

UNIT IV	**NETWORK SECURITY**	**6**

Computer and Network Security Concepts: OSI Security Architecture, Security Attacks, Security Services and Mechanisms-Data Encryption Standard –Advanced Encryption Standard– RSA Algorithm – Hash Functions – Secure Hash Algorithm.		
UNIT V	**HARDWARE SECURITY**	**6**
Introduction to hardware security, Hardware Trojans: Introduction, SoC Design Flow, Hardware Trojans , Hardware Trojans in FPGA Designs, Hardware Trojans Taxonomy Side –Physical Attacks and Countermeasures – Design for Security.		
		30 PERIODS
PRACTICAL EXPERIMENTS:		
Experiments using C		
1.	Implement the Data Link Layer framing methods: Bit stuffing / Character stuffing.	
2.	Implementation of Error Detection Technique using CRC.	
3.	Implementation of Distance Vector Routing algorithm (Routing Information Protocol) with 5 nodes (Bellman-Ford).	
4.	Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).	
5.	Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.	
Experiments using Tool Command Language		
1.	Implement and realize the Network Topology - Star, Bus and Ring using NS2.	
2.	Implementation of Stop and Wait and Sliding Window Protocols using NS2.	
3.	Implementation of Go back-N and Selective Repeat Protocols using NS2.	
		30 PERIODS
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the fundamental concepts of network models, layers and their functions	
CO2:	Identify the routing protocols and IP addressing scheme to design the network.	
CO3:	Illustrate the functions of the transport and application layer.	
CO4:	Utilize the various security mechanisms involved in designing the network.	
CO5:	Interpret the hardware security attacks and countermeasures.	
TEXT BOOKS:		
1.	Behrouz.A.Forouzan, “Data Communication and Networking”, Fifth Edition, TMH, 2017.(Unit – I,II,III)	
2.	William Stallings, “Cryptography and Network Security Principles and Practice”, Seventh Edition, Pearson Education, 2017(Unit- IV)	
REFERENCES:		
1.	Swarup Bhunia, Mark Tehranipoor, “Hardware Security –A Hands-On Learning Approach”, Morgan Kaufmann, 2018.(Unit – V).	
2.	James.F.Kurose and Keith.W. Ross, “Computer Networking – A Top – Down Approach”, Sixth Edition, Pearson, 2017.	
3.	Larry Peterson Bruce Davie, “Computer Networks: A system Approach”, Fifth Edition, Morgan Kaufmann Series in Networking- Publisher, 2011.	
4.	William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2013.	
5.	William Stallings, “Network Security Essentials Applications and Standards”, Fourth Edition, Pearson Education, 2013.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	2	1	-	-	1	-	2	2	2	1	1
CO2	2	2	1	1	2	1	-	-	1	-	2	2	2	1	1
CO3	2	2	1	1	2	1	-	-	-	-	2	2	2	1	1
CO4	2	2	1	1	2	1	-	-	1	-	2	2	2	1	1
CO5	2	2	1	1	2	1	-	-	-	-	2	2	2	1	1
CO	2	2	1	1	2	1	-	-	1	-	2	2	2	1	1

EC22502	VLSI DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of IC technology components and their characteristics.
- To impart technical knowledge for optimizing the system design.
- To understand the combinational and sequential logic circuits and design principles.
- To design arithmetic building blocks

UNIT I	INTRODUCTION TO MOS TRANSISTOR	6

MOS transistor, CMOS logic, CMOS Fabrication and layout, Structure and Operation of nMOS and pMOS Transistors, Ideal and Non-Ideal IV Characteristics, C-V Characteristics, Inverter, DC Transfer characteristics, scaling.

UNIT II	PERFORMANCE ESTIMATION	6

Delay estimation: Transient Response, RC delay model, Linear delay model, Logical effort of path, Timing anysis delay model, Power Dissipation: Static and Dynamic Power Dissipation, Energy-Delay optimization, Low power architectures.

UNIT III	DESIGN OF COMBINATIONAL LOGIC GATES IN CMOS	6

Static CMOS design: Complementary CMOS, Ratioed Logic, Pass Transistor Logic - Dynamic CMOS Design – Basic principles, speed and power dissipation, Signal Integrity issues, cascading dynamic gates.

UNIT IV	DESIGN OF SEQUENTIAL LOGIC CIRCUITS	6

Static Latches and Registers-Dynamic Latches and Registers-Pulse Registers- Sense amplifier based Registers-Pipelining: Latch, NORA-CMOS- Nonbistable Sequential Circuits.

UNIT V	DESIGNING ARITHMETIC BUILDING BLOCKS	6

Binary Adder-Transmission Gate Based Adder-Manchestor Carry-Chain Adder- -Carry-By Pass Adder-Linear Carry Select Adder-Square Root Carry Select Adder-Carry Lookahead adder-Array Multipliers – Modifies Booth's Recoding-Carry Save Multipliers- Wallace Tree Multipliers- Shifters

30 PERIODS

PRACTICAL EXPERIMENTS:

1.	Implementation of an Adder (Min 8 Bit) using HDL.
2.	Implementation of a Multiplier (4 Bit Min) using HDL.
3.	Implementation of Multiplexer/Demultiplexer, Encoder/ Decoder using HDL.
4.	Implementation of basic sequential circuits using HDL.
5.	Implementation of a Universal Shift Register using HDL.

Requirements: Xilinx ISE/Altera Quartus/equivalent EDA Tools along with Xilinx/Altera/ equivalent FPGA Boards for experiments 1 to 5.

6.	Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual /Automatic Layout.
7.	Design and simulate a 4-bit synchronous counter using a Flip-Flops. Generate Manual/Automatic Layout.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Describe the fundamentals of MOS transistor and its characteristics.
CO2:	Explain power dissipation and the delay models of CMOS circuits.
CO3:	Construct static and dynamic CMOS logic gates.
CO4:	Develop sequential logic circuits in CMOS logic.
CO5:	Design arithmetic building blocks.

TEXT BOOKS:

1.	Neil H.E. Weste, David Money Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Fourth 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,V).

REFERENCES:

1.	Vikram Arkalgud Chandrasetty, "VLSI Design -A practical Guide for FPGA and ASIC Implementations, Springer, University of South Australia, 2011.
2.	Sung-Mo kang, Yusuf Leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits: Analysis& Design", Fourth edition, McGraw Hill Education, 2013.

3.	John Michael Williams, “Digital VLSI Design with Verilog”, Second Edition, Springer, 2014.
4.	Sneh Saurabh, “Introduction to VLSI Design Flow”, Cambridge University Press, 2023.
5.	Vaibbhav Taraate, “Digital Design from the VLSI perspective: Concepts for VLSI beginners”, Springer nature, 2022.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	-	-	-	-	-	-	2	2	2	1
CO2	2	2	2	2	-	-	-	-	-	-	-	2	2	2	1
CO3	2	2	2	2	1	-	-	-	1	-	-	2	2	2	1
CO4	2	2	2	2	2	-	-	-	1	-	-	2	2	2	1
CO5	2	2	2	2	2	-	-	-	1	-	-	2	2	2	1
CO	2	2	2	2	1	-	-	-	1	-	-	2	2	2	1

EC22503	MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

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

UNIT I	THE 8086 MICROPROCESSOR	6

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines

UNIT II	8086 SYSTEM BUS STRUCTURE	6

8086 signals – Basic configurations – System bus timing – I/O programming – Introduction to Multiprogramming – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations

UNIT III	I/O INTERFACING	6

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface – Interrupt controller – Programming and applications Case studies: Traffic Light control, LED display and LCD display.

UNIT IV	MICROCONTROLLER	6

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V	INTERFACING MICROCONTROLLER	6

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - Stepper Motor and Waveform generation

30 PERIODS

PRACTICAL EXPERIMENTS:

8086 Programs using kits	
1.	Basic arithmetic and Logical operations
2.	Move a data block without overlap
3.	Code conversion, decimal arithmetic and Matrix operations.
Peripherals and Interfacing Experiments	
4.	Traffic light controller
5.	Stepper motor control
6.	A/D and D/A interface and Waveform Generation
8051 Experiments using kits	
7.	Basic arithmetic and Logical operations
8.	Square and Cube program, Find 2’s complement of a number

30 PERIODS

	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the basic concepts of Microprocessors, addressing modes and instruction set of 8086.
CO2:	Illustrate the detailed hardware and software structure of the microprocessor.
CO3:	Explain how peripherals (8255, 8253, etc.) are interconnected with the microprocessor.
CO4:	Interpret the overview of the internal architecture and various operating modes of a typical microcontroller.
CO5:	Develop assembly language programs for interrupts, subroutines, macros, peripheral devices, and interfaces in the 8086 and 8051 architectures.
TEXT BOOKS:	
1.	Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007. (Unit I-III)
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)
REFERENCES:	
1.	Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012
2.	A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" Third Edition, Tata McGraw Hill, 2012
3.	Krishna Kant, "Microprocessors and Microcontrollers", Prentice Hall of India, 2013.
4.	V. Udayashankara, M.S. Mallikajunaswamy, "8051 Microcontroller Hardware, Software and Applications", McGraw-Hill, 2017
5.	K.Uma Rao, Andhe Pallavi, "The 8051 and MSP430 Microcontrollers, Architecture and Programming and Applications", Wiley, 2019.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
CO2	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
CO3	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
CO4	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
CO5	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1
CO	2	2	2	1	1	1	-	-	-	-	2	2	2	1	1

EC22504	**TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**
COURSE OBJECTIVES:					
• To encourage the students to study and review advanced engineering developments.					
• To prepare and present technical reports.					
• To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.					
• To encourage the students to face the placement interviews.					
METHOD OF EVALUATION					
During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of two periods per week, 15 students are expected to present the seminar. Each student is expected to present atleast twice during the semester and the student is evaluated based on that. At the end of the semester, he / she has to submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.					
TOTAL:30 PERIODS					
COURSE OUTCOMES:					
At the end of the course, the students will be able to:					

CO1:	Describe the selection of a subject, narrow the subject into a topic and state an objective.
CO2:	Illustrate to collect the relevant bibliography and prepare a working outline.
CO3:	Outline the understanding of the authors' contributions and critically analyze each paper.
CO4:	Outline the linking of papers and prepare a draft of the paper.
CO5:	Describe the writing of final paper and give final presentation.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO2	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2
CO3	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO5	-	-	-	-	-	-	-	-	2	2	-	3	2	2	2
CO	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2

EC22505	**INPLANT/INDUSTRIAL TRAINING**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**1**

COURSE OBJECTIVES:

- To provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required
- To apply the technical knowledge in real industrial situations.
- To gain experience in writing technical reports/projects.
- To expose the students to experience the engineer's responsibilities and ethics.
- To promote academic, professional and/or personal development.

Inplant/Industrial Training Duration

The students may undergo Industrial training for a period as specified in the Curriculum during the summer / winter vacation. In this case, the training has to be undergone continuously for a period of at least two weeks in an organization.

METHOD OF EVALUATION

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.

TOTAL:30 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Interpret how the theoretical aspects learned in classes are integrated into the practical world.
CO2:	Make use of the opportunity to learn new skills and supplement knowledge.
CO3:	Develop communication and teamwork skills
CO4:	Motive the student for higher education.
CO5:	Formulate to learn strategies like time management, multi-tasking etc in an industrial setup

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO2	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2
CO3	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	2	2
CO5	-	-	-	-	-	-	-	-	2	2	-	3	2	2	2

CO	-	-	-	-	-	-	-	2	2	2	-	3	2	2	2

SD22502	CODING SKILLS AND SOFT SKILLS TRAINING – PHASE III	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To make the students to develop logics using basic Programming Logics, Decisional statements,Arrays and Strings.
- To help the students to know how to use classes and objects and implement programs using OOPs concepts.
- To guide students to model systems using System C.
- To train the students on interview skills with mock interviews and updated / enhanced resumes
- To prepare students for taking initiatives and decision making with critical thinking.

UNIT I	BASIC PROGRAMMING CONSTRUCTS & SOFT SKILLS: TIME MANAGEMENT	12

Structured Vs Object oriented programming language – Output of programs on basic I/O functions – Logic building using Decisional Statements – Programs on Patterns and Numbers - Debugging – Puzzles - Company specific programming examples.

Soft Skills: Time management: Prioritizing – Delegation - Decision-making - Goal setting – Multitasking - Problem solving - Strategic thinking - Scheduling – Planning - to-do lists and checklists -Evaluating urgent tasks - Auditing and improving workflows - Filtering notifications - Setting thoughtfuldeadlines – Evaluating the work done schedules – Grouping similar tasks – Learn to say 'no'.

UNIT II	PROGRAMMING USING FUNCTIONS AND ARRAYS & SOFT SKILLS:STRESS MANAGEMENT AND EMOTIONAL QUOTIENT	12

Logic building using modular approach – Programming using Friend Function – Programs on Matrices and Strings – Puzzles – Output of programs - Company specific programming examples.

Soft Skills: Stress management: Using guided meditation - Maintain physical exercise and good nutrition - Manage social media time - Connect with others – read and relax. **Emotional Quotient**: Overcoming challenges – defusing conflict - Self-awareness - Self-regulation - Professional etiquette – Avoiding doubt – Introducing others – Courteousness – Non-interruption – Avoiding gossip.

UNIT III	IMPLEMENTING OOPS CONCEPTS & SOFT SKILLS: VALUES OF LIFEAND BEHAVIOURAL ATTITUDES	12

Discussion on basics of OOPs Concepts – Solving problems based on Data Members and Member Functions – Programs based on Construction and Destruction of Objects - Puzzles - Output of Programs – Understanding Access Specifiers – Company specific programming examples.

Soft Skills: Values of life: Loyalty to others and responsibilities – Living with Spirituality – Maintaining humility – Possessing compassion – Proving being honest – developing kindness – Learning to have integrity – Embracing responsibility. **Behavioural attitudes:** Behaving with sportive attitude – Respecting the freedom of the others – Being bold – Enhancing fun and joy.

UNIT IV	LOGIC BUILDING USING INHERITANCE, ABSTRACTION, POLYMORPHISM AND ENCAPSULATION & SOFT SKILLS: EMPLOYERSEXPECTATIONS AND RESUME ENHANCEMENT	12

Understanding Super class and Derived Class – Logic building based on inheritance – Programming usingPure Virtual Function and Abstract Classes- The Final Keyword – Programming Using FunctionOverloading and Overriding – Understanding Encapsulation - Puzzles - Output of Programs – Companyspecific programming examples.

Soft Skills: Employers expectations: Contributing to the team – Being with stability – Developing the ability to grow - Improving the productivity. **Resume enhancement:** Select the best template for your skills, experience, and goals Adding skills to be an expert - Robusting and compelling objective – Displaying online presence - Quantifying accomplishments various roles.

UNIT V	SYSTEM DESIGN LANGUAGES & SOFT SKILLS: INTERVIEW SKILLS	12

System Design Languages: Review of C++ basics from the SystemC perspective - SystemC concepts: Processes, Modules, Ports, Interfaces, Channels, and SystemC data types - SystemC simulation kernel **Soft Skills: Interview Skills**: Clarifying interview questions - Communicate nonverbally - Knowing theresume thoroughly - Leveraging knowledge of the company and interviewer - Mock interviews – Gettingrehearsed before moving for interviews.

	TOTAL: 60 PERIODS
SUGGESTIVE ASSESSMENT METHODS:	
1.	Pre Assessment Test – To check the student's previous knowledge in Programming skills.
2.	Internal Assessment I for coding skills will be conducted for 100 marks which are thencalculated to 20.
3.	Internal Assessment II for coding skills will be conducted for 100 marks which are then calculated to 20.
4.	Model Exam for coding skills will be conducted for 100 marks which are then calculated to 20.
5.	A test for Soft Skills will be conducted for 100 marks which will be then calculated to 40.
6.	For assignments, students should attend all the practice tests conducted online on HackerRank. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
7.	The total of 100 marks obtained from the tests will be then calculated to 60 marks and additional of 40 marks will be given for assignments which will make it a total of 100.
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Develop programs using Functions, Strings and Arrays.
CO2:	Develop applications using OOPs Concepts.
CO3:	Know how to model systems using System C.
CO4:	Apply all the interview skills learned with updated resumes and language skills balancing technical skills and interpersonal skills.
CO5:	Attend different job interviews with emotional balance and achieve the target with rightplanning and unique solutions.
TEXT BOOKS:	
1.	Balagurusamy E, "Object Oriented Programing with C++", Eighth Edition ,Tata McGraw Hill Education Pvt.Ltd,2020.
2.	Anthony Williams, "C++ Concurrency in Action", Second Edition, Manning Publications, 2019.
REFERENCES:	
1.	Bjarne Stroustrup, "A Tour of C++", Second Edition, Pearson Education, 2018.
2.	Scott Meyers, "Effective Modern C++", O'REILLY Publication, 2014.
3.	Stanely Lippman, Josee Lajoie, Barbara Moo, "C++ Primer", Fifth Edition, Pearson Education, , 2012.
.	Bjarne Stroustrup, "The C++ Programming Language", Fourth Edition, Pearson Education, 2013.
5.	S.Sobana, R.Manivannan, G.Immanuel,"Communication and Soft Skills", VK Publications, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	1	1	1	-	-	-	1	2	-	1	2
CO2	2	2	2	-	1	1	1	-	-	-	1	2	-	1	2
CO3	2	2	2	-	1	1	1	-	-	-	1	2	-	1	2
CO4	-	-	-	-	-	-	-	1	2	2	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	2	2	-	2	-	-	-
CO	2	2	2	-	1	1	1	1	2	2	1	2	-	1	2

AC22501	**ENTREPRENEURSHIP DEVELOPMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
COURSE OBJECTIVES:					
• Explaining the types, characteristics of entrepreneurship and its role in economic development					
• Applying the theories of achievement motivation and the principles of entrepreneurship development program to enterprise.					
• Selecting the appropriate form of business ownership in setting up an enterprise					

• Applying the fundamental concepts of finance and accounting to enterprise.		
• Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.		
UNIT I	**ENTREPRENEURSHIP**	**6**
Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur, Entrepreneurial Competencies – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth.		
UNIT II	**BUSINESS PLAN**	**6**
Sources of business ideas and tests of feasibility: Significance of writing the business plan/ project proposal; Contents of business plan/ project proposal; Designing business processes, location, layout, operation; Project Appraisal, preparation of project report		
UNIT III	**SMALL SCALE INDUSTRIES**	**6**
Legal formalities in setting up of SSIs, Business Laws, Governmental Setup in promoting small industries, Status of Small Scale Industrial Undertakings, Steps in starting a small industry, Ownership Structures		
UNIT IV	**FINANCING AND ACCOUNTING**	**6**
Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management		
UNIT V	**SUPPORT TO ENTREPRENEURS**	**6**
Government Policy for Small Scale Enterprises – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry, Social Responsibility of Business		
		TOTAL: 30 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the types, characteristics of entrepreneurship and its role in economic development.	
CO2:	Apply the theories of achievement motivation and the principles of entrepreneurship development program	
CO3:	Select the appropriate form of business ownership in setting up an enterprise.	
CO4:	Apply the fundamental concepts of finance and accounting to enterprise.	
CO5:	Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise	
TEXT BOOKS:		
1.	S.S.Khanka, "Entrepreneurial Development" , S.Chand& Co. Ltd., Ram Nagar NewDelhi,1999.	
2.	Kurahko&Hodgetts, " Entrepreneurship – Theory, process and practices", Sixth Edition, Thomson learning, 2004.	
REFERENCES:		
1.	Charantimath, P. M., "Entrepreneurship Development and Small Business Enterprises", Pearson, 2006	
2.	Hisrich R D and Peters M P, "Entrepreneurship" Fifth Edition, Tata McGraw-Hill, 2002.	
3.	Mathew J Manimala," Entrepreneurship theory at cross roads: paradigms and praxis", Second Edition, Dream tech, 2006.	
4.	Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	1	-	-	1	-	1	2	1	2	-	1	-	-	-
CO2	-	-	1	-	1	1	1	2	2	2	-	1	-	-	-
CO3	-	-	1	-	-	2	1	1	1	1	-	1	-	-	-
CO4	1	-	1	-	-	2	1	-	1	1	1	-	-	-	-
CO5	-	1	-	1	-	1	1	-	1	1	-	1	-	-	-
CO	1	1	1	1	1	2	1	2	1	1	1	1	-	-	-

HS22501	VALUE EDUCATION – II	L	T	P	C

		1	**0**	**0**	**0**
COURSE OBJECTIVES:					
• To impart knowledge on essential qualities to become a good leader.					
• To prepare them to have the ability to relate with others and contribute to industrial and human development.					
• To teach the significance of being responsible citizens of the society.					
UNIT I	**UNDERSTANDING THE SOCIETY AND BECOMING A LEADER**				**3**
Problems of our society and their causes – styles of leadership – qualities and skills of leadership.					
UNIT II	**PRACTICING LEADERSHIP FOR SOCIAL CHANGE**				**4**
Possible areas of changes in the society with education – Utilising Engineering education to create social changes – strategies and people movement for the change.					
UNIT III	**BALANCING PROFESSIONAL, PERSONAL, FAMILY FOR FULLNESS OF LIFE**				**4**
Healthy adult as an individual and family – stages of life – strategies to balance life					
UNIT IV	**INNOVATIVE SOCIAL COMMITMENT, SPIRITUALITY AND SOCIAL NETWORKING**				**4**
Social commitment as a healthy spirituality – systematic contribution to society and industry – Networking professionals for growth and change.					
TOTAL: 15 PERIODS					
COURSE OUTCOMES:					
At the end of the course, the students will be able to:					
CO1:	Demonstrate the essential steps to become good leaders.				
CO2:	Identify the various societal problems and also the solution.				
CO3:	Realize their role and contribution to nation building.				
CO4:	Apply the essential steps to become value-based professionals				
REFERENCES:					
1.	Warren G.Bennis,"On Becoming a Leader. Basic Books" ,2009.				
2.	Suresh Agarwal, "Social Problems in India", Rajat Publications, 2015.				
3.	Biswaranjan Mohanty, "Constitution, Government and Politics in India", New Century Publication, 2009.				
4.	Myles Munroe. "Releasing Your Potential", Destiny Image, 2007				
5.	Kelsang Gyatso, "How to Solve Our Human Problems: The Four Noble Truths",Tharpa Publications, 2005.				
6.	Ifeanyi Enoch Onuoha , "Overcoming the challenges of life", Author house, 2011.				
7.	John C Maxwell, "Five Levels of Leadership, the Proven Steps to Maximize Your Potential", Center Street, 2011				

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO2	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO3	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO4	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-
CO	-	-	-	-	-	2	-	1	1	2	-	2	-	-	-

SEMESTER VI

HS22601	**PROFESSIONAL ETHICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To identify and analyze ethical issues in engineering					
• To recognize the code of ethics with appropriate perspective as per industrial standards					
• To understand the ethical situations in risky situation					
• To provide services in their areas of expertise					

• To be aware of the role of engineers in solving global issues		
UNIT I	**ENGINEERING ETHICS, MORAL REASONING AND ETHICAL THEORIES**	**10**
Senses of 'Engineering Ethics' – Variety of Moral Issues – Types of Inquiry – Social Ethics vs Scientific Ethics vs Experiential Ethics – Moral Dilemmas – Moral Autonomy – Kohlberg's Theory – Gilligan's Theory – Professions and Professionalism – Professional Ideals and Virtues – Theories about Right Action – Uses of Ethical Theories.		
UNIT II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**8**
Role of Professional Ethics in Engineering Based Product Development – Engineering as Experimentation – Engineers as Responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law – Case Study		
UNIT III	**ENGINEERS' RESPONSIBILITY FOR SAFETY AND RISK**	**8**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analyses and Reducing Risk – Case Studies.		
UNIT IV	**RESPONSIBILITIES AND RIGHTS**	**9**
Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Whistle Blowing – Employee Rights – Discrimination – Intellectual Property Rights (IPR).		
UNIT V	**GLOBAL ISSUES AND ROLE OF ENGINEERS**	**10**
Multinational Corporations – Environmental Ethics – Computer Ethics – Ethics of AI – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Corporate Social Responsibility – Ethics in Engineering Practice and Research – Ethical Audit.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Visualize the scope of engineering ethics and ethical decision making.	
CO2:	Develop a perspective on engineering as an experiment.	
CO3:	Detail the importance of assessing safety and risk and reducing the risk.	
CO4:	Realize the responsibilities and rights of engineers, employees, employers and public.	
CO5:	Recognize the role of ethics related to MNC, Environment, Computer, AI, and while acting as manager, consultant, and experts.	
TEXT BOOKS:		
1.	Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill Education, 2017.	
2.	Govindarajan M, Natarajan S, Senthil Kumar V.S, "Engineering Ethics", Prentice Hall of India Pvt. Ltd., 2015.	
REFERENCES:		
1.	Robert McGinn R., "The Ethical Engineer: Contemporary Concepts & Cases", Princeton University Press, February 2018.	
2.	Mark Coeckelbergh, "AI Ethics", The MIT Press, April 2020.	
3.	Qin Zhu, Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, Fifth Edition, 2022.	
4.	Deborah C. Poff and Alex C. Michalos, "Encyclopedia of Business and Professional Ethics", Springer Nature, Switzerland AG, May 2023.	
5.	Frederic G. Reamer, "Social Work Values and Ethics", Columbia University Press, New York, Sixth Edition, May 2024.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	3	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	3	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-
CO	-	-	-	-	-	2	2	3	2	1	-	2	-	-	-

Mapping of Course Outcomes to Programme Outcomes

EC22601	DIGITAL COMMUNICATION	L	T	P	C
		3	0	2	4
COURSE OBJECTIVES:					
• To study the various waveform coding schemes.					
• To learn the various baseband transmission & reception schemes.					
• To understand the various digital modulation schemes.					
• To know the basics of information source &discrete memoryless channels.					
• To know the fundamentals of error control coding.					
UNIT I	**INFORMATION THEORY**				**9**
Discrete Memoryless source, Information, Entropy— Source coding theorem — Shannon — Fano & Huffman codes- Discrete Memoryless channels — Binary Symmetric Channel, Mutual Information -Channel Capacity —Hartley - Shannon law					
UNIT II	**WAVEFORM CODING & REPRESENTATION**				**9**
DPCM — Delta Modulation — ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ — Bipolar NRZ — Manchester					
UNIT III	**BASEBAND TRANSMISSION & RECEPTION**				**9**
ISI — Nyquist criterion for distortion less transmission — Pulse shaping — Correlative coding — Eye pattern — Correlation receiver, Adaptive Equalization					
UNIT IV	**DIGITAL MODULATION SCHEME**				**9**
Geometric Representation of signals — Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK — QAM — Structure of Non-coherent Receivers — Principle of DPSK					
UNIT V	**ERROR CONTROL CODING**				**9**
Channel coding theorem — Linear Block codes — Cyclic codes — Convolutional codes — Viterbi Decoder.					
					45 PERIODS
PRACTICAL EXPERIMENTS:					
1.	Phase Shift Keying - Modulation and Demodulation				
2.	Delta Modulation and Demodulation				
3.	Line coding schemes				
4.	Simulation of DPSK, QPSK and QAM generation schemes				
5.	Simulation of Linear Block and Cyclic error control coding schemes				
6.	Communication link simulation				
					30 PERIODS
					TOTAL: 75 PERIODS
COURSE OUTCOMES:					
At the end of the course, the students will be able to:					
CO1:	Explain different line coding and digital pulse modulation schemes				
CO2:	Discuss the various base band transmission & reception schemes				
CO3:	Compute the spectral characteristics of band pass signaling schemes and their noise performance				
CO4:	Interpret various information coding				
CO5:	Design error control coding schemes				
TEXT BOOKS:					
1.	Simon S. Haykin, “Digital Communication Systems”, John Wiley, 2017.				
2.	H. Taub, D. Schilling, “Principles of Communication Systems”, Fourth Edition, TMH, 2017.				
REFERENCES:					
1.	B. Sklar, “Digital Communications: Fundamentals and Applications”, Third Edition, Kindle Edition, 2021.				
2.	B.P. Lathi, Zhi Ding “Modern Digital and Analog Communication Systems”, Oxford University Press, 2019.				
3.	H P Hsu, Schaum Outline Series - “Analog and Digital Communications”, TMH 2017.				
4.	V.K.Khanna, “Digital Communication”, S. Chand Publishers, 2010.				
5.	K. Sam Shanmugam, “Digital and Analog Communication Systems’, John Wiley, 2013.				

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	2	2	-	-	-	-	2	2	3	-	-

CO2	3	2	2	2	2	2	-	-	-	-	2	2	3	-	-
CO3	2	2	3	2	2	2	-	-	-	-	2	2	3	-	-
CO4	2	3	2	2	2	2	-	-	-	-	2	2	3	-	-
CO5	2	2	3	2	2	2	-	-	-	-	2	2	3	-	-
CO	2	2	2	2	2	2	-	-	-	-	2	2	3	-	-

EC22602	**EMBEDDED SYSTEMS AND IoT DESIGN**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
COURSE OBJECTIVES:					
• To learn the concepts of embedded system design.					
• To understand the real time processing in an embedded system.					
• To learn the architecture of IoT					
• To learn design flow of IoT					
• To build an IoT based system.					
UNIT I	**INTRODUCTION TO EMBEDDED SYSTEM DESIGN**				**6**
Embedded system design process –Design example: Model train controller- ARM Processor – Instruction Set– CPU – Programming Input and Output, Models for programs – Assembly, Linking and Loading					
UNIT II	**PROCESSES AND OPERATING SYSTEMS**				**6**
Structure of a real time system – Task Assignment and Scheduling – Priority based scheduling – Interprocess Communication Mechanisms – Audio Player - Real time OS – Multi tasking OS					
UNIT III	**FUNDAMENTALS OF IoT**				**6**
Introduction to IoT& Devices – Characteristics – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG					
UNIT IV	**IoT PROTOCOLS AND DESIGN FLOW**				**6**
IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet. IoT Platform Design – Methodology – IoT Reference Model – Domain Model - Communication Model.					
UNIT V	**IoT SYSTEM DESIGN**				**6**
Basic building blocks of an IoT device – Raspberry Pi – Board – Interfaces– Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.					
					30 PERIODS
PRACTICAL EXERCISES:					
Experiments using ARM					
1.	Blinking of LEDs and LCD				
2.	Interfacing using peripherals such as keyboard and stepper Motor				
3.	Interfacing using peripherals such as ADC and DAC				
Experiments using Raspberry pi					
4.	Interfacing sensors with Raspberry pi				
5.	Setup a cloud platform to log the data				
Mini projects for IoT					
6.	Smart Cities				
7.	Smart Health Monitoring System				
					30 PERIODS
					TOTAL: 60 PERIODS
COURSE OUTCOMES:					
At the end of the course, the students will be able to:					
CO1:	Develop a model of an embedded system.				
CO2:	Outline the concepts of real time operating systems				
CO3:	Learn the architecture of IoT				
CO4:	Realize the various protocols of the IoT.				
CO5:	Design an IoT based system for any application				
TEXT BOOKS:					
1.	Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher, 2012. (UNIT - I, II,)				

2.	Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015. (Unit – III, IV, V)
REFERENCES:	
1.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017
2.	Adrian McEwen, Designing the Internet of Things, Wiley, 2013.
3.	Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, Pearson Education, 2020.
4.	Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition, Cengage Learning, 2012.
5.	Lyla B.Das, "Embedded Systems : An Integrated Approach" Pearson Education, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	1	2	-	-	-	-	-	2	2	1	1
CO2	2	2	2	2	1	2	-	-	-	-	-	2	2	1	1
CO3	2	2	2	2	2	2	-	-	-	-	-	2	2	1	1
CO4	2	2	2	2	3	3	-	-	-	-	-	2	2	1	1
CO5	2	2	3	3	3	3	-	-	-	-	-	3	2	1	1
CO	2	2	2	2	2	2	-	-	-	-	-	2	2	1	1

SD22602	**CODING SKILLS AND QUANTITATIVE APTITUDE – PHASE I**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To equip the students with the foundational knowledge and practical skills in HTML and CSS.
- To empower students with the knowledge and skills of JavaScript effectively for Web Development.
- To gain hands-on experience with real-world React Applications.
- To improve aptitude, problem solving skills and reasoning ability of the students
- To demonstrate the use of mathematical reasoning by justifying through numerical skills.

UNIT I	**Understand HTML Fundamentals & QA & LR**	**12**

A Dive into Web Creation - Basic HTML Tags - Semantic Tags - Miscellaneous Tags - Text Formatting Tags - Lists - Links and Images - Forms - Project Work.
Quants: Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression), HCF & LCM, Decimal Fractions, Simplification (Including Expression & Evaluation).
Logical Reasoning: Analogy - Blood Relations/Family Tree.

UNIT II	**Master CSS Basics & QA & LR**	**12**

Unveiling the Art of CSS - Selectors and Specificity - Box Model and Layout - Typography and Fonts - Colors and Backgrounds - Project Work.
Quants: Average-Problem on Ages.
Logical Reasoning: Coding-Decoding

UNIT III	**JavaScript Expedition & Routing & QA & LR**	**12**

JavaScript Expedition - Variables and Data Types - Control Flow - Loops - Functions - Arrays & Objects - DOM Manipulation - Project Work.
Quants: Ratio & Proportions - Partnership-Mixtures and Alligations.
Logical Reasoning: Cryptarithmetic Problems, Syllogisms.

UNIT IV	**Learn React.js Fundamentals & QA & LR**	**12**

Creating first React Application - JSX - React Components - State and Props - Event Handling - Project Work.
Quants: Time & Work-Chain Rule-Pipes and Cisterns.
Logical Reasoning : Calendar – Clocks - Images (Mirror & Water).

UNIT V	**Build Interactive Web Applications & QA & LR**	**12**

React Lifecycle Methods - Using Lists and Keys - React in IoT: Real Time Data Visualization, Dashboard

Interfaces - Integration with IoT Platforms - Project Work. **Quants: Time, Speed & Distance -** Problems on Trains, Boats & Streams. **Logical Reasoning:** Cubes and Dices - Data Sufficiency.	
TOTAL: 60 PERIODS	
SUGGESTIVE ASSESSMENT METHODS:	
1.	Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning
2.	Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
3.	Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
4.	For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally the total marks obtained by a student in all assignments will be reduced to 40 marks.
5.	Thus 60 marks from internal and 40 marks from assignments will make it a total of 100.
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Construct webpages using HTML and CSS.
CO2:	Construct interactive and dynamic web applications using JavaScript.
CO3:	Construct a real-world React application.
CO4:	Apply quantitative techniques to solve a variety of problems and can enhance their employability quotient and to establish a stronger connection with the technical environment in which they operate.
CO5:	Interpret solutions for problems within short duration and can also think critically and apply basic mathematics skills to interpret data, draw conclusions and solve problems.
TEXT BOOKS:	
1.	Robin Wieruch," The Road to React: with React18 and React Hooks", CreateSpace Independent Publishing Platform, 2024.
2.	Stoyan Stefanov, "React: Up & Running: Building Web Applications", Second Edition, O' Reilly Publications, 2021.
3.	Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, Reprint, 2023.
4.	Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd., New Delhi, , Reprint, 2016.
REFERENCES:	
1.	Zac Gordan, Mikall Angela Hill, Robbie Addair, "React Explained: Your Step-By-Step Guide to React", oS Training Publishers, 2020.
2.	Alex Banks, Eve Porcello, "Learning React: Functional Web Development with React and Redux", O' Reilly Publications, 2017.
3.	Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, 2016
4.	Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, 2016.
5.	Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers., Reprint, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO4	1	1	1	-	-	-	-	-	1	-	-	1	-	-	1
CO5	1	1	1	-	-	-	-	-	1	-	-	1	-	-	1
CO	2	2	2	-	2	-	-	-	1	-	-	2	-	-	1

SEMESTER VII

MS22701	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the evolution of Management and its principles.
- To discuss the functions of management and their importance in business.
- Learn the application of the principles in an organization like planning, organizing, directing and controlling.
- Analyze the position of self and company goals towards business.

UNIT I	INTRODUCTION TO MANAGEMENT	9

Definition of Management – Role of Managers in the Workplace – Management Functions, Levels, Roles and Skills – Evolution of Management – Influence of the External Environment and the Organization's Culture – Diversity, Equity, and Inclusion – Types of Business organizations – Managing in a Global Environment – Managing Corporate Social Responsibility and Ethics – Current trends and issues.

UNIT II	PLANNING	9

Foundations of planning – Planning process – Types of planning – Objectives – Setting objectives – MBO – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making process –Entrepreneurial Ventures – Business Plan Development in Entrepreneurship – Contemporary issues in planning.

UNIT III	ORGANIZING AND STAFFING	9

Nature and purpose – Organization structure design – Departmentalization – Delegation of authority – Centralization and decentralization – Managing Human Resources – HR Planning – Recruitment and Decruitment – Selection, Orientation, Training and Development, Performance Management – Career planning, development and management – Managing change and innovation – Recent issues in HRM.

UNIT IV	DIRECTING AND LEADING	9

Understanding and managing individual behavior – Perception, Personality, Attitude, and Learning – Motivating Employees – Motivation theories – Managing Groups and Teams – Team Dynamics – Effective Leadership – quality, styles, skills and theories of leadership – Communication management – Process and Forms of communication – Barrier in communication – Effective communication styles and Negotiation skills.

UNIT V	MANAGEMENT CONTROL	9

Management control – Use of computers and IT in Management control – System and process of controlling – Planning and Control Techniques- CPM-PERT-Productivity problems and management – Control and performance – Direct and preventive control – Levers of control framework – Reporting – Managing Operations – Modern issues in control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Outline the fundamentals of Managerial functions and Business Environment.
CO2:	Explain the various planning processes and become competent when involved in team to achieve success.
CO3:	Demonstrate the concept of organizing for the effective functioning of a management.
CO4:	Practice and develop managerial styles to anticipate the consequences of each leadership style.
CO5:	Apply the controlling techniques to the practical situations concerning the management of people and organizations in real business life.

TEXT BOOKS:

1.	Stephen P. Robbins, Mary A. Coulter and Lori Long, "Management", Sixteenth Edition Pearson Education, 2024.
2.	P C Tripathi, P N Reddy, Ashish Bajpai, "Principles of Management", Tata McGraw Hill, 2021.

REFERENCES:

1.	Almas Sabir, "Principles of Management", Partridge Publishing Singapore, 2019.
2.	Harold Koontz, Heinz Weihrich and Mark V. Cannice, "Essentials of Management", Tata McGraw Hill, 2020.
3.	Chandran J S, " Principles of Management- Text & Cases", Third Edition, Sultan & Chand publications, 2024.

4.	Oliver Laasch, “Principles of Management: Practicing Ethics, Responsibility, Sustainability”, Second Edition, SAGE Publications Ltd; 2021.
5.	David Bright, “Principles of Management”, 2023.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	1	-	-	-	-	-	-	2	1	1
CO2	-	1	1	-	-	-	-	-	-	-	-	-	2	1	-
CO3	1	-	-	2	-	-	1	-	2	-	1	1	-	-	2
CO4	-	1	1	1	2	-	-	1	2	-	-	-	1	1	1
CO5	1	-	-	-	1	1	-	-	-	3	-	1	1	-	1
CO	2	1	1	2	2	1	1	1	2	3	1	1	2	1	1

EC22701	ANTENNA AND RF COMMUNICATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To inculcate understanding of the basics required for circuit representation of RF networks
- To provide the principles of antenna and its radiation
- To provide a comprehensive understanding of RF antenna systems.
- To instill knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques

UNIT I	**RF NETWORKS CIRCUIT REPRESENTATION**	**6**

Importance of Radio frequency design – RF behavior of passive components –resistor, capacitor and inductor, Scattering matrix- S matrix formulation of two-port junction – Properties of S parameters – Reciprocal and lossless networks.

UNIT II	**ANTENNA FUNDAMENTALS**	**6**

Definitions – Radiation intensity – Directive gain – Directivity – Power gain – Beam width – Band width – Gain– Near and Far field regions.

UNIT III	**RF ANTENNAS**	**6**

Half wave dipole, E and H plane sectoral Horns, Microstrip antennas – feeding methods, rectangular patch antenna.

UNIT IV	**MICROWAVE COMPONENTS**	**6**

Directional couplers - two-hole directional couplers- Isolator - Circulator – Attenuator.

UNIT V	**MICROWAVE TUBES AND MEASUREMENTS**	**6**

Microwave tubes- Principle of operation of Reflex Klystron, Magnetron. Microwave measurements– wavelength, impedance, attenuation.

Practical Experiments:

1. Measurement of S-parameters for a) inductor, b) capacitor using network analyzer.
2. Simulation of microstrip patch antenna using ADS software.
3. Radiation pattern measurement of microwave rectangular horn antenna.
4. S – parameter measurement of Circulator.
5. Frequency and wave length measurement of microwave signal within waveguide.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the circuit representation of RF networks.
CO2:	Discuss the basics of antenna and its radiation
CO3:	Design the various types of RF antennas.
CO4:	Explain the operating principles of basic passive microwave devices

CO5:	Discuss the operation of the microwave tubes and measuring various parameters using microwave bench setup
TEXT BOOKS:	
1.	Samuel Y Liao, "Microwave Devices & Circuits", Third Edition, Pearson Education, 2021.
2.	Constantine A. Balanis, "Antenna Theory and Applications", Fourth Edition, Wiley, 2021.
REFERENCES:	
1.	M.M. Radmanesh, "RF & Microwave Electronics Illustrated", Pearson Education, 2015.
2.	Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", South Asia Edition 2012.
3	David M. Pozar, "Microwave Engineering", Fourth Edition, John Wiley & Sons, Inc, 2011.
4.	B. Razavi, "RF Microelectronics", Prentice Hall Communications Engineering and Emerging Technologies, 2011.
5.	Reinhold.Ludwig and Pavel Bretshko, "RF Circuit Design", Second Edition, Pearson Education, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
CO3	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
CO4	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
CO5	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1
CO	3	2	2	1	2	-	-	-	-	-	-	1	1	1	1

SD22702	**CODING SKILLS AND QUANTITATIVE APTITUDE – PHASE II**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To help students to work with Database.
- To help them create a simple Spring Boot application and gain foundational skills in Spring Boot by exploring Spring Boot Starters, RESTful web services, Dependency Injection, and Perform Basic CRUD operations.
- To understand applications of Spring Boot in IoT
- To improve aptitude, problem solving skills and reasoning ability of the students.
- Demonstrate the use of mathematical reasoning by justifying through numerical skills.

UNIT I	**DATABASE BASICS & QUANTS – TIME, SPEED AND DISTANCE**	**6**

Introduction to Database- Database Design Principles – SQL Basics – Querying a Database

Quants: Time, Speed and Distance - Time, Speed & Distance - Problems on Trains-Boats & Stream

UNIT II	**DEVELOPING BACK END USING SPRING BOOT & QUANTS – PERCENTAGE & INTEREST**	**6**

Introduction to Spring Boot – Creating a simple Spring Boot Application- Bean Scopes and Life Cycle

Quants: Percentage & Interest - Percentage-Interest (Simple Interest, Compound Interest)-Profit & Loss

UNIT III	**BUILDING RESTFUL WEB SERVICES & QUANTS – PROBABILITY**	**6**

Spring Boot Starters – Introduction to REST - Dependency Injection – Handling HTTP Methods

Quants: Probability - Probability-Permutations & Combinations

UNIT IV	**DATA PERSISTENCE WITH SPRING DATA JPA, REPOSITORIES & LOGICAL REASONING**	**6**

Path Variables and Request Parameters – Overview of JPA and Hibernate – Setting up Spring Data JPA in a Spring Boot project - Creating and using Repositories – Basic CRUD operations with JPA Repository.

Logical Reasoning: Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)- Direction sense test - Linear/Seating Arrangements - Series completion

UNIT V	**SPRING BOOT FOR IOT APPLICATIONS & LOGICAL REASONING**	**6**

Data Integration and Processing – Device Communication Protocols – Device Management – Data Storage

and Analytics – Project Work.

Logical Reasoning: Logical Venn Diagram/Syllogisms - Odd man out/Finding missing elements - Crypt arithmetic Questions – Puzzles

Suggestive Assessment Methods:

1) Pre-Assessment Test – To check the student's previous knowledge in Programming skills and quantitative aptitude and logical reasoning.
2) Internal Assessment I for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
3) Internal Assessment II for coding skills and quantitative aptitude will be conducted for 100 marks which are then calculated to 30.
4) Post-Assessment: Evaluating students' knowledge gained from the Coding Skills and Quantitative Aptitude Training – Phase II Skill Development Course.
5) For assignments, students should attend all the practice tests conducted online on HackerRank and google form. Each assignment will be for 100 marks and finally the total marks obtained by a student in all tests will be reduced to 40 marks.
6) The total of 100 marks obtained from the tests will be then reduced to 60 marks and additional of 40marks will be given for assignments which will make it a total of 100.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Design and Query a Database.
CO2:	Apply Data Persistence and CRUD operations using Spring Boot.
CO3:	Implement a hands-on project using Spring Boot
CO4:	Apply quantitative techniques to solve variety of problems and can enhance their employability quotient and to establish a stronger connect with the technical environment in which they operate.
CO5:	Find solutions for problems within short duration and can also think critically and apply basic mathematics skills to interpret data, draw conclusions and solve problems.

TEXT BOOKS:

1.	Craig Walls, "Spring Boot in Action", Manning Publishers, Sixth Edition, March 2022.
2.	Felipe Gutierrez, "Pro Spring Boot 2: An authorative Guide to Building Microservices, Web and Enterprise Applications, and Best Practices", Apress Publishers, Second Edition, 2018.
3.	Agarwal R.S, "Quantitative Aptitude," S. Chand and Company Pvt. Ltd., New Delhi, 2016.
4.	Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S. Chand and Company Pvt. Ltd., New Delhi, 2016.

REFERENCES:

1.	Alex Antonov, "Spring Boot 2.0 Cookbook", Packt Publishers, Second Edition, 2018.
2.	John Carnell," Spring Microservices in Action", Manning Publishers, Second Edition, 2021
3	Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd, New Delhi, 2016
4.	Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi,2016.
5.	Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers.,Reprint, 2016.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO2	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-	1
CO4	1	1	1	-	-	-	-	-	1	-	-	1	-	-	1
CO5	1	1	1	-	-	-	-	-	1	-	-	1	-	-	1
CO	2	2	2	-	2	-	-	-	1	-	-	2	-	-	1

EC22702	MINI PROJECT	L	T	P	C
		0	0	6	3

COURSE OBJECTIVES

- Understand and apply the stages of product development, from ideation through to prototyping and testing.
- Design and build electronic and embedded systems using microcontrollers and PCB design.
- Develop project management skills including scheduling, budgeting, and resource allocation.
- Improve teamwork, problem-solving, and technical documentation skills.
- Learn to conduct and apply market research and user-centered design principles.

Suggested Projects

1. Smart Home Automation System
2. Portable Air Quality Monitoring Device
3. Smart Energy Meter
4. Automated Plant Watering System
5. Health Monitoring Wearable Device
6. Smart Door Lock System with Face Recognition
7. Automatic Trash Sorting System
8. Smart Traffic Light System with Emergency Vehicle Detection
9. Personal Weather Station
10. RFID-Based Inventory Management System
11. Smart Parking Management System
12. Voice-Controlled Home Assistant
13. Smart Bicycle Security System
14. Wireless Power Transmission for Low-Power Devices

TOTAL: 90 PERIODS

COURSE OUTCOMES

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

CO1: Design a system architecture and prototype a functional electronic product.

CO2: Demonstrate proficiency in using microcontrollers, sensors, PCB design, and soldering.

CO3: Apply debugging, testing, and troubleshooting techniques.

CO4: Present and document their project in a professional format.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

SEMESTER VIII

EC22801	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OBJECTIVES:

- To train the students in identifying problem and developing the structured methodology to solve the identified problem in the industry or research problem at research Institution or college.
- To train the students in conducting experiments, analyze and discuss the test results, and make conclusions.

- To train the students in preparing project reports, presentation and to face reviews and viva voce examination.

METHOD OF EVALUATION

The students shall individually / or as group work on a specific topic approved by the department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the College and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the regulations.

TOTAL: 240 PERIODS

COURSE OUTCOMES:

At the end of the project, the students will be able to:

CO1:	Formulate and analyze problem / create a new product/ process.
CO2:	Design and conduct experiments to find solution
CO3:	Analyze the results and provide solution for the identified problem, prepare project report and make presentation.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
CO2	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3
CO	3	3	3	3	3	2	2	2	2	2	2	3	3	3	3

PROFESSIONAL ELECTIVES

VERTICAL 1: VLSI DESIGN AND TECHNOLOGY

EC22511	VLSI TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire knowledge on crystal structure, process of crystal growth, properties of materials used for crystal and examine the technique suitable for specific applications.
- To study about the methods of adding impurities to the base crystal
- To gain knowledge about device implantation on the crystal using various processing
- To discuss the different assembly and packaging techniques

UNIT I MATERIAL PROPERTIES & CRYSTAL GROWTH **9**

Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing consideration, Vapour phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Poly Silicon, Oxidation induced defects.

UNIT II LITHOGRAPHY AND RELATIVE PLASMA ETCHING **9**

Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, relative Plasma Etching techniques and Equipment.

UNIT III DEPOSITION, DIFFUSION AND METALISATION **9**

Deposition process, Polysilicon, plasma assisted Deposition, Models of Diffusion in Solids, Flick's one

dimensional Diffusion Equation - Atomic Diffusion Mechanism - Measurement techniques - Range theory Implant equipment. Annealing Shallow junction - High energy implantation - Physical vapour deposition - Patterning.		
UNIT IV	**PROCESS SIMULATION AND VLSI PROCESS INTEGRATION**	**9**
Ion implantation - Diffusion and oxidation - Epitaxy - Lithography - Etching and Deposition- NMOS IC Technology - CMOS IC Technology - MOS Memory IC technology - Bipolar IC Technology - IC Fabrication.		
UNIT V	**ASSEMBLY TECHNIQUES AND PACKAGING OF VLSI DEVICES**	**9**
Analytical Beams - Beams Specimen interactions - Chemical methods - Package types - banking design consideration - VLSI assembly technology - Package fabrication technology.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the material properties and crystal growth.	
CO2:	Outline the different lithography and etching techniques.	
CO3:	Discuss the deposition, diffusion and metallization techniques.	
CO4:	Illustrate the different process integration technologies for IC fabrication.	
CO5:	Describe the different assembly and packaging techniques for VLSI Devices	
TEXT BOOKS:		
1.	S.M.Sze, "VLSI Technology", Second Edition, Mc.Graw Hill, 2017.	
2.	S.A.Campbell, “The Science of Micro Electronic Fabrication”, Oxford series, Second Edition, 2012.	
REFERENCES:		
1.	Douglas A. Pucknell and Kamran Eshraghian, " Basic VLSI Design", Prentice Hall India, 2003.	
2.	Amar Mukherjee, "Introduction to NMOS and CMOS VLSI System design’, Prentice Hall India, 2000.	
3.	Wayne Wolf ,"Modern VLSI Design", Prentice Hall India, 2013.	
4.	Hubert Kaeslin, ,“Digital Integrated Circuit Design From VLSI Architectures to CMOS Fabrication”, Cambridge University Press, 2009.	
5.	Plummer, Deal and Griffin, “Silicon VLSI Technology Fundamentals, Practice and Modeling”, Prentice Hall Series, 2012.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1
CO2	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1
CO3	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1
CO4	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1
CO5	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1
CO	2	3	2	2	1	-	-	-	-	-	-	1	2	1	1

EC22512	**DIGITAL SYSTEM DESIGN WITH FPGA**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**
COURSE OBJECTIVES:					
• Understand the various abstraction levels in Verilog HDL, VHDL and System Verilog					
• Design the complex combinational and sequential logic circuits using various constructs in Verilog, VHDL and System Verilog					
• Understand the types of programmable logic devices and building blocks of FPGA and thus implement the design using FPGAs.					
UNIT I	**VERILOG HDL**				**6**
Lexical Conventions - Ports and Modules- Gate level Modeling: Basic verilog gate primitives-Rise, Fall and Turn off delays-Min, Max and Typical delays- Behavioral modeling, Data flow modeling, Structural modeling					
UNIT II	**MODELING USING VERILOG**				**6**

Behavioral, Data Flow and Structural Realization of Adder/Subtractor-MUX-DEMUX –Decoder-Priority Encoder - Latches – FlipFlops – Counters-Shift Registers- Verilog Test benches.		
UNIT III	**VHDL AND ITS MODELING**	**6**
Basic Language Elements, Behavioral modeling, Data flow modeling, Structural modeling, Subprograms, Packages.		
UNIT IV	**SYSTEM VERILOG**	**6**
Data types, procedural statements, connecting the testbench and design, Randomization in System Verilog.		
UNIT V	**PLDs AND FPGA**	**6**
Types of Programmable Logic Devices: PLA, PAL, CPLD, FPGA – Altera, Xilinx, Implementation in FPGA.		
		30 PERIODS
PRACTICAL EXPERIMENTS:		
1.	Gate-level modelling of Basic gates, combinational and sequential circuits	
2.	Structural modelling of Combinational and sequential circuits	
3.	Dataflow modelling of Combinational and sequential circuits	
4.	Behavioural Modelling of Combinational and sequential circuits	
5.	FPGA Implementation of Combinational and sequential circuits	
6.	Functional verification using system Verilog	
		30 PERIODS
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Describe the basics of hardware description languages of Verilog	
CO2:	Implement the different types of modeling techniques using Verilog	
CO3:	Design and simulate various combinational circuits and sequential circuits using VHDL.	
CO4:	Explain the basic concepts of system Verilog and functional verification	
CO5:	Demonstrate digital system designs using FPGA	
TEXT BOOKS:		
1.	S.Palnitkar, “Verilog HDL:A Guide to Digital Design and Synthesis”, Second Edition, Prentice Hall, 2003.	
2.	J. Bhasker ,“A VHDL Primer”, Third Edition, Prentices Hall, 2015.	
REFERENCES:		
1.	Wayne Wolf, “FPGA Based System Design”, Prentices Hall Modern Semiconductor Design Series, 2011.	
2.	A.Albert Raj, T. Latha, “VLSI Design”, Fifth Edition, Prentice Hall of India, 2014.	
3.	Charles H Roth Jr, Lizy Kurian John and Byeong Kil Lee,” Digital Systems Design using Verilog”, Cengage Learning, 2016.	
4.	S.Ramachandran, “Digital VLSI Systems Design”, Springer International Edition, 2011.	
5.	Ming-Bo Lin,” Digital Systems Design and Practice: Using Verilog HDL and FPGAs”, Create Space Independent Publishing Platform, 2015.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1
CO2	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1
CO3	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1
CO4	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1
CO5	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1
CO	2	2	2	2	3	1	-	-	-	-	-	2	2	2	1

EC22613	**VLSI TESTING AND DESIGN FOR TESTABILITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					

• To introduce test requirements, logic and fault simulation.		
• To study the design for testability.		
• To know about testing and diagnosis of memory.		
• To introduce test generation and test compression.		
• To study testability in analog and mixed signals circuits.		
UNIT I	**TEST REQUIREMENTS, LOGIC AND FAULT SIMULATION**	**9**
Importance of testing, Testing during the VLSI lifecycle, Challenges in VLSI testing, Levels of abstraction in VLSI testing, Simulation models, Logic simulation, Fault simulation.		
UNIT II	**DESIGN FOR TESTABILITY**	**9**
Testability analysis, Basics of design for testability, Scan cell designs, Scan architectures, Scan design rules, Scan design flow, Special-purpose scan designs, RTL design for testability.		
UNIT III	**MEMORY TEST AND DIAGNOSIS**	**9**
RAM functional fault models and test algorithms, RAM fault simulation and test algorithm generation, Memory Built-In Self-Test, Refined fault models and diagnostic test algorithms, BIST with Diagnostic Support, RAM Defect Diagnosis and Failure Analysis, RAM Redundancy Analysis Algorithms, Built-In Self-Repair.		
UNIT IV	**TEST GENERATION AND TEST COMPRESSION**	**9**
Random Test Generation, Designing a Stuck-At ATPG for Combinational Circuits, Designing a sequential ATPG, Designing a Simulation-Based ATPG, Advanced Simulation-Based ATPG, Hybrid Deterministic and Simulation-Based ATPG, ATPG for Non-Stuck-At Faults, Test Stimulus Compression, Test Response Compaction, BIST Design Rules, Test Pattern Generation, Logic BIST Architectures.		
UNIT V	**ANALOG AND MIXED-SIGNAL TESTING**	**9**
Introduction, Analog Circuit Testing, Mixed-Signal Testing, IEEE 1149.4 Standard for a Mixed-Signal Test Bus, IEEE 1149.4 Test Modes.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain testability requirements and logic and fault simulation of VLSI circuits	
CO2:	Describe the design for testability in ICs	
CO3:	Illustrate memory test and diagnosis for RAM	
CO4:	Explain the various test generation and compression techniques.	
CO5:	Demonstrate fault detection in analog and mixed signal circuits.	
TEXT BOOKS:		
1.	Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, "VLSI Test Principles and Architectures Design for Testability", Elsevier, 2011.	
2.	M.L.Bushnell and V.D Agrawal, "Essential of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits", Springer, 2013.	
REFERENCES:		
1.	Gordon Roberts, Friedrich Taenzler, and Mark Burns, "An Introduction to Mixed- Signal IC Test and Measurement", Second Edition, Oxford University Press, 2012.	
2.	Mark Burns and Gordon W.Roberts, "An Introduction to Mixed-Signal IC Test and Measurement", Oxford University Press, 2011.	
3.	Z.Navabi, "Digital System Test and Testable Design", Springer, 2011.	
4.	Laung-Terng Wang, Cheng-Wen Wu, and Xiaoqing Wen, "VLSI Test Principles and Architectures", The Morgan Kaufmann, 2013.	
5.	D.D. Gajski, N.D. Dutt,A.C.-H. Wu and S.Y.-L. Lin, "High Level Synthesis: Introduction to Chip and System Design",Springer, 2012.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	2	-	-	-	-	-	-	2	2	2	1
CO2	3	2	1	2	3	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	2	2	-	-	-	-	-	-	1	2	2	1
CO4	2	3	3	3	3	-	-	-	-	-	-	1	2	2	1
CO5	3	3	3	2	2	-	-	-	-	-	-	2	2	2	1
CO	3	3	2	2	2	-	-	-	-	-	-	2	2	2	1

EC22614	ANALOG IC DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the basics of single stage analog CMOS amplifiers
- To gain knowledge in noise characteristics of amplifiers
- To study the performance parameters of amplifiers
- To comprehend the compensation techniques
- To learn the different types of analog CMOS subcircuits

UNIT I	SINGLE STAGE AMPLIFIERS	6

Basic MOS physics and equivalent circuits and models - CS, CG and Source Follower- differential amplifier with active load- Cascode and Folded Cascode configurations with active load- design of Differential and Cascode Amplifiers- to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT II	HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS	6

Miller effect, association of poles with nodes, frequency response of CS, CG and Source Follower, Cascode and Differential Amplifier stages, statistical characteristics of noise, noise in Single Stage amplifiers, noise in Differential Amplifiers.

UNIT III	FEEDBACK AND MULTI STAGE OPERATIONAL AMPLIFIERS	6

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, Single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV	STABILITY AND FREQUENCY COMPENSATION	6

Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two Stage Op Amps, Slewing in Two Stage Op Amps, Other Compensation Techniques..

UNIT V	ANALOG CMOS SUBCIRCUITS	6

MOS Switch, MOS Diode/Active Resistor, Current sinks and sources, current mirror, High speed comparators. Case study: Design of sample and hold circuit.

30 PERIODS

PRACTICAL EXPERIMENTS:

1.	Design a CMOS inverter and analyze its characteristics.
2.	Design a Common source amplifier and analyze its performance.
3.	Design a Common drain amplifier and analyze its performance.
4.	Design a Common gate amplifier and analyze its performance.
5.	Design a differential amplifier with resistive load using transistors.
6.	Design three stage and five stage ring oscillator circuits and compare its frequencies.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Design single stage amplifiers
CO2:	Describe the frequency and noise performance of amplifiers.
CO3:	Design feedback and multistage operational Amplifiers
CO4:	Investigate stability analysis of operational amplifiers.
CO5:	Explain different types of analog CMOS subcircuits.

TEXT BOOKS:

1.	Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2016. (Unit I, II, III, IV)
2.	P. Allen and D. Holberg, “CMOS Analog Circuit Design”, Second Edition, Oxford University Press, 2012. (Unit V)

REFERENCES:

1.	Rudy J. van de Plassche, Willy M.C. Sansen, Johan Huijsing, “ Analog Circuit Design-Low-Power Low-Voltage, Integrated Filters and Smart Power”, Springer, 2013.
2.	Gabriel Alfonso Rincón-Mora, “Analog IC Design - An Intuitive Approach”, Lulu Enterprises Incorporated, 2014.
3.	Arjuna Marzuki, “CMOS Analog and Mixer-Signal Circuit Design: Practical and Innovations”,

	CRC Press, Taylor & Francis group, 2020.
4.	Jacob Baker "CMOS: Circuit Design, Layout, And Simulation", Third Edition, Wiley IEEE Press,2010.
5.	Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Sixth Edition, Wiley Publishers, 2024.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	3	3	-	-	-	1	-	-	2	2	2	1
CO2	2	2	2	2	-	-	-	-	-	-	-	2	2	2	1
CO3	2	2	2	2	-	-	-	-	-	-	-	2	2	2	1
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2	2	1
CO5	2	2	2	2	-	-	-	-	-	1	-	2	2	2	1
CO	2	2	2	2	3	-	-	-	1	1	-	2	2	2	1

EC22715	ASIC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the concepts of Overview of ASIC And PID, ASIC Physical Design.
- To discuss the concepts of Logic Synthesis, Simulation and Testing,
- To learn about SOC Design and high performance applications.

UNIT I OVERVIEW OF ASIC AND PLDs **9**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices : ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs .

UNIT II PROGRAMMABLE ASICs **9**

Programmable ASIC Logic cells for ACTEL and XILINX-DC & AC inputs and outputs –Clock and Power inputs – ACTEL and XILINX I/O blocks – Programmable ASIC Architecture: Xilinx XC 4000- FLEX 8000/10000, ACTEL's ACT-1,2,3 and their speed performance, Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs .

UNIT III 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.

UNIT IV LOGIC SYNTHESIS, SIMULATION AND TESTING **9**

Design systems - Logic Synthesis - Verilog and VHDL synthesis - Types of simulation -Boundary scan test - Fault simulation - Automatic test pattern generation.

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, Digital Camera, High performance digital filters for sigma-delta ADC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the types of ASICs, Programming technologies and PLDs.
CO2:	Outline the different programmable logic cells and ASICs.
CO3:	Describe the physical design of ASICs.
CO4:	Illustrate the logic synthesis, logic simulation and testing methods.
CO5:	Discuss the system on chip designs for high performance applications

TEXT BOOKS:

1.	M.J.S. Smith," Application Specific Integrated Circuits", Pearson, 2013
2.	Sudeep Pasricha and NikilDutt, "On-Chip Communication Architectures System on Chip Interconnect", Elsevier, 2008.

REFERENCES:

1.	Jan. M. Rabaey et al, "Digital Integrated Circuit Design Perspective" Second Edition, PHI, 2007.
2.	P.K.Chan& S. Mourad," Digital Design using Field Programmable Gate Array", Prentice Hall,

	2011.
3.	H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley, 2006.
4.	David A.Hodges, “Analysis and Design of Digital Integrated Circuits”, Third Edition, MGH, 2014.
5.	J. Old Field, R.Dorf,”Field Programmable Gate Arrays”, John Wiley& Sons, Newyork, 1995.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	3	2	3	2	-	-	-	-	-	-	2	2	2	1
CO2	2	2	1	2	3	-	-	-	-	-	-	1	2	2	1
CO3	2	3	3	2	2	-	-	-	-	-	-	1	2	2	1
CO4	2	3	3	3	3	-	-	-	-	-	-	1	2	2	1
CO5	2	3	3	2	2	-	-	-	-	-	-	2	2	2	1
CO	2	3	2	2	2	-	-	-	-	-	-	2	2	2	1

EC22716	LOW POWER IC DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of low power VLSI design.
- To understand the low power design approaches.
- To understand the impact of power on system performances.
- To develop the low power low voltage adders and multipliers
- To develop the low power low voltage memories

UNIT I FUNDAMENTALS OF LOW POWER CIRCUITS **6**

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT II LOW-POWER DESIGN APPROACHES **6**

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT III LOW-VOLTAGE LOW-POWER ADDERS **6**

Introduction, Standard Adder Cells, CMOS Adder’s Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques – Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles

UNIT IV LOW-VOLTAGE LOW-POWER MULTIPLIERS **6**

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT V LOW-VOLTAGE LOW-POWER MEMORIES **6**

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

30 PERIODS

PRACTICAL EXPERIMENTS:

1.	Modeling and sources of power consumption
2.	Power estimation at different design levels (mainly circuit, transistor, and gate)
3.	Power optimization for combinational circuits
4.	Power optimization for sequential circuits
5.	Power optimization for RT and algorithmic levels.

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the fundamentals of Low power circuit design.
CO2:	Outline the low power design approaches.
CO3:	Design the Low-Voltage Low-Power adders.
CO4:	Develop the Low-Voltage Low-Power multipliers.
CO5:	Design the Low Power, Low Voltage Memories.
TEXT BOOKS:	
1.	Ajit Pal, "Low-Power VLSI Circuits and Systems", Springer, 2016.
2.	Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004.
REFERENCES:	
1.	Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012.
2.	Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
3.	Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998.
4.	Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
5.	Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	2	-	-	-	-	-	-	2	2	1	1
CO2	2	2	1	2	2	-	-	-	-	-	-	1	2	1	1
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	1	1
CO4	2	2	2	2	2	-	-	-	-	-	-	1	2	1	1
CO5	2	2	2	2	2	-	-	-	-	-	-	2	2	1	1
CO	2	3	2	2	2	-	-	-	-	-	-	2	2	1	1

EC22717	**VLSI SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSEOBJECTIVES:

- To learn the fundamentals of floating point numbers.
- To study various floating point arithmetic and logical operations.
- To learn the Signal transformations.
- To design the filters for digital signal processing.
- To understand the mathematical calculations of CORDIC algorithm.

UNITI	**FLOATING POINT REPRESENTATIONS**	**6**

Floating point numbers – The ANSI/IEEE Floating point standard – Basic Floating point algorithms – Conversions and Exceptions –Logarithmic Number Systems.

UNIT II	**FLOATING POINT OPERATIONS**	**6**

Floating point Adders/Subtractors – Pre and Post shifting – Rounding and Exceptions – Floating point multipliers – Logarithmic Arithmetic Unit.

UNIT III	**SIGNAL TRANSFORMATIONS**	**6**

DSP Fundamentals – Sampling rate-Latency and pipelining – Fast Fourier Transform – Discrete Cosine Transform – Wavelet Transform.

UNIT IV	**PIPELINE/PARALLEL ARCHITECTURE OF FILTERS**	**6**

Finite Impulse Response (FIR) Filter – Hardware architecture of w-tap FIR filter – Infinite Impulse Response (IIR) Filter – Hardware architecture of w-tap IIR filter.

UNIT V	**ALGORITHMIC TRANSFORMATIONS**	**6**

The CORDIC Algorithm – Rotations and Pseudo rotations – Basic CORDIC Iterations – CORDIC Hardware – Generalized CORDIC – Using the CORDIC Method – An Algebraic Formulation.

	30 PERIODS
PRACTICAL EXPERIMENTS:	
1.	Floating point addition and multiplication using Verilog.
2.	Design and implementation of 8-bit ALU using Verilog.
3.	Implementation of 8 point FFT using Verilog.
4.	Implementation of FIR filter using Verilog.
5.	Implementation of CORDIC-Based Square Root Calculation using Verilog.
	30 PERIODS
	TOTAL: 60 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the fundamentals of floating point representation.
CO2:	Explain the different types of floating operations
CO3:	Describe the concepts of signal transformations.
CO4:	Outline hardware designs of IIR and FIR filter
CO5:	Discuss the concepts of CORDIC based algorithms
TEXT BOOKS:	
1.	Behrooz Parhami, "Computer Arithmetic Algorithms and Hardware Designs", Oxford University Press Publication, 2015.
2.	Roger Woods**,** John McAllister, Gaye Lightbody, Ying Yi, "FPGA Implementation of Signal Processing Systems", John Wiley and Sons, Ltd., 2017.
REFERENCES:	
1.	Uwe Meyer-Baese, "Digital Signal Processing with Field Programmable gate Arrays", Springer Publication, 2014.
2.	John G. Proakis' "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson Education, 2014.
3.	Israel Korean, "Computer Arithmetic Algorithms", Second Edition, A K Peters/CRC Press, 2018.
4.	D.A, Patterson and J.L. Hennessy, Computer Organization and Design: Hardware / Software Interface, 4th Edition, Elsevier, 2011.
5.	Jean –Michel Mulle, "Hand Book of Floating Point Arithmetic" Brikhauser Publication, 2010.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	2	1	2	-	-	-	1	-	1	2	2	1	2
CO2	2	2	2	1	3	-	-	-	1	-	1	2	2	2	2
CO3	2	2	2	2	3	-	-	-	1	-	1	2	2	2	2
CO4	2	2	2	2	3	-	-	-	1	-	1	2	2	2	2
CO5	2	2	2	2	3	-	-	-	1	-	1	2	2	2	2
CO	2	2	2	2	3	-	-	-	1	-	1	2	2	2	2

VERTICAL 2 : IMAGE AND SIGNAL PROCESSING

EC22521	**STATISTICAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To introduce the basics of discrete time random signal processing.					
• To learn the concept of estimation and signal modeling.					
• To know about optimum filters and adaptive filtering and its applications.					
UNIT I	**DISCRETE RANDOM SIGNAL PROCESSING**				**9**
Discrete random processes: Ensemble averages, Wide sense stationary process, Properties, Sample mean and variance, Auto-correlation and Auto-correlation matrices, Auto covariance and Cross covariance, properties, Power spectral density, Filtering random process, Spectral Factorization Theorem, Special types of random processes: AR, MA, ARMA Processes, Yule-Walker equations.					

UNIT II	PARAMETER ESTIMATION THEORY	9
Principle of estimation and applications, Properties of estimates, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound Efficient estimators; Criteria of estimation, Methods of maximum likelihood and its properties, Bayesian estimation, Mean square error and MMSE, Mean Absolute error, MAP estimation.		
UNIT III	**SPECTRUM ESTIMATION**	**9**
Estimation of spectra from finite duration signals, Bias and Consistency of estimators, Non-Parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation, Performance analysis of estimators.		
UNIT IV	**SIGNAL MODELING AND OPTIMUM FILTERS**	**9**
Introduction: Least square method, Pade approximation, Prony's method, FIR Wiener filter: Filtering – Linear Prediction – Non Causal and Causal IIR Wiener Filter, discrete Kalman filter.		
UNIT V	**ADAPTIVE FILTERS**	**9**
FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive Recursive Filters: RLS adaptive algorithm.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Illustrate discrete-time random processes and filtering.	
CO2:	Explain appropriate parametric estimation methods for spectral estimation.	
CO3:	Infer the spectral estimation method for a discrete time random signal.	
CO4:	Apply the signal modeling and optimum filter for discrete time random signal.	
CO5:	Summarize various adaptive filters for different applications.	
TEXT BOOKS:		
1.	Monson H. Hayes, "Statistical Digital Signal Processing and Modelling", John Willey and Sons, (Reprint 2008).	
2.	Simon Haykin, "Adaptive Filter Theory", Pearson Prentice Hall, 2014.	
REFERENCES:		
1.	D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", Artech House Publishers, 2005.	
2.	Steven. M. Kay, "Modern Spectral Estimation, Theory and Application", Pearson India, 2009.	
3.	A. Veloni, N.I. Miridakis, E. Boukouvala, "Digital and Statistical Signal Processing", CRC Press, 2019.	
4.	S. Nandi, D. Kundu, "Statistical Signal Processing- Frequency Estimation", Second Edition, Springer Nature Singapore, 2020.	
5.	M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, "Statistical Signal Processing with Applications", PHI, 1996.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1
CO2	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1
CO3	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1
CO4	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1
CO5	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1
CO	2	2	1	2	-	-	-	-	-	-	-	1	2	2	1

EC22522	AUDIO AND SPEECH PROCESSING	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					

• To study the basic concepts of audio and speech signals		
• To discuss the speech processing methods in time and frequency domain		
• To gain knowledge about linear predictive analysis of speech signals		
• To learn the significance of different speech coding techniques		
• To study the various transform coders for audio coding		
UNIT I	**FUNDAMENTALS OF SPEECH AND AUDIO**	**9**
Introduction- Speech production mechanism –Discrete time modelling of Speech production – Classification of Speech sounds – Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous Masking - Perceptual Entropy.		
UNIT II	**TIME AND FREQUENCY DOMAIN ANALYSIS**	**9**
Time-dependent processing of speech - short-time energy and average magnitude, short-time average zero-crossing rate, speech vs. silence discrimination using energy and zero-crossing. Pitch Extraction using time and frequency domain methods - Cepstral analysis of Speech, Formant Estimation, Homomorphic Vocoders.		
UNIT III	**LINEAR PREDICTIVE ANALYSIS OF SPEECH**	**9**
Basic Principles of linear predictive analysis – Auto correlation method, Covariance method – Solution of LPC equations – Cholesky method– Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis using LPC parameters.		
UNIT IV	**SPEECH CODING TECHNIQUES**	**9**
Scalar quantization- Max quantizer, companding, adaptive quantization, Vector Quantization-VQ distortion, Model based coding- Basic linear predictive coder, VQ LPC coder, MELP, LPC Residual Coding-Multi pulse linear prediction, CELP.		
UNIT V	**AUDIO CODING AND TRANSFORM CODERS**	**9**
Lossless Audio Coding-Lossy Audio Coding- Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET DFT Coder, CNET MDCT Coder 1 - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the basic concepts of audio and speech signal.	
CO2:	Interpret the time and frequency domain parameters of signals	
CO3:	Outline the pitch and formant of speech signals using linear predictive method.	
CO4:	Summarize various speech coding techniques.	
CO5:	Compare various audio and transform coders.	
TEXT BOOKS:		
1.	Udo Zölzer, “Digital Audio Signal Processing", Third Edition, John Wiley & sons Ltd Publications, 2022.	
2.	L. R. Rabiner and R.W. Schaffer, “Digital Processing of Speech signals”, Prentice Hall, 2007.	
REFERENCES:		
1.	Mark Kahrs, Karlheinz Brandenburg, “Applications of Digital Signal Processing to Audio and Acoustics”, Reprint, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, 2013.	
2.	Thomas F. Quatieri, “Discrete-time speech signal processing - Principles and practice”, Pearson, 2012.	
3.	Andreas Spanias, Ted Painter, Venkatraman,” Atti- Audio Signal Processing and Coding”, Wiley-Interscience, A John Wiley & Sons, Inc., Publications,2007.	
4.	Wai C.Chu, “Speech Coding Algorithms foundation and evolution of standardized coders”, Wiley-Interscience, A John Wiley & Sons, Inc., Publications,2008.	
5.	Ben Gold, Nelson Morgan, Dan Ellis, “Speech and audio signal processing-Processing and perception of speech and music”, Second edition, Wiley-Interscience, A John Wiley & Sons, Inc., Publications, 2011.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-

CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-
CO	2	2	1	-	-	-	-	-	-	-	-	2	2	-	-

EC22623	**BIO SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To study the characteristics of various bio-signals and its spectrum
- To learn linear and non-linear filters for random noise signal
- To know the significance of event detection in biosignal.
- To study the features of biosignals.
- To gain the knowledge about automated classification and decision-making techniques.

UNIT I	**SIGNALS AND SPECTRUM**	**9**

Introduction to Biomedical Signals- Characteristics of some dynamic biomedical signals, Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum, non-stationary process, fixed segmentation, adaptive segmentation in EEG, PCG and HRV signals.

UNIT II	**NOISES AND FILTERS**	**9**

Noises- random, structured and physiological noises. Filters- IIR and FIR filters. homomorphic filtering. Frequency Domain Filtering, LMS adaptive filter, adaptive noise cancelling in ECG.

UNIT III	**EVENT DETECTION**	**9**

Event detection in ECG – Derivative based approaches, Pan Tompkins Algorithm, Dicrotic Notch Detection, Correlation analysis of EEG signals, matched filtering.

UNIT IV	**ANALYSIS OF BIOSIGNAL**	**9**

Average of Signals-PCG, ECG and EMG. Signal length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor.

UNIT V	**BIOSIGNAL CLASSIFICATION AND RECOGNITION**	**9**

Statistical signal classification, linear discriminate function, Back propagation neural network based classification. Case study: 1. Various methods used to extract features from EEG signal Case Study 2: Diagnosis and monitoring of sleep apnea

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Outline the characteristics of bio signals and its spectrum.
CO2:	Develop linear and non-linear filtering techniques to eliminate noise and artifacts from Biosignals
CO3:	Compare the significance of event detection in biosignal.
CO4:	Summarize the features of bio signals.
CO5:	Develop classification methods to classify the bio-signals using optimal features.

TEXT BOOKS:

1.	Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley-Interscience /IEEE Press, 2015.
2.	Willis J.Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall of India, New Delhi, 2006.

REFERENCES:

1.	P.Ramesh Babu, “Digital Signal Processing”, Seventh Edition, Scitech publications, Chennai, 2021..
2.	Arnon Cohen, “”Biomedical Signal Processing Vol 2: Compression and automatic recognition”,CRC Press Inc., 2021
3.	Katarzyna J. Blinowska, Jarosław Żygierewicz, “Practical Biomedical Signal Analysis Using MATLAB” Second Edition, CRC press, 2021.
4.	Wai C.Chu, “Biomedical Signal Processing, Advances in Theory, Algorithms and Applications”, Wiley-Interscience, A John Wiley & Sons, Inc., Publications, 2003.
5.	D C Reddy “Biomedical Signal Processing: Principles and Techniques”, Tata McGraw-Hill Publishing Co. Ltd, 2005.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-

EC22624	IMAGE AND VIDEO PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the fundamentals of digital image processing and image transforms.
- To expose to simple image enhancement techniques in spatial and frequency domain.
- To learn the fundamentals of various image segmentation and feature extraction methods.
- To know the basic concept of video processing.
- To learn the principal of 2-D motion estimation.

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Elements of digital image processing systems - Elements of visual perception- sampling and quantization of an image- Relationship between pixels- Image transforms: 2-D Discrete Fourier Transform, properties, Discrete Cosine Transform (DCT), Hadamard Transform.

UNIT II IMAGE ENHANCEMENT **9**

Basic intensity transformations – Histogram equalization and specification techniques – Spatial domain - Smoothing and sharpening Filters , Frequency domain -Smoothing and sharpening filters – Selective filtering, Homomorphic filtering- Pseudo color image processing, Full color image processing.

UNIT III IMAGE SEGMENTATION AND FEATURE EXTRACTION **9**

Point, Line and Edge detection – Thresholding, Segmentation by Region Growing and by Region Splitting and Merging - Region segmentation using clustering and superpixels- Feature extraction*:* Boundary preprocessing -Boundary feature descriptors -Region feature descriptors.

UNIT IV VIDEO PROCESSING **9**

Analog video, Digital images and video, Time varying image formation models: 3D motion models, Geometric image formation, Photometric image formation, sampling of video signals, Digital Video Applications, video filtering operations- multi-frame noise filtering.

UNIT V 2-D MOTION ESTIMATION **9**

Motion Models, 2D Apparent Motion Estimation, Differential Methods, Matching Methods, Non-linear Optimization Methods, Transform-Domain Methods, 3-D Motion and Shape Estimation .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the fundamentals of digital image processing and image transformations.
CO2:	Summarize various image enhancement techniques in spatial domain and frequency domain.
CO3:	Apply segmentation and feature extraction techniques to images.
CO4:	Explain the basic steps of video processing.
CO5:	Outline the principles of 2-D motion estimation.

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing', Fourth Edition, Pearson Education, 2018.
2. Yao Wang, Joem Ostarmann and Ya-quin Zhang, “Video processing and Communication“, PHI, 2007.

REFERENCES:

1. Anil K. Jain, “Fundamentals of Digital Image Processing”, Second Handbook, Visionas, 2018.
2. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
3. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing using

	MATLAB", Second Edition, McGraw Hill Education, 2017
4.	D. E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 2011.
5.	William K. Pratt, "Introduction to Digital Image Processing", Fourth Edition, John Wiley, Ne Apple Academic Press Inc. w York, 2013.
6.	Milan Sonka, Vaclav Hlavac, et al. , "Image Processing, Analysis and Machine Vision with MindTap", Fourth Edition, Cengage India Private Limited , 2017.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1
CO2	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1
CO3	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1
CO4	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1
CO5	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1
CO	2	2	2	1	-	-	-	-	-	-	-	2	2	2	1

EC22725	DSP PROCESSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of DSP processor.
- To know the DSP processor architectures for DSP devices.
- To study advanced DSP Architecture.
- To learn the DSP algorithms and applications.
- To gain the knowledge of various interfaces and applications of DSP processor.

UNIT I	PROCESSOR FUNDAMENTALS	9

DSP processor packaging- Fixed point verses floating point DSP processor data paths – pipelining - TMS320 family of DSPs - Architecture of C5x - Memory architecture of a DSP processor -Von Neumann - Harvard - VLIW architecture- Addressing modes.

UNIT II	ARCHITECTURES FOR PROGRAMMABLE DIGITAL SIGNAL PROCESSING DEVICES	9

Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing.

UNIT III	TMS320C6X PROGRAMMABLE DSP PROCESSOR	9

Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools

UNIT IV	IMPLEMENTATION OF BASIC DSP ALGORITHMS	9

The Q – notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters, An FFT Algorithm for DFT Computation, Overflow and Scaling, Bit – Reversed Index Generation & Implementation on the TMS32OC54xx. DaVinci Digital media processor.

UNIT V	INTERFACING AND DSP PROCESSOR APPLICATIONS	9

Memory Space Organization, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA), Synchronous Serial Interface, A CODEC Interface Circuit, DSP Based Bio-telemetry Receiver, DSP – based Power Meter

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the DSP computational building blocks to achieve speed in DSP processor.
CO2:	Outline the architectures for programmable DSP devices.
CO3:	Apply knowledge of various types of addressing modes, interrupts, peripherals and pipelining structure of TMS320C6x processor.
CO4:	Develop basic DSP algorithms using DSP processors.
CO5:	Summarize the synchronous serial interface and multichannel buffered serial port (McBSP) of DSP device.

TEXT BOOKS:	
1.	Avtar Singh and S. Srinivasan, “Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx” Cengage Learning India Private Limited, Delhi 2012.
2.	Rulph Chassaing and Donald Reay, “ Digital Signal Processing and applications with the TMS320C6713 and TMS320C6416 DSK, ”, Second Edition, Wiley India (P) Ltd, New Delhi, 2010.
REFERENCES:	
1.	B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications”, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2010.
2.	Emmanuel C. Ifeachor & Barrie. W. Jervis, “Digital Signal Processing”, Second Edition, Pearson Education / Prentice Hall, 2002.
3.	Peter Pirsch, "Architectures for Digital Signal Processing", John Wiley, 2009.
4.	Sanjit K. Mitra, “Digital Signal Processing – A Computer Based Approach”, Fourth Edition, Tata Mc Graw Hill, 2011.
5.	A. V. Oppenheim, R.W. Schafer and J.R. Buck, “Discrete-Time Signal Processing”, Third Edition, Pearson Education India, 2014.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1
CO2	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1
CO3	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1
CO4	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1
CO5	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1
CO	3	2	2	2	2	-	-	-	-	-	-	1	1	-	1

EC22726	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning.
- To learn the basic concepts of neural network.
- To discuss the basic concepts of deep learning.

UNIT I	MATHEMATICAL BACKROUND	9

Machine Learning–Types of Machine Learning –Machine Learning process, Examples of machine learning applications, Review of Linear Algebra – Arithmetic of matrices, Norms, Eigen decomposition

UNIT II	SUPERVISED LEARNING	9

Linear Regression - Least Squares –- single & multiple variables ,Logistic Regression, Support Vector Machines –Kernel Methods , K-Nearest Neighbors ,Tree based Methods –Decision Trees, Random Forest.

UNIT III	UNSUPERVISED LEARNING	9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - spectral clustering- Measures of dissimilarity- Dimensionality Reduction –Principal Component Analysis, Independent Components Analysis. Factor analysis.

UNIT IV	NEURAL NETWORKS	9

Introduction - Building Blocks of Neural Network, activation functions, learning algorithms, Early Models, Perceptron, XOR problem, Multilayer perceptron, Under-fitting / Overfitting -Cross-Validation.

UNIT V	INTRODUCTION TO DEEP LEARNING	9

Back Propagation Neural network– network training – Loss Functions- gradient descent optimization – stochastic gradient descent, shallow networks to deep networks – Convolution Neural Networks – convolution layer, pooling layer drop out.

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Explain the mathematical and statistical prospective of machine learning algorithms.
CO2:	Summarize supervised learning models appropriate to specific applications.
CO3:	Explain various unsupervised learning algorithms.
CO4:	Outline the concept of artificial neural network model.
CO5:	Summarize the concept of deep learning model.
TEXT BOOKS:	
1.	Christopher M. Bishop, "Pattern Recognition and Machine Learning",Reprint, Springer, 2016
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
REFERENCES:	
1.	Tom Mitchell, "Machine Learning", Third Edition, McGraw Hill, 2017.
2.	Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014.
3.	Hal Daumé III, "A Course in Machine Learning", Alanna Maldonado, 2023.
4.	Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015.
5.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

Mapping of Course Outcome to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO3	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO4	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO5	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-
CO	2	2	1	-	-	-	-	-	-	-	-	2	2	1	-

EC22727	**BIOMETRIC SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To know the basics concepts in biometrics and its operational process.					
• To study the structure and advantages of multi-biometric systems and the various levels of fusion					
• Understand the importance of security and privacy in biometrics, including policies and measures for protecting personal biometric data.					
UNIT I	**INTRODUCTION TO BIOMETRICS**				**9**
Overview of biometrics and its applications – Types of Biometrics- passive biometrics – active biometrics -Biometrics Vs traditional techniques – Benefits of biometrics - Elements of digital image processing systems - Elements of visual perception- sampling and quantization of an image – Biometric Authentication systems –Key biometric processes: verification, identification and biometric matching, Need for strong authentication –biometrics and privacy					
UNIT II	**FINGERPRINT IDENTIFICATION**				**9**
History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement Fingerprint Patterns, Fingerprint Features, Feature Extraction - Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, Techniques to counter Fingerprint Morphing					
UNIT III	**FACE RECOGNITION**				**9**

Face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Morphing – Detection methods		
UNIT IV	**IRIS RECOGNITION**	**9**
Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde‘s approach, Iris matching, Techniques for detecting Morphing in Iris Recognition - Challenges		
UNIT V	**VOICE RECOGNITION**	**9**
Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Common Threats to Voice Recognition - Security Measures for Voice Recognition Systems		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
Upon completion of the course, the students will be able to	
CO1:	Explain the principles of biometric systems.
CO2:	Demonstrate the process of fingerprint recognition technique.
CO3:	Illustrate face recognition techniques
CO4:	Summarize iris recognition system
CO5:	Demonstrate voice recognition system.
TEXT BOOKS	
1	Anil K. Jain, Arun A. Ross, Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011.
2	James Wayman & Anil Jain, “Biometric Systems- Technology Design and Performance Evaluation”, Springer (SIE), 2011
REFERENCES	
1	Paramjit S. K. Chahal, Pushpinder S. Gill, "Handbook of Biometrics for Forensic Science", Springer, 2018.
2	John D. Woodward Jr, “Biometrics: Advanced Identity Verification", CRC Press, 2015.
3	Arun A. Ross, "Biometrics: Security and Privacy Concerns", Springer, 2017.
4	David Zhang, Zhi-Hua Zhou, "Multibiometrics: Techniques and Applications" Springer, 2011.
5.	S. Rajasekaran, S. S. Iyengar, Shlomo Zilberstein, "Biometric Recognition: Challenges and Applications", Wiley-IEEE Press, 2014.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO2	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO3	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO4	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO5	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1

VERTICAL 3 : HEALTHCARE DEVICES AND TECHNOLOGY

EC22531	**BIOMEDICAL SENSORS AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:
• To understand the basic theory of Bio potential Electrodes.
• To understand the fundamentals of Bio potential measurement
• To design Bio potential amplifiers for acquisition of bio signals.
• To study the various non-electrical physiological parameter measurement. and bio chemical

measurements.		
• To study the various bio chemicalmeasurements.		
UNIT I	**BIOPOTENTIAL ELECTRODES**	**9**
Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half-cell potential, circuit model for the measurement with two electrodes, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and its equivalent circuits.		
UNIT II	**BIOPOTENTIAL MEASUREMENT**	**9**
Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, EMG – unipolar and bipolar mode-Nerve conduction velocity		
UNIT III	**BIOPOTENTIAL AMPLIFIER**	**9**
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Artifacts and removal.		
UNIT IV	**NON ELECTRICAL PHYSIOLOGICAL PARAMETER MEASUREMENT**	**9**
Temperature, respiration rate and pulse rate measurements, Pulse oximetry, Blood Pressure: direct methods - - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, oscillometric method, ultrasonic method. Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermo dilution method.		
UNIT V	**BIOCHEMICAL MEASUREMENT**	**9**
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors – colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Describe the electrode behavior and circuit models.	
CO2:	Describe the fundamental concepts of Bio potential recording	
CO3:	Design bio amplifiers for biosignal processing	
CO4:	Summarize the basic concepts for nonelectrical physiological parameter measurement	
CO5:	Summarize the chemical biosensors used to monitor the critical care analytes	
TEXT BOOKS:		
1.	Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Fourth Edition, Pearson Education, , 2014.	
2.	John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, 2020.	
REFERENCES:		
1.	Khandpur R.S, "Handbook of Biomedical Instrumentation", Third Edition, Tata McGraw Hill, New Delhi, 2014.	
2.	L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", Third Edition John Wiley and Sons, 2008..	
3.	Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second Edition, Pearson Education India, 2015.	
4.	Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.	
5.	Sawhney G S , "Biomedical Electronics And Instrumentation Made Easy", K International Publishing House Pvt. Ltd, 2011.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	1	2	-	-	-	-	-	-	-	1	1	-	1
CO2	2	2	1		-	2	-	-	-	-	-	1	1	-	2
CO3	2	1	2	2	-	2	-	-	-	-	-	1	2	-	1
CO4	1	1	1	2	-	-	2	-	-	-	-	1	1	-	1

CO5	1	1	1	1	-	-	-	-	-	-	-	1	1	-	1
CO	1	1	1	2	-	2	2	-	-	-	-	1	1	-	1

EC22532	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamental parameters related to cardiology.
- To study the measuring and recording of EEG and EMG signals.
- Discuss the concepts of heat and photon therapy in medical applications.
- Explain the diagnostic equipment related to respiratory system.
- Explain therapeutic devices related to sensory system.

UNIT I **CARDIAC EQUIPMENT** **9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Cardiac Pacemaker- Internal and External Pacemaker, Programmable pacemakers, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit.

UNIT II **NEUROLOGICAL AND BIOMECHANICAL EQUIPMENT** **9**

Multi-channel EEG recording system, Epilepsy, Evoked Potential – Visual, Auditory and Somatosensory, EEG Bio Feedback Instrumentation. Recording and analysis of EMG waveforms, Nerve conduction velocity measurement, Muscle stimulators, nerve stimulators,-Electrotherapy unit, Inferential Therapy Unit, TENS, Functional Electrical Stimulation., EMG Bio Feedback Instrumentation, GAIT Assessment and Therapy.

UNIT III **HEAT & PHOTON THERAPY EQUIPMENT** **9**

High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Basic principles of Biomedical LASERS: Applications of lasers in medicine - CO2 laser, He-Ne laser, Nd-YAG and Ruby laser.

UNIT IV **RESPIRATORY MEASUREMENT AND ASSIST SYSTEM** **9**

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Ventilators, types – Pressure, Volume, and Time controlled, Humidifiers, Nebulizers.

UNIT V **SENSORY DIAGNOSTIC EQUIPMENT** **9**

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Develop therapeutic devices for ailments related to cardiology
CO2:	Summarize the role of electrical and mechanical energies in healing neurological and biomechanical disorders
CO3:	Discuss the application of heat and photon therapy in biomedical field
CO4:	Describe the diagnostic equipment related to respiratory system
CO5:	Describe the diagnostic techniques of sensory responses.

TEXT BOOKS:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”,Fourth Edition, Pearson Education, 2014.
2. John G.Webster and Amit J. Nimunka “Medical Instrumentation Application and Design”, Fifth Edition, John Wiley, Indian Adaptation, 2021

REFERENCES:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Third Edition, Tata McGraw Hill, New Delhi, 2014.
2. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, Third Edition, John Wiley and Sons, 2008.
3. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Second Education, Pearson Education India, 2015.
4. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design”, McGraw-Hill

	Publisher, 2003.
5.	Murugan Veerabadhram, “Diagnostic and Therapeutic Equipment- II”, Notion Press, 2021.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	2	2	-	-	-	-	-	-	-	1	2	-	1
CO2	1	2	1	1	-	2	-	-	-	-	-	1	1	-	2
CO3	2	1	1	1	-	2	1	-	-	-	-	-	2	1	1
CO4	1	2	1	2	-	1	2	-	-	-	-	1	1	-	2
CO5	1	1	1	1	-	-	-	-	-	-	-	1	1	-	1
CO	1	2	1	1	-	2	2	-	-	-	-	1	1	1	1

EC22633	MEDICAL IMAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE 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, Dental Radiography: Dental X-ray Machine.

UNIT II COMPUTED TOMOGRAPHY **9**

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

UNIT III MAGNETIC RESONANCE IMAGING **9**

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

UNIT IV NUCLEAR IMAGING **9**

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET.

UNIT V RADIATION THERAPY AND RADIATION SAFETY **9**

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments, Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students 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 for visualizing sections of the body using Magnetic Resonance Imaging.
CO4:	Demonstrate the applications of radionuclide imaging.
CO5:	Analyze the imaging techniques and choose appropriate imaging equipment for better diagnosis and radiation safety.
TEXT BOOKS:	
1.	Isaac Bankman, I. N. Bankman,"Handbook of Medical Imaging: Processing and Analysis(Biomedical Engineering)",Second Edition Academic Press,2008
2.	Jacob Beutel (Editor), M. Sonka (Editor), "Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis", SPIE Press 2000
REFERENCES:	
1.	Khandpur R.S, "Handbook of Biomedical Instrumentation", Third Edition, Tata McGraw – Hill, New Delhi, 2014.
2.	Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ", Springer - Verlag New York, 2011
3.	Milan Sonka and Vaclav Hlavac, et al, "Image Processing, Analysis and Machine Vision with MindTap", Vikas Publishing House, 2017.
4,	Anil Jain K, "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
5.	Khin Wee Lai, Dyah Ekashanti Octorina Dewi, "Medical Imaging Technology", Springer Singapore, 2015

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	3	2	2	2	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	1	-	-	-	-	-	2	2	3	2
CO3	3	3	2	2	2	2	-	-	-	-	-	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	-	-	-	-	-	1	2	2	1
CO	3	3	3	2	2	2	-	-	-	-	-	2	2	2	1

EC22634	**WEARABLE DEVICES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the hardware requirement of wearable systems and sensors
- To study the signal processing and energy harvesting in wearable devices.
- To apply the concept of BAN in health care systems.
- To study the concepts related to smart textiles.
- To summarize the applications of wearable devices in the field of medicine.

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, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

UNIT II	**SIGNAL PROCESSING AND 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, Datamining. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles

UNIT III	**WIRELESS HEALTH SYSTEMS**	**9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges-System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.		
UNIT IV	**SMART TEXTILE**	**9**
Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, respiration.		
UNIT V	**APPLICATIONS OF WEARABLE SYSTEMS**	**9**
Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end 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:	Apply the concepts of BAN in health care systems.	
CO4:	Illustrate the concept of smart textile.	
CO5:	Compare the various wearable devices in healthcare system.	
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	
REFERENCES:		
1.	Edward Sazonov and Micheal R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Elsevier, 2014	
2.	Mehmet R. Yuce and JamilY.Khan, “Wireless Body Area Networks Technology, Implementation applications”, Pan Stanford Publishing Pte.Ltd, Singapore, 2012	
3.	Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.	
4.	Nilanjan Dey, Amira S. Ashour, Simon James Fong, Chintan Bhatt, “Wearable and Implantable Medical Devices: Applications and Challenges”, 2019.	
5,	Edward Sazonov and Micheal R Neuman, “Wearable Sensors: Fundamentals, Implementation and Applications”, Elsevier, 2014	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	2	2	1	1	-	-	-	1	2	2	1
CO2	2	2	2	1	2	2	1	1	-	-	-	2	2	2	2
CO3	2	2	2	1	2	2	2	1	-	-	-	2	2	2	1
CO4	2	2	2	2	2	1	2	1	-	-	-	2	2	2	2
CO5	2	2	2	2	2	1	1	2	-	-	-	2	2	2	1
CO	2	2	2	2	2	2	2	1	-	-	-	2	2	2	2

EC22735	HUMAN ASSIST DEVICES AND IMPLANT TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.
- To understand tests to assess the hearing loss and development of electronic devices to compensate for the loss and analyze recent techniques used in modern clinical applications.

• To understand the prosthetic and orthotic devices		
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, Schematic for temporary bypass of left ventricle.		
UNIT II	**CARDIAC ASSIST DEVICES**	**9**
Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.		
UNIT III	**ARTIFICIAL KIDNEY**	**9**
Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney and Implanting Type.		
UNIT IV	**HEARING AIDS AND RECENT TRENDS**	**9**
Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids, wearable devices for hearing correction, Transcutaneous electrical nerve stimulator bio-feedback, Diagnostic and point-of-care platforms		
UNIT V	**PROSTHETIC AND ORTHOTIC DEVICES**	**9**
Hand and Arm Replacement – Different types of Models Externally Powered Limb Prosthesis, Intelligent prosthesis, Lower Limb and Upper limb orthotic devices, Ultrasonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually Challenged, Text to voice converter, Screen readers Sensory Assist Devices, Materials for Prosthetic and orthotic devices, Haptic Devices.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the principles and construction of artificial heart.	
CO2:	Illustrate the characteristics of cardiac assist devices and related issues.	
CO3:	Describe the principle of dialyzer	
CO4:	Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and demonstrate the tests to assess the hearing loss and development of wearable devices.	
CO5:	Develop different types of models for Prosthetic and orthotic purpose.	
TEXT BOOKS:		
1.	Marion. A. Hersh, Michael A. Johnson, “Assistive Technology for visually impaired and blind”,Springer Science & Business Media, 2010.	
2.	Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, “Clinical Engineering”, CRC Press, 2010.	
REFERENCES:		
1.	Gray E Wnek, Gray L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering” Marcel Dekker Inc New York 2004	
2.	D.S. Sunder, “Rehabilitation Medicine”, Third Edition, Jaypee Medical Publication, 2010.	
3	Kenneth J. Turner,”Advances in Home Care Technologies: Results of the match Project” Springer, 2011.	
4.	Gerr M. Craddock,” Assistive Technology-Shaping the future”, IOS Press, 2003.	
5,	Matthew Dipaola,”3D Printing in Orthopaedic Surgery”, Elsevier 2019.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	2	-	-	-	-	-	3	3	1	2
CO2	3	3	3	2	2	3	-	-	-	-	-	2	2	2	2
CO3	3	3	3	3	3	2	-	-	-	-	-	3	3	3	2
CO4	3	3	1	1	3	2	-	-	-	-	-	2	3	1	3
CO5	3	3	3	3	3	3	-	-	-	-	-	2	3	3	2

CO	3	3	3	2	3	2	-	-	-	-	-	2	3	2	2

EC22736	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of brain computer interface.
- To study event related potentials and sensory motor rhythms.
- To study the various signal acquisition and feature extraction methods suitable for BCI.
- To design feature translation methods for BCI.
- To study 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 signal acquisition - Signal Preprocessing – Artifacts removal

UNIT II	ELECTROPHYSIOLOGICAL SOURCES	9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT III	FEATURE EXTRACTION METHODS	9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA,ARMA models – PCA – Linear and Non-Linear Features.

UNIT IV	FEATURE TRANSLATION METHODS	9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V	APPLICATIONS OF BCI	9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Describe BCI system and its potential applications.
CO2:	Explain event related potentials and sensory motor rhythms.
CO3:	Discuss various feature extraction methods used for BCI.
CO4:	Summarize the classifiers suitable for fearture translation in BCi
CO5:	Illustrate app BCI for various applications.

TEXT BOOKS:

1.	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.
2.	Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 2007.

REFERENCES:

1.	R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 2008.
2.	Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 2019.
3.	Maureen Clerc, Laurent Bougrain,”Brain-Computer Interfaces 1: Methods and Perspectives, Volume 1” John Wiley & Sons, 2016.
4.	Nick F. Ramsey, José del R. Millán,” Brain-Computer Interfaces”, Elsevier, 2020.
5.	Rajesh P.N.Rao,” Brain-Computer Interfacing: An Introduction” Cambridge University Press, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	1	2	2	1	1	-	-	-	2	1	1	1
CO2	2	2	2	2	2	2	1	1	-	-	-	2	1	1	2

CO3	2	1	2	2	2	2	1	1	-	-	-	2	1	1	1
CO4	2	1	2	2	2	2	1	1	-	-	-	2	1	1	2
CO5	2	1	2	2	2	2	1	1	-	-	-	2	1	1	2
CO	2	2	2	2	2	2	1	1	-	-	-	2	1	1	2

EC22737	**ENVIRONMENTAL RADIATION AND SAFETY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the principles of nuclear radiation and its various sources.
- To analyze the biological and environmental effects of radiation.
- To master the techniques for detecting and measuring radiation.
- To implement safety protocols and adhere to radiation protection standards.
- To explore the applications nuclear radiation in biomedical engineering.

UNIT I	**ENVIRONMENTAL IMPACTS OF RADIATION**	**9**

Environmental pollutants -health impacts. Basics of Nuclear Radiation- Definition and types- Atomic Structure and Radioactivity- Sources of Nuclear Radiation-Natural and man-made, Emissions from Nuclear power plants and minerals processing units – environmental impacts. Radiation Units and Measurements

UNIT II	**BIOLOGICAL EFFECTS OF NUCLEAR RADIATION**	**9**

Interaction of Radiation with Biological Matter-Ionization, excitation, and radiation chemistry, Biological Effects-Cellular and molecular damage, Acute vs. chronic effects, Radiation Syndromes-Acute radiation syndrome (ARS), Long-term effects -cancer, genetic mutations, radiation-induced cancers Radiation effect on pregnancy and fertility, Dose-Response Relationships- Threshold and non-threshold models, Linear no-threshold (LNT) hypothesis

UNIT III	**DETECTION AND MEASUREMENT OF NUCLEAR RADIATION**	**9**

Radiation Detection Instruments-Geiger-Müller counters, scintillation detectors, semiconductor detectors, Radiation Dosimetry-Personal dosimeters (TLD, OSL), environmental monitoring, Instrument Calibration and Maintenance- accuracy and reliability, Data Interpretation

UNIT IV	**RADIATION PROTECTION AND SAFETY PROTOCOLS**	**9**

Principles of Radiation Protection- Time, distance, and shielding, Radiation Protection Standards - International (ICRP, IAEA) and national (NCRP, EPA). Safety Protocols - Management of radiation accidents/Emergency Radiological incident response, Diagnosis, evaluation and treatment of radiation exposure, decontamination procedures

UNIT V	**NUCLEAR RADIATION IN BIOMEDICAL ENGINEERING**	**9**

Medical Imaging and Diagnosticso-X-ray, CT, PET, SPECT. Radiation Therapy-External beam radiation therapy, brachytherapy, Types of radiopharmaceuticals, characteristics of radio pharmaceuticals, Radiopharmaceuticals for diagnosis and treatments in human, Dispensing of radio pharmaceuticals, RIA radiopharmaceuticals and kits production

TOTAL: 45 PERIODS

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	2	1	1	-	2	2	1	2	1	1	1	1	-	1
CO2	2	2	1	-	-	-	-	2	2	1	-	1	1	-	2
CO3	2	1	2	1	-	-	-	2	1	2	1	1	2	-	1
CO4	1	1	1	1	-	3	3	1	1	1	1	1	1	-	1
CO5	1	1	1	1	-	-	-	1	1	1	1	1	1	-	1

CO	1	1	1	1	-	1	1	1	1	1	1	1	1	-	1

VERTICAL 4 : IoT AND ITS APPLICATIONS

Mapping of Course Outcomes to Programme Outcomes

EC22541	SENSORS AND ACTUATORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of sensing and exploration of various sensors.
- To realize the significance of inductive and capacitive transducers.
- To build the tools for micro sensors and actuators.
- To design the sensors processing techniques.

UNIT I	FUNDAMENTAL OF SENSORS	9

Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer.

UNIT II	INDUCTIVE AND CAPACITIVE TRANSDUCERS	9

Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, Capacitive transducers: - Principle of operation, construction details, characteristics of capacitive transducers – different types & signal conditioning.

UNIT III	ACTUATORS	9

Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria.

UNIT IV	MICRO SENSORS AND MICRO ACTUATORS	9

Micro Sensors: Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, biosensors, temperature micro sensors

M**icro Actuators:** Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic.

UNIT V	SENSOR PROCESSING TECHNIQUES	9

Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, and Surface silicon micro machining.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the working principle and behaviour of sensors
CO2:	Relate and realize the importance of inductive and capacitive transducers
CO3:	Describe the classification of actuators
CO4:	Demonstrate the mechanism of micro sensors and actuators
CO5:	Choose the processing stages of sensors.

TEXT BOOKS:

1.	Patranabis.D, “Sensors and Transducers”, Wheeler publisher, 2011.
2.	Sergej Fatikow and Ulrich Rembold, “Microsystem Technology and Microbotics”, Springer – Verlag Newyork, Inc, 2013.

REFERENCES:

1.	Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” Fourth Edition, Springer, 2010.
2.	Robert H Bishop, “The Mechatronics Hand Book- Mechatronic Sytems, Sensors and Actuators”, Second Edition, CRC Press, 2016.
3.	Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
4.	Massood Tabib and Azar, “Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures”, Kluwer academic publishers, Springer, 2013.
5.	Manfred Kohl, “Shape Memory Actuators”, Springer, 2013.

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	2	1	2	-	-	-	-	-	1	1	1	1
CO2	2	2	1	2	1	2	-	-	-	-	-	1	1	1	1
CO3	2	1	2	1	2	2	-	-	-	-	-	1	1	1	1
CO4	2	2	2	2	2	2	-	-	-	-	-	1	1	1	1
CO5	2	1	1	2	2	1	-	-	-	-	-	1	1	1	1
CO	2	1	2	2	2	2	-	-	-	-	-	1	1	1	1

EC22542	PROGRAMMING EMBEDDED SYSTEM WITH C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To use C language effectively in embedded system.
- To understand the concept real time operating system.
- To visualize the interfacing of peripherals with controllers.
- To understand the need for code optimization.

UNIT I COMPILERS AND LINKING **9**

Know the hardware, Basic principles of embedded programming with example, Blinking LED- Role of infinite loop. The build process-compiling, Linking- Startup Code, Locating, Building the LED Program-compile, Format and output file, make files

UNIT II DOWNLOADING AND MEMORY **9**

Downloading-Deebug Monitors-Redboot, ROM, Managing ROM and Redboot, Remote Debuggers, Emulators, Simulators, Hardware tool, version control.Types of Memory, Direct Memory Access, Endian Issues, Memory Testing, Developing a Test Strategy, Validating memory contents. Using Flash Memory

UNIT III PERIPHERALS AND INTERRUPTS **9**

Control and Status Register, The device driver philosophy, Device driver design, Interrupts, Interrupt Map, Interrupt Service Routine, Working of Timers, Interrupt Issues, serial Ports.

UNIT IV OPERATING SYSTEMS **9**

The Scheduler- Real Time Scheduling, Scheduling points, Locking and Unlocking, Tasks, Task States, Task Priorities, Task Synchronization, Message Passing, interrupt handling, real Time Characteristics, RTOS selection, Mutex Task Synchronization.

UNIT V OPTIMIZATION TECHNIQUES **9**

Increasing code efficiency, Decreasing code size. Problems with optimizing compilers, Reducing memory usage, Power saving techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the basic concepts of embedded programming.
CO2:	Summarize the type of memory and its role in downloading, booting and debugging.
CO3:	Outline the concepts and interrupts and peripherals
CO4:	Identify the functions of Operating system in embedded applications.
CO5:	Apply the Optimization techniques to save power and memory usage

TEXT BOOKS:

1. Appala Naidu Bandaru, Shareef Mohamed, PadmaPriya C A , “C language for embedded system developer”, 2022
2. Rajkamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Second Edition, Pearson Education, 2011

REFERENCES:

1. K.Uma Rao, and Andhe Pallavi,”The 8051 and MSP430 Microcontrollers: Architecture, Programming and Applications, Wiley publishers, 2019.
2. Alka Kalra and Sanjeev Kumar Kalra,“Architecture and Programming of 8051 Microcontroller**”,** Laxmi Publications, 2010.
3. Elecia White, “Making Embedded Systems Design Pattern for Great Software.” O'Reilly Media, 2011.
4. Mark Siegesmund,” Embedded C Programming: Techniques and Applications of C and PIC

	MCUS Newnes, 2014
5.	Prof Suraj Gaikwad,"8051 Microcontroller Architecture Interfacing & Programming, 2023

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO2	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1

EC22643	IoT SYSTEM ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basic concepts of IoT architecture.
- Understand the fundamentals of M2M and IoT technology.
- Understand the various reference architectures.
- Identify the standards and applications of IoT.

UNIT I OVERVIEW OF IoT ARCHITECTURE **9**

Evolution of IoT, Need for ARM, IoT-An Architectural Overview, IoT Architecture-State of the Art, Building an architecture, Main design principles and needed capabilities, standards considerations.

UNIT II M2M AND IoT TECHNOLOGY FUNDAMENTALS **9**

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT III REFERENCE ARCHITECTURE **9**

Reference Model and architecture, IoT reference Model - IoT Reference Architecture- Event-driven Architectures, Service oriented Architecture. IoT Domain Model, Information Model, Functional Model - Communication Model.

UNIT IV IoT COMMUNICATION ARCHITECTURE **9**

IoT nodes, IoT Edge, 6LOWPAN, ipv4/ipv6, MQTT, CoAP, Application aware communication, Network and channel aware communication – Topologies and Hierarchy

UNIT V IoT ARCHITECTURE STANDARDS AND SECURE IoT ARCHITECTURE **9**

ETSI standard for IoT Architecture : Standards for IoT for Home, Energy, People, motion, City. IoT- A Trust Model, Thrust analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the basic concepts of IoT architecture.
CO2:	Illustrate the fundamentals of M2M and IoT technology.
CO3:	Relate various reference architectures.
CO4:	Identify the various IoT communication architectures.
CO5:	Utilize the standards and secure IoT architectures.

TEXT BOOKS:

1.	Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob Van Kranenburg, Sebastian Lange, Stefan Meissner, "Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, USA, 2013.
2.	Peter Waher, "Learning Internet of Things", Packt publishing, Birmingham –Mumbai, 2015

REFERENCES:

1.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, Wiley Publications, 2013.
2.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, VPT, 2014.
3.	John R. Vacca, “Cloud Computing Security: Foundations and Challenges”, CRC Press, 2016.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things key applications and protocols”, Wiley, 2011.
5.	Raj Kamal, “Internet of Things Architecture and Design Principles”, McGraw Hill Education (India) Private Limited, 2017.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO3	3	2	2	1	-	-	1	-	-	-	-	1	1	1	1
CO4	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO5	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1

EC22644	IoT PROTOCOLS AND NETWORKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the various Protocols of IoT in data link layer, network layer, transport and Session layer.
- Understand the various IoT service layer protocols & security Protocols.
- Understand the various application layer protocols for IoT
- Understand the concept of Cloud Computing in IoT.

UNIT I	**IoT DATALINK LAYER & NETWORK LAYER PROTOCOLS**	**9**

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

UNIT II	**TRANSPORT & SESSION LAYER PROTOCOLS**	**9**

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT

UNIT III	**SERVICE LAYER PROTOCOLS & SECURITY**	**9**

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4.

UNIT IV	**APPLICATION PROTOCOLS FOR IoT**	**9**

UPnP, CoAP, MQTT, XMPP. SCADA, WebSocket; IP-based protocols: 6LoWPAN, RPL; Authentication Protocols; IEEE 802.15.4.

UNIT V	**IoT AND CLOUD**	**9**

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT Core - AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the various Protocols of IoT data link layer & network layer.
CO2:	Illustrate the various Protocols of IoT transport & session layer.
CO3:	Outline the various IoT service layer protocols & security Protocols.
CO4:	Identify the various application protocols for IoT.
CO5:	Apply the concepts of Cloud Computing in IoT.

TEXT BOOKS:

1.	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, Academic Press, 2014.

2.	Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-On Approach”, A hand on approach text book series, 2013.
REFERENCES:	
1.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118-47347-4, Wiley Publications, 2013
2.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, VPT, 2014.
3.	John R. Vacca, “Cloud Computing Security: Foundations and Challenges”, CRC Press, 2016.
4.	Olivier Hersent, David Boswarthick, Omar Elloumi,”The Internet of Things key applications and protocols”, Wiley, 2011.
5.	David Hanes **,** Gonzalo Salgueiro **,** Patrick Grossetete **,** Robert Barton**,** Jerome Henry, “ IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, Cisco Press, 2017.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO3	3	2	2	1	-	-	1	-	-	-	-	1	1	1	1
CO4	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO5	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO	3	2	2	1	-	-	1	-	-	-	-	1	1	1	1

EC22745	**SMART IoT APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the application and legal perspectives of IoT.
- To understand the concept of automation to control various applications.

UNIT I SMART ENVIRONMENT **9**

Smart Environment: Forest Fire Detection, Air Pollution, Snow Level Monitoring, Landslide and Avalanche Prevention, Earthquake Early Detection. Smart Water: Potable water monitoring, Chemical leakage detection in rivers, Swimming pool remote measurement, Pollution levels in the sea, Water Leakages, River Floods

UNIT II SMART CITIES **9**

Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Phone Detection, Electromagnetic Field Levels, Traffic Congestion, Smart Lighting, Waste Management, Smart Roads. Smart Metering : Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation

UNIT III HOME AUTOMATION AND SMART LOGISTICS **9**

Home Automation: Energy and Water Use, Intrusion Detection Systems. Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation

Smart Retail: Supply Chain Control, NFC Payment, Intelligent Shopping Applications, Smart Product Management. Logistics: Quality of Shipment Conditions, Item Location, Storage Incompatibility Detection, Fleet Tracking

UNIT IV SMART INDUSTRIAL CONTROL AND AGRICULTURE **9**

Industrial Control: M2M Applications, Indoor Air Quality, Temperature Monitoring, Ozone Presence, Indoor Location, Vehicle Auto-diagnosis, Perimeter Access Control, Liquid Presence, Radiation Levels, Explosive and Hazardous Gases. Agricultural: Green Houses, Golf Courses, Meteorological Station Network, Compost, Hydroponics, Offspring Care, Animal Tracking, Toxic Gas Levels

UNIT V IoT LEGAL PERSPECTIVES AND STANDARDIZATION **9**

Self-Regulation, International Legal Framework, Security and Privacy: Privacy Enhancing Technologies, Legal Challenges for a Privacy Framework, Responsibility for Violations of Privacy, Tackling Environmental Concerns ISO, IEC, ETSI, IEEE, IETF, ITU-T, OASIS, OGC and one M2M

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Outline smart environment and its applications applications.
CO2:	Summarize smart metering and smart city applications.
CO3:	Illustrate smart retail and logistics applications
CO4:	Identify the smart industrial control and agricultural applications in IoT.
CO5:	Apply the standardization of IoT and IoT legal perspectives in various applications
TEXT BOOKS:	
1.	Ovidiu Vermesan, Peter Friess, "Internet of Things – From research and innovation to market deployment",River Publishers Series in Communication, CRC Press, 2014
2.	Aboul Ella Hassanien, Mohammed Elhoseny, Syed Hassen Ahmed, Amit Kumar Singh, "Security in Smart Cities: Models, Applications and Challenges", Springer, 2018.
REFERENCES:	
1.	Libelium Inc, "Internet of Things: Case Studies", http://www.libelium.com/resources/case-studies White papers, Spain, 2018
2.	Raj Kamal. "Internet of Things-Architecture and Design Principles", Tata McGrawHill, India, 2017.
3.	Atta ur Rehman Khan, Qusay F. Hassan, Sajjad A. Madani," Internet of Things Challenges, Advances, and Applications, CRC Press, 2017.
4.	Yasser Ismai; "Internet of Things (IoT) for Automated Smart Applications", Intech Open, 2019.
5.	Ovidiu Vermesan, Peter Friess, "Internet of Things – Converging Technologies for Smart Environments and Integrated Eco Systems", River Publishers Series in Communication, USA, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO2	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO3	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO4	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO5	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1
CO	2	1	-	-	-	-	-	-	-	-	-	1	1	1	1

EC22746	**MOBILE APPLICATION DEVELOPMENT FOR IoT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To know the basics concepts in mobile applications.
- To describe the cloud computing architecture.
- To develop the mobile application.

UNIT I	**OVERVIEW OF MOBILE APPLICATION**	**9**

Mobile System – Mobile Interface and Applications – Mobile Cloud - APP Components – APP Resources – APP Mainfest – Introduction of 2D Graphics Techniques – Advanced UI Design – Audio implementations in Android – Executing Video in Android.

UNIT II	**MOBILE EMBEDDED SYSTEM ARCHITECTURE**	**9**

Scheduling Algorithms – Memory Technology – Mobile Embedded Systems – Messaging and Communication Mechanisms Local Data – Sqlite Database – Content Provider – Fixed Time Model – Probabilistic Time Model – Nondeterministic Polynomial Time Problems.

UNIT III	**MOBILE CLOUD COMPUTING**	**9**

Introduction – Concepts of Mobile Cloud Computing – Main Techniques of Mobile Cloud Computing – Mobile Cloud Computing Architecture. Introduction – Basic Graph Models and Techniques.

UNIT IV	**MOBILE DEVICES IN BIG DATA**	**9**

Overview of Big Data – Big Data Processing – Mobile Big Data Storage – Fundamental Timing Optimizations - Time and Power Optimizations with Loop Scheduling.

UNIT V	CASE STUDY IN IoT	9
Mobile Apps: Smart Home Development - Smart Agriculture - Healthcare Monitoring - Smart Cities - Energy Management.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the overview of mobile application	
CO2:	Demonstrate the embedded system architecture	
CO3:	Illustrate the techniques of Mobile Cloud Computing	
CO4:	Construct big data storage for mobile devices	
CO5:	Develop a Mobile App for IoT applications.	
TEXT BOOKS:		
1.	Meikang Qiu, Wenyun Dai, and Keke Gai, "Mobile Applications Development with Android Technologies and Algorithms", Chapman and Hall/CRC Publication, 2016.	
2.	Shaun Lewis, Mike Dunn, "Native Mobile Development", O'Reilly Media, Inc,2019.	
REFERENCES:		
1.	Jon Duckett, Gilles Ruppert, and Jack Moore, "JavaScript and Jquery: Interactive Front- End Web Development", CreateSpace Independent Publishing Platform, 2017.	
2.	Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", John Wiley & Sons, 2012.	
3.	Nishith Pathak, Anurag Bhandari, "IoT, AI, and Blockchain for .NET: Building a Next-Generation Application from the Ground Up", Apress, 2018.	
4.	Valentino Lee, Heather Schneider, Robbie Schell, "Mobile Applications: Architecture, Design, and Development" Prentice Hall, April 2004.	
5.	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Second Edition, Pearson Education, 2011.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	2	1	2	-	-	-	-	-	1	1	1	1
CO2	2	2	1	2	1	2	-	-	-	-	-	1	1	1	1
CO3	2	1	2	1	2	2	-	-	-	-	-	1	1	1	1
CO4	2	2	2	2	2	2	-	-	-	-	-	1	1	1	1
CO5	2	1	1	2	2	1	-	-	-	-	-	1	1	1	1
CO	2	1	2	2	2	2	-	-	-	-	-	1	1	1	1

EC22747	AI AND IoT IN ROBOTICS	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
• To understand the fundamentals of Artificial Intelligence					
• To understand the design and implementation process of IoT system.					
• To understand the fundamentals of Robotics.					
• To explore the concepts and techniques of autonomous navigation and path planning.					
• To achieve proficiency in Robot Operating System					
UNIT I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**				**6**
Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)					
UNIT II	**IOT DESIGN**				**6**

Introduction, Physical design of IoT, Logical design of IoT, IoT enabling technologies, Domain specific IoTs, IoT design methodology, logical design IoT physical devices (such as Raspberry Pi, pcDuino, Beaglebone black, Cubieboard), introduction to cloud computing: cloud models, cloud service examples, cloud based services & applications, Virtualization, commercial clod providers.		
UNIT III	**INTRODUCTION TO ROBOTICS**	**6**
Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, Overview of robot subsystems, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots		
UNIT IV	**AI BASED PATH PLANNING SYSTEMS**	**6**
Introduction to Autonomous Navigation and Path Planning, Definition and basic concepts of autonomous navigation and path planning, Applications of autonomous navigation and path planning, Sensors and odometry, Camera modelling and calibration, structure from motion, visual motion estimation, Trajectory planning for Mobile Robots and Unmanned Aircraft System (UAS)		
UNIT V	**ROBOT OS**	**6**
Introduction to Robot Operating System (ROS), ROS2, and GAZEBO, Autonomous Navigation and Path Planning Algorithms, Real-world case studies and examples of autonomous navigation and path planning		
		30 PERIODS
PRACTICAL EXPERIMENTS:		
Robot Programming		
1.	Robot Programming and Simulation for Shape Identification	
2.	Robot Programming and Simulation of X, Y, Z axis models	
Experiments using Machine Learning		
3.	Character and Image Recognition Using Machine Learning Algorithms	
4.	Statistical and Price Prediction using Deep Learning Methodologies	
Mini projects for IoT		
5.	Smart Applications	
		30 PERIODS
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the fundamentals of Artificial Intelligence	
CO2:	Illustrate IoT systems, including both physical and logical aspects.	
CO4:	Explain the fundamentals of Robotics	
CO4:	Explain the concepts and techniques of autonomous navigation and path planning.	
CO5:	Apply Robot Operating System for real-world applications.	
TEXT BOOKS:		
1.	Ashutosh Kumar Dubey, Abhishek Kumar, S. Rakesh Kumar, " AI and IoT-Based Intelligent Automation in Robotics", Wiley Scrivener, 2021.	
2.	Amrita Rai, Deepti Sharma, Shubhyansh Rai, Amandeep Singh, Krishna Kant Singh,"IoT-Aided Robotics Development and Applications with AI", Springer 2021	
REFERENCES:		
1.	Alex Khang, Anuradha Misra, Shashi Kant Gupta, Vrushank Shah," AI-Aided IoT Technologies and Applications for Smart Business and Production", CRC Press, 2023.	
2.	Francis X. Govers , Artificial Intelligence for Robotics - Second Edition: Build intelligent robots using ROS 2, Python, OpenCV and AI/ML techniques for real world tasks, Packt Publishing 2024	
3.	Alex Khang," AI and IoT-Based Technologies for Precision Medicine", IGI Global, 2023	
4.	Alex Khang, Vugar Abdullayev, Vladimir Hahanov and Vrushank Shah, "Advanced IoT Technologies and Applications in the Industry 4.0 Digital Economy", CRC Press	
5.	Robin R. Murphy, "Introduction to AI Robotics," Second Edition, Bradford Books, 2019.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1
CO2	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1

CO3	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1
CO4	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1
CO5	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1
CO	2	2	2	-	2	2	-	-	-	-	1	1	1	2	1

VERTICAL 5 : WIRELESS AND SPACE TECHNOLOGIES

Mapping of Course Outcomes to Programme Outcomes

EC22551	**4G/5G COMMUNICATION NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To explore the security features in 5G networks.

UNIT I	**EVLOUTION OF WIRELESS NETWORKS**	**9**

Networks evolution: 2G, 3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment - Options, Challenges and Applications.

UNIT II	**5G CHANNEL ACCESS METHODS**	**9**

OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods.

UNIT III	**RADIO ACCESS NETWORK FOR 5G**	**9**

5G requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols.

UNIT IV	**DYNAMIC SPECTRUM MANAGEMENT AND MM-WAVES**	**9**

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V	**SECURITY IN 5G NETWORKS**	**9**

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Summarize the evolution of wireless networks.
CO2:	Illustrate the concepts and challenges of 5G networks.
CO3:	Comprehend the 5G architecture and protocols.
CO4:	Exemplify the dynamic spectrum management.
CO5:	Identify the security aspects in 5G networks.

TEXT BOOKS:

1.	Saro Velrajan,"An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases", 2020. [Unit I- III]
2.	Stephen Rommer, "5G Core networks: Powering Digitalization", Academic Press, 2019. [Unit IV- V]

REFERENCES:

1.	Jyrki. T.J.Penttinen,"5G Simplified: ABCs of Advanced Mobile Communications"' Copyrighted Material, 2019.
2.	Wan Lee Anthony, "5G system Design: An end to end Perspective", Springer Publications, 2019.
3.	Saad Z. Asif ,"5G Mobile Communications Concepts and Technologies", CRC Press, 2019.
4.	Wei Xiang, Kan Zheng, Xuemin(Sherman) Shen ,"5G Mobile Communications", Springer,2017.
5.	Jonathanrodriguez," Fundamentals of 5G mobile networks", John Wiley &Sons Ltd, 2015.

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1
CO2	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1
CO3	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1
CO4	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1
CO5	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1
CO	2	2	2	2	-	1	-	-	-	-	-	2	2	1	1

EC22552	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on the needs for avionics for both Civil and military aircraft.
- To gain knowledge on avionics architecture and Avionics data bus.
- To understand the various cockpit displays and human interfaces.
- To gain knowledge on the concepts of auto pilot
- To learn different navigation aids

UNIT I INTRODUCTION TO AVIONICS **9**

Basics of Avionics– Need for Avionics in civil and military aircraft and space systems – Integrated Avionics Architecture –Military and Civil system – Typical avionics System and Sub systems – Design and Technologies.

UNIT II DIGITAL AVIONICS BUS ARCHITECTURE **9**

Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC429, ARINC-629, AFDX/ARINC-664, ARINC-818 – Aircraft system Interface.

UNIT III COCKPIT DISPLAYS AND MAN-MACHINE INTERACTION **9**

Trends in display technology- CRT, LED, LCD, EL and plasma panel - Touch screen - Direct voice input (DVI) –-Civil cockpit and military cockpit: MFD, MFK, HUD, HDD, HMD, HOTAS – Glass cockpit.

UNIT IV AIR DATA SYSTEMS AND AUTO PILOT **9**

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

UNIT V OPTICAL NETWORKS **9**

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the avionics systems and its need for civil and military aircrafts considering the reliability and safety aspects.
CO2:	Identify the suitable architecture and data bus for avionic systems.
CO3:	Compare the different display technologies used in cockpit.
CO4:	Explain the principles of auto pilot systems.
CO5:	Select the appropriate communication and navigation techniques based on requirements.

TEXT BOOKS:

1. R.P.G. Collinson, “Introduction to Avionics Systems”, Springer Publications, Second Edition, 2013.
2. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., Ninth Edition, 2015.

REFERENCES:

1. R P G, Collinson “Introduction to Avionics Systems”, Third Edition, Springer,2011.
2. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Cary Spitzer, Thomas Ferrell, Uma Ferrell, “Digital Avionics Systems”, CRC Press, Third Edition, 2017.
4. Myron Kayton, Walter R. Fried “Avionics Navigation Systems” Second Edition, Wiley Publication, 2008

5.	Jim Curren, “Trend in Advanced Avionics”, IOWA State University, 1992.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	1	1	-	-	-	-	-	-	-	1	-	2	3
CO2	2	2	1	2	-	-	-	-	-	-	-	1	-	2	3
CO3	2	2	1	1	1	-	-	-	-	-	-	1	-	2	3
CO4	2	1	1	1	-	-	-	-	-	-	-	1	-	2	3
CO5	2	2	1	2	1	-	-	-	-	-	-	1	-	2	3
CO	2	2	1	2	1	-	-	-	-	-	-	1	-	2	3

EC22653	OPTICAL COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the various optical fiber modes and configuration of optical fibers.
- To study 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 FIBER COMMUNICATION **9**

Introduction - The General systems - Advantages of Optical Fiber Communication- Ray Theory Transmission: Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew Rays, Electromagnetic Mode Theory for Optical Propagation: Modes in a Planar Guide, Phase and group velocity - Cylindrical Fiber: Step index fibers, Graded index fibers - Single mode fibers: Cut off wavelength.

UNIT II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS **9**

Attenuation - Material absorption losses in silica glass fibers: Intrinsic absorption, Extrinsic absorption - Linear scattering losses: Rayleigh Scattering, Mie Scattering -Nonlinear scattering losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering–Fiber Bend Loss–Dispersion-Chromatic dispersion: Material dispersion, Waveguide dispersion-Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber.

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

The laser: Introduction-Basic concepts: Absorption and emission of radiation, Population inversion , Optical feedback and laser oscillation, Optical emission from semiconductors: The PN junction, Spontaneous emission, Carrier recombination, Stimulated emission and lasing, Hetero junctions- LED: Introduction-Power and Efficiency – LED structures: Planar LED, Dome LED, Surface emitter LED, Edge emitter LED-LED Characteristics. Optical Detectors: Introduction ,Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photo diode, P-I-N Photo Diode and Avalanche Photodiode.

UNIT IV OPTICAL FIBER MEASUREMENTS AND COUPLING **9**

Introduction-Total fiber attenuation measurement, Fiber dispersion measurements in time domain and frequency domain, Fiber cut off wavelength measurements, Numerical aperture measurements, Fiber diameter measurements, Reflectance and optical return loss, Source to Fiber Power Launching-Lensing schemes for coupling management-Fiber to Fiber joints-LED coupling to single mode fibers-Fiber splicing ,Optical fiber connectors.

UNIT V OPTICAL NETWORKS **9**

Introduction- Optical network concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Public telecommunications network overview- Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, Open Systems Interconnection reference model, Optical transport network, Internet Protocol,Optical network deployment : Long haul networks, Metropolitan area networks, Optical Ethernet: Network protection, restoration and survivability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Explain the basic mechanisms involved in optical fiber communication system.

CO2:	Summarize the transmission characteristics associated with dispersion and polarization techniques.
CO3:	Outline the basic principles of working of optical sources and detectors for optical communication system applications.
CO4:	Identify various optical fiber measurements and coupling techniques.
CO5:	Utilize optical network concepts for the selection of optical switching networks.
TEXT BOOKS:	
1.	John M. Senior, “Optical Fiber Communication”, Fourth Edition, Pearson Education, 2010.
2.	Gred Keiser, "Optical Fiber Communication”, Fifth Edition, McGraw Hill Education (India) Private Limited., Reprint 2013.
REFERENCES:	
1.	Mishra and Ugale,”Fibre Optic Communication”,Wiley, 2013.
2.	Govind P. Agrawal, “Fiber-Optic Communication Systems”, Fourth Edition, John Wiley & Sons, 2010
3.	Milorad Cvijetic,Ivan Djordjevic “Advanced Optical Communication Systems and Networks”, Artech house, 2013.
4.	Biswanath Mukherjee, Ioannis Tomkos, Massimo Tornatore” Handbook of Optical Networks”, Springer, 2020.
5.	P Chakrabarti, "Optical Fiber Communication”, McGraw Hill Education (India)Private Limited,2016.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO2	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO3	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO4	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO5	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1

EC22654	**RADAR AND NAVIGATIONAL AIDS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To become familiar with fundamentals of radar.
- To gain knowledge about the different types of radar and their operations.
- To learn the radar antennas, transmitters and receivers.
- To learn the radio direction finding methods and various radio ranges.
- To become familiar with various radar navigation techniques.

UNIT I	**INTRODUCTION TO RADAR EQUATION**	**9**

The Origin 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, Antenna Parameters, System losses.

UNIT II	**CW, MTI AND PULSE DOPPLER RADAR**	**9**

Unmodulated CW radar-Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Pulse Doppler Radar.

UNIT III	**DETECTION OF SIGNALS IN NOISE**	**9**

Matched Filter Receiver –Detection Criteria – Detectors –Automatic Detector - Integrators -The Radar operator - Signal Management - The Radar Antenna - Reflector Antennas - Electronically Steered Phased

Array Antennas – Phase Shifters - Frequency-Scan Arrays. Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron–The Radar Receiver - Super heterodyne Receiver.		
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, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar.		
UNIT V	**MODERN NAVIGATION**	**9**
Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment – Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization –Inertial Navigation - Principles of Operation - Navigation Over the Earth.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the Radar fundamentals and Radar equations.	
CO2:	Summarize the various types of radars and their operation.	
CO3:	Demonstrate the various radar antennas, transmitters and receivers for signal transmission and detection.	
CO4:	Utilize the appropriate radio direction finding methods and radio ranges for various applications.	
CO5:	Identify the methods of landing and navigation systems based on applications.	
TEXT BOOKS:		
1.	Habibur Rahman, Fundamental Principles of Radar, Taylor and Francis, 2019.	
2.	N.Nagaraja, “Elements of Electronics Navigation”,TMH, 2017.	
REFERENCES:		
1.	M.I.Skolnik , “Introduction to Radar Systems”, Third Edition, Tata McGraw Hill 2017	
2.	M. R. Richards, J. A. Scheer, W. A. Holm, Editors “Principles of Modern Radar, Basic Principles”, SciTech Publishing, 2012	
3.	Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004	
4.	J.C Toomay, " Principles of Radar", Third Edition –PHI,2010	
5.	Nathansan, “Radar design principles-Signal processing and environment”, Second Edition, PHI, 2007	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO2	2	2	1	1	1	-	-	-	-	-	-	1	-	-	3
CO3	2	2	1	1	-	-	-	-	-	-	-	1	-	-	3
CO4	2	2	1	1	-	-	-	-	-	-	-	2	-	-	3
CO5	2	2	1	1	2	-	-	-	-	-	-	2	-	-	3
CO	2	2	1	1	2	-	-	-	-	-	-	2	-	-	3

EC22755	**SATELLITE COMMUNICATION AND BROADCASTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES:					
• To study the basics of satellite orbits.					
• To understand the satellite and earth segments.					
• To study the various methods of satellite access.					
• To explore the applications of satellites					
• To understand the basics of satellite Networks.					

UNIT I	SATELLITE ORBITS	9
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, Inclined orbit, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage, Launching orbit.		
UNIT II	**SPACE SEGMENT**	**9**
Spacecraft Technology- Structure, Primary power, Altitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and Command-Transponders-The Antenna Subsystem, Anik satellites, Advanced Tiros-N Spacecraft.		
UNIT III	**SATELLITE LINK DESIGN**	**9**
Space link, Transmission Losses, Link power budget Equation, System Noise, Carrier to Noise ratio, The Uplink, Down Link, Effects of rain, Combined Uplink and downlink C/N Ratio, Inter modulation Noise, Inter satellite Links, Interference, Antenna Gain function.		
UNIT IV	**SATELLITE ACCESS TECHNIQUES AND SERVICES**	**9**
Modulation and Multiplexing: Voice, Data, Video, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods. Mobile satellite services: GSM, GPS Position Location Principles.		
UNIT V	**DIRECT BROADCAST SATELLITES**	**9**
Introduction, orbital Spacing, Power rating and number of transponder, Bit rate for digital Television, Forward Error Correction, Home Receiver Outdoor Unit (ODU), Home Receiver Indoor Unit (IDU), Down link Analysis, Uplink, HDTV.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the various satellite orbits and launching.	
CO2:	Describe the various earth and space segments in satellite communication.	
CO3:	Outline the satellite link design and interference analysis.	
CO4:	Identify the various satellite access and services.	
CO5:	Interpret the satellite systems for direct broadcasting.	
TEXT BOOKS:		
1.	Dennis Roddy, "Satellite Communication", Fourth Edition, Mc Graw Hill International, 2017. (Unit I-IV)	
2.	Timothy, Pratt, Charles,W.Bostain, Jeremy E.Allnutt, "SatelliteCommunication",Third Edition, Wiley Publications, 2021 (Unit V)	
REFERENCES:		
1.	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Second Edition, Prentice Hall/Pearson, 2013.	
2.	M.Richharia, "Mobile Satellite Communications :Principles and Trends", Wiley publishers 2014	
3.	Tri T. Ha, "Digital Satellite Communications", Second Edition, Mc Graw Hill education, 2017.	
4.	Anil K Maini, Varsha Agrawal " Satellite Technology: Principles and Applications, John Wiley and Sons,2014.	
5.	K N Raja Rao "Satellite Communication: Concepts and Applications", Second Edition, PHI 2013	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO2	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO3	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO4	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO5	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1

EC22756	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:		
• To study and understand the concepts and design of a Cellular System.		
• To study and understand mobile radio propagation and various digital modulation techniques.		
• To understand the concepts of multiple access techniques and wireless networks to learn the evolution of wireless networks.		
• To characterize the structure of receiver and receive diversity.		
• To optimize different wireless systems and standards.		
UNIT I	**THE CELLULAR CONCEPT**	**9**
Introduction-Frequency Reuse- Channel assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations. Interference and System Capacity: Co-Channel Interference and System Capacity-Channel Planning for Wireless Systems, Adjacent Channel Interference, Power Control for Reducing Interference, Trunking and Grade of Service. Improving Coverage and Capacity In Cellular Systems: Cell Splitting, Sectoring.		
UNIT II	**MOBILE RADIO PROPAGATION**	**9**
Large Scale Path Loss: Introduction to Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster angle- Diffraction, Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread and Coherence Time. Types of Small- Scale Fading: Fading Effects due to Multipath Time Delay Spread, Fading Effects due to Doppler Spread.		
UNIT III	**MULTIPLE ACCESS TECHNIQUES**	**9**
Introduction: Introduction to Multiple Access- Frequency Division Multiple Access (FDMA)- Time Division Multiple Access(TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access(CDMA)- Space Division Multiple Access(SDMA)- Capacity of Cellular Systems: Capacity of Cellular CDMA, Capacity of CDMA with multiple Cells.		
UNIT IV	**MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY**	**9**
Digital Modulation – An Overview: Factors that influence the choice of Digital Modulation, Linear Modulation Techniques: Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS)- Modulation in Fading and Multipath Channels- Equalization, Diversity and Channel Coding: Introduction-Fundamentals of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity, Rake Receiver.		
UNIT V	**WIRELESS SYSTEMS AND STANDARDS**	**9**
AMPS & ETACS System overview – Call handling – GSM System – Services and features – Architecture – Radio Subsystem – GSM Call – Frame Structure – Signal Processing – CDMA Digital Cellular Standard (IS-95) – Frequency & Channel Specification – Forward CDMA channel – Reverse CDMA channel. Introduction to OFDM system – Cyclic prefix – Matrix representation case study: IEEE 802.11a wireless LAN.		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Illustrate the fundamentals of wireless communication systems.	
CO2:	Interpret mobile radio propagation and multipath models.	
CO3:	Exemplify the concepts of multiple access techniques.	
CO4:	Investigate the structure of receiver and receive diversity.	
CO5:	Examine different wireless systems and standards.	
TEXT BOOKS:		
1.	Rappaport,T.S., “Wireless communications”, Second Edition, Pearson Education, 2010.	
2.	Aditya.K.Jegannatham, “Principles of Modern Wireless Communication Systems”, Tata McGraw Hill, 2016.[Unit-V]	
REFERENCES:		
1.	Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011.	
2.	Van Nee, R. and Ramji Prasad, ―OFDM for wireless multimedia communications, Artech House, 2000.	
3.	David Tse and Pramod Viswanath, ―Fundamentals of Wireless Communication, Cambridge University Press, 2012.	
4.	Upena Dalal, ―Wireless Communication”, Oxford University Press, 2009.	
5.	Andreas.F. Molisch, ―Wireless Communications”, Second Edition, John Wiley – India, 2011.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	-	-	-	-	-	-	2	2	1	1
CO2	2	2	2	2	1	-	-	-	-	-	-	2	2	1	1
CO3	2	2	2	2	1	-	-	-	-	-	-	2	2	1	1
CO4	2	2	2	1	1	-	-	-	-	-	-	2	2	1	1
CO5	2	2	2	2	1	-	-	-	-	-	-	2	2	1	1
CO	2	2	2	2	1	-	-	-	-	-	-	2	2	1	1

EC22757	AIR BALUN APPLICATION IN COMMUNICATION TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide an in-depth understanding of various types of antennas and their key parameters.
- To explore various types of baluns and their role in communication systems.
- To provide a comprehensive understanding of the air balun design and its applications in RF antenna systems.
- To examine real-world installations of RF communication systems, with a focus on design and testing.
- To familiarize students with cutting-edge technologies like 5G, satellite communication and the Internet of Things (IoT).

UNIT I	INTRODUCTION TO COMMUNICATION SYSTEMS AND EMERGING TECHNOLOGIES	9

Communication System Evolution, Technological Drivers of Emerging Communication Systems, 6G and Future Wireless Systems, Millimeter-Wave (mmWave) Communication.

UNIT II	INTRODUCTION TO BALUNS	9

Introduction, balanced to unbalanced transformer, types of baluns: Current, Voltage and Transmission Line baluns, applications of baluns in communication systems.

UNIT III	AIR BALUN CONCEPT	9

Overview of the air balun design, comparison of air baluns with other baluns, applications of air baluns in RF antenna systems, construction and implementation of air baluns, practical challenges and benefits of air baluns in communication.

UNIT IV	PRACTICAL COMMUNICATION SYSTEM DESIGN	9

Combining transmission lines, baluns and antennas, designing and testing RF communication systems, real-world examples of communication system installations.

UNIT V	NEXT-GENERATION COMMUNICATION TECHNOLOGIES	9

Artificial Intelligence in Communication Networks, Block chain in Communication Systems, The Role of Autonomous Systems (drones, self-driving cars) in Communication, Satellite-Based Internet for Remote Areas.

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Understand the technological evolution of communication systems and the advanced concepts that defines the future of wireless networks.
CO2:	Understand the concepts of baluns in communication systems
CO3:	Understand air baluns, from their basic design and construction to their application in advanced RF antenna systems.
CO4:	Design and test practical RF communication systems for real-world applications.
CO5:	Identify emerging technologies like AI, Blockchain, satellite communication and their implications for communication system design.
TEXT BOOKS:	
1.	Simon Haykin ,“ Communication Systems ”, Wiley, 2010.
2.	Theodore S. Rappaport, " Wireless Communications: Principles and Practice”, Pearson, Second Edition, 2023.
REFERENCES:	
1.	Olivier Hersent, David Boswarthick and Omar Elloumi,”The Internet of Things: Key Applications and Protocols”,Kindle Edition,2011.
2.	Leon W Couch, “Digital & Analog Communication Systems”, Third Edition, Pearson Education India, Eighth Edition, 2013.
3.	Constantine A. Balanis, “Antenna Theory and Applications”, Wiley, Fourth Edition, 2021.
4.	Erik Dahlman, Stefan Parkvall, Johan Skold , “5G NR: The Next Generation Wireless Access Technology “, Academic Press , Second Edition, 2018.
5.	Jerry Sevick and Raymond A. Mack, "Transmission Line Transformers: Theory and practice”, SciTech Publishing Inc, Fifth Edition, 2014.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO2	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO3	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO4	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO5	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1
CO	2	2	2	1	1	-	-	-	1	-	1	2	2	-	1

OPEN ELECTIVES - I

EC22681	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
• To introduce the concepts of Robotic systems					
• To understand the concepts of Instrumentation related to Robotics					
• To understand the concepts of robotic drives and actuators					
• To introduce the principles of robotic system modelling					
• To explore the concepts of control mechanisms in robotics					
UNIT I	**INTRODUCTION TO SENSORS AND TRANSDUCERS**				**9**
An Introduction to Robotics, sensors and Transducers, Characteristics of instrument and measurement systems. Smart Sensing, AI sensing, Need of sensors in Robotics, Robotics sensors and transducers Position sensors– optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors – Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors. Bend Sensor, Odor Sensor					
UNIT II	**ELECTRIC MOTORS**				**9**

Introduction, classification, AC motors, DC motors, stepper motors, types of stepper motors, half step mode operation, micro step mode, Servo motors.		
UNIT III	**INTRODUCTION TO ROBOT DRIVES AND ACTUATORS**	**9**
Introduction, drives and actuators, classification of actuator systems, functions and classification of drive systems, chain and linkages, lead screw, ball screws, belt drives, gear drives, precision gear boxes, harmonic drives, speed reducers, classification of grippers.		
UNIT IV	**INTRODUCTION AND SYSTEM MODELLING**	**9**
Introduction to manipulator control problem, open and closed loop control, forward and inverse dynamics considerations, properties of the dynamic model, introduction to nonlinear systems and control schemes.		
UNIT V	**ROBOTICS CONTROL**	**9**
Control of robot manipulator - state equations - constant solutions -linear feedback systems, single axis PID control - PD gravity control -computed torque control, variable structure control and impedance control.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Describe the fundamentals of robotics.
CO2:	Utilize the various instrumentations that support in building robots.
CO3:	Explain the concepts of drives and actuators in robotics
CO4:	Formulate robotic system models
CO5:	Apply the concepts of control mechanisms in robotics
TEXT BOOKS:	
1.	John J. Craig, 'Introduction to Robotics: Mechanics and Control', Fourth Edition, Pearson Education, 2021.
2.	Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, 'Robotics Engineering: An Integrated Approach', PHI Learning, New Delhi, 2010.
REFERENCES:	
1.	Reza N.Jazar, 'Theory of Applied Robotics Kinematics, Dynamics and Control', Springer, Indian Reprint, 2010.
2.	Mikell. P. Groover, Mitchell Weiss, Roger. N. Nagel, Nicholas G.Odrey,'Industrial Robotics - Technology, Programming, and Applications', Second Edition, Tata McGraw Hill, 2017.
3.	Huang, A., Chien, M., 'Adaptive Control of Robot Manipulators: A Unified Regressor-free Approach', Singapore: World Scientific Publishing Company, 2010.
4.	Santibáñez, V., Loría Perez, J. A., Loría, A., Davila, V. S., Kelly, R., 'Control of R o b o t Manipulators in Joint Space', Springer Science, 2008.
5.	Siciliano, B., Bastin, G., Canudas de Wit, C, 'Theory of Robot Control', Springer London Ltd. 2012.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1	2	-	-	-	-	2	3	-	-	-
CO2	3	2	2	2	1	2	-	-	-	-	2	3	-	-	-
CO3	3	2	2	2	2	2	-	-	-	-	2	3	-	-	-
CO4	3	2	2	2	3	3	-	-	-	-	2	3	-	-	-
CO5	3	2	3	3	3	3	-	-	-	-	2	3	-	-	-
CO	3	2	2	2	2	2	-	-	-	-	2	3	-	-	-

EC22682	MEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:		
• To illustrate origin of bio potentials and its propagation.		
• To understand the different types of electrodes and its placement for various recordings		
• To design bio amplifier for various physiological recordings		
• To learn the different measurement techniques for non-physiological parameters.		
• To summarize different biochemical measurements.		
UNIT I	**FUNDAMENTALS OF BIOMEDICAL ENGINEERING**	**9**
Sources of physiological signals, Transducer Types, Bio-potential Electrodes, Sensors, Signals-Types, Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes. Signal Processing and Methods of signal processing.		
UNIT II	**BIOPOTENTIAL MEASUREMENTS**	**9**
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, Principles of vector cardiography. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG.		
UNIT III	**BIO AMPLIFIERS**	**9**
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering.		
UNIT IV	**MEASUREMENT OF BIOLOGICAL PARAMETERS**	**9**
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method		
UNIT V	**BIOCHEMICAL MEASUREMENT AND BIOSENSORS**	**9**
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors, Blood gas analyzers - colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description) – Bio Sensors – Principles		
TOTAL: 45 PERIODS		
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Summarize different bio potentials, need for electrodes and its type.	
CO2:	Illustrate different electrode placement methods used in bio potential signal measurement.	
CO3:	Identify different types of bio amplifiers and its applications	
CO4:	Choose various technique for non-electrical physiological measurement	
CO5:	Identify the types of biochemical measurement and biosensors.	
TEXT BOOKS:		
1.	Leslie Cromwell, "Biomedical Instrumentation and measurement", Second edition, Prentice Hall of India, New Delhi, 2015.	
2.	Khandpur. R.S," Handbook of Biomedical Instrumentation, Third Edition, McGraw Hill Education 2014.	
REFERENCES:		
1.	Sawhney G. S, 'Biomedical Electronics and Instrumentation', TechSar Pvt Limited 2011.	
2.	Arumugam M," Biomedical Instrumentation", Anuradha Publications, 2017.	
3.	Sawhney G. S, 'Fundamentals of Biomedical Engineering' Second Edition New Age International Pvt Ltd, 2022.	
4.	Gowri Nambi, "Biomedical Engineering A quick reference guide" Notion Press, 2019.	
5.	W. Mark Saltzman "Biomedical Engineering: Bridging Medicine and Technology" Second Edition, Cambridge University Press 2015.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1
CO2	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1

CO3	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1
CO4	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1
CO5	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1
CO	2	1	1	-	-	2	-	-	-	-	-	1	1	1	1

EC22683	**FUNDAMENTALS OF EMBEDDED AND IoT**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To understand the concepts of 8086microprocessor and 8051 microcontroller.
- To interface microprocessors with supporting chips.
- To learn the concepts of Embedded system design.
- To learn the architecture of IoT
- To learn design flow of IoT

UNIT I	**INTRODUCTION TO MICROCONTROLLER**	**6**

Introduction to 8086 microprocessor - Architecture, Introduction to 8051 microcontroller – Architecture, addressing modes, instruction set, Assembly language programming

UNIT II	**I/O INTERFACING**	**6**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface , I2C,– Interrupt controller – Programming and applications Case studies: Traffic Light control, LED display and LCD display

UNIT III	**INTRODUCTION TO EMBEDDED SYSTEM DESIGN**	**6**

Embedded system design process –Design example: Model train controller- ARM Processor – Instruction Set– CPU – Programming Input and Output, Models for programs – Assembly, Linking and Loading

UNIT IV	**FUNDAMENTALS OF IoT**	**6**

Introduction to IoT& Devices – Characteristics – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF – YANG

UNIT V	**IoT PROTOCOLS AND DESIGN FLOW**	**6**

Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet. IoT Platform Design – Methodology – IoT Reference Model – Domain Model - Communication Model.

30 PERIODS

PRACTICAL EXERCISES:

Programs using kits	
1.	Basic arithmetic and Logical operations using 8086 and 8051.
Peripherals and Interfacing Experiments	
2.	Interfacing using peripherals such as keyboard and stepper Motor
3.	Traffic light controller
Experiments using ARM	
4.	Blinking of LEDs and LCD
5.	Interfacing using peripherals such as ADC and DAC
Experiments using Raspberry pi	
6.	Interfacing sensors with Raspberry pi

30 PERIODS

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1:	Describe the basic concepts of Microprocessors and microcontrollers, addressing modes and instruction set.
CO2:	Explain how peripherals are interconnected with the microprocessor.
CO3:	Develop a model of an embedded system
CO4:	Learn the architecture of IoT
CO5:	Realize the various protocols of the IoT.

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family -

	Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007. (Unit I, II)
2.	Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015. (Unit – III, IV, V)
REFERENCES:	
1.	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017
2.	Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher, 2012.
3.	Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, Pearson Education, 2020.
4.	Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
5.	Lyla B.Das, "Embedded Systems: An Integrated Approach" Pearson Education, 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	2	2	1	2	-	-	-	-	-	2	2	1	1
CO2	2	2	2	2	1	2	-	-	-	-	-	2	2	1	1
CO3	2	2	2	2	2	2	-	-	-	-	-	2	2	1	1
CO4	2	2	2	2	3	3	-	-	-	-	-	2	2	1	1
CO5	2	2	3	3	3	3	-	-	-	-	-	3	2	1	1
CO	2	2	2	2	2	2	-	-	-	-	-	2	2	1	1

OPEN ELECTIVES – II

EC22781	BIOMETRIC TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basics concepts in biometrics and its operational process.
- To study the structure and advantages of multi-biometric systems and the various levels of fusion
- Understand the importance of security and privacy in biometrics, including policies and measures for protecting personal biometric data.

UNIT I	**INTRODUCTION TO BIOMETRICS**	**9**

Overview of biometrics and its applications – Types of Biometrics- passive biometrics – active biometrics -Biometrics Vs traditional techniques – Benefits of biometrics - Elements of digital image processing systems - Elements of visual perception- sampling and quantization of an image

UNIT II	**FINGERPRINT IDENTIFICATION**	**9**

History of fingerprint pattern recognition - General description of fingerprints- fingerprint sensors, fingerprint enhancement Fingerprint Patterns, Fingerprint Features, Feature Extraction - Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based

UNIT III	**FACE RECOGNITION**	**9**

Face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images

UNIT IV	**IRIS RECOGNITION**	**9**

Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde's approach, Iris matching

UNIT V	**VOICE RECOGNITION**	**9**

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program

TOTAL: 45 PERIODS

COURSE OUTCOMES:	
Upon completion of the course, the students will be able to	
CO1:	Explain the principles of biometric systems.
CO2:	Demonstrate the process of fingerprint recognition technique.
CO3:	Illustrate face recognition techniques
CO4:	Summarize iris recognition system
CO5:	Demonstrate voice recognition system.
TEXT BOOKS	
1.	Anil K. Jain, Arun A. Ross, Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011.
2.	James Wayman & Anil Jain, "Biometric Systems- Technology Design and Performance Evaluation", SPRINGER (SIE), 2011
REFERENCES	
1.	Paramjit S. K. Chahal, Pushpinder S. Gill, "Handbook of Biometrics for Forensic Science", Springer, 2018.
2.	John D. Woodward Jr, "Biometrics: Advanced Identity Verification", CRC Press, 2015.
3.	Arun A. Ross, "Biometrics: Security and Privacy Concerns", Springer, 2017.
4.	David Zhang, Zhi-Hua Zhou, "Multibiometrics: Techniques and Applications" Springer, 2011.
5.	S. Rajasekaran, S. S. Iyengar, Shlomo Zilberstein, "Biometric Recognition: Challenges and Applications", Wiley-IEEE Press, 2014.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO2	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO3	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO4	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO5	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1
CO	2	2	1	-	-	1	-	-	-	-	-	1	1	-	1

EC22782	MOBILE APP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know the basics concepts in mobile applications.
- To describe the cloud computing architecture.
- To develop the mobile application.

UNIT I	OVERVIEW OF MOBILE APPLICATION	9

Mobile System – Mobile Interface and Applications – Mobile Cloud - APP Components – APP Resources – APP Mainfest – Introduction of 2D Graphics Techniques – Advanced UI Design – Audio implementations in Android – Executing Video in Android.

UNIT II	MOBILE EMBEDDED SYSTEM ARCHITECTURE	9

Scheduling Algorithms – Memory Technology – Mobile Embedded Systems – Messaging and Communication Mechanisms Local Data – Sqlite Database – Content Provider – Fixed Time Model – Probabilistic Time Model – Nondeterministic Polynomial Time Problems.

UNIT III	MOBILE CLOUD COMPUTING	9

Introduction – Concepts of Mobile Cloud Computing – Main Techniques of Mobile Cloud Computing – Mobile Cloud Computing Architecture. Introduction – Basic Graph Models and Techniques.

UNIT IV	MOBILE DEVICES IN BIG DATA	9

Overview of Big Data – Big Data Processing – Mobile Big Data Storage – Fundamental Timing Optimizations - Time and Power Optimizations with Loop Scheduling.

UNIT V	CASE STUDY IN MOBILE APPLICATION	9

Mobile Apps: Smart Home Development - Smart Agriculture - Healthcare Monitoring - Smart Cities - Energy Management.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
Upon completion of the course, the students will be able to	
CO1:	Explain the overview of mobile application
CO2:	Demonstrate the embedded system architecture
CO3:	Illustrate the techniques of Mobile Cloud Computing
CO4:	Construct big data storage for mobile devices
CO5:	Develop a Mobile App for smart applications.
TEXT BOOKS	
1	Meikang Qiu, Wenyun Dai, and Keke Gai, "Mobile Applications Development with Android Technologies and Algorithms", Chapman and Hall/CRC Publication, 2016.
2	Shaun Lewis, Mike Dunn, "Native Mobile Development", O'Reilly Media, Inc,2019.
REFERENCES	
1	Jon Duckett, Gilles Ruppert, and Jack Moore, "JavaScript and Jquery: Interactive Front- End Web Development", CreateSpace Independent Publishing Platform, 2017.
2	Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", John Wiley & Sons, 2012.
3	Tammy Noergaard," Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Second edition, 2013.
4.	Prasanth Kumar Pattnaik, Rajib Mall," Fundamentals of Mobile Computing", PHI Learning Pvt.Ltd, 2012.
5.	Lauren Darcey and Shane Conder, "Android Wireless Application Development", Second edition, Pearson Education, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	2	1	2	-	-	-	-	1	1	1	1	1
CO2	2	2	1	2	1	2	-	-	-	-	1	1	1	1	1
CO3	2	1	2	1	2	2	-	-	-	-	1	1	1	1	1
CO4	2	2	2	2	2	2	-	-	-	-	1	1	1	1	1
CO5	2	1	1	2	2	1	-	-	-	-	1	1	1	1	1
CO	2	1	2	2	2	2	-	-	-	-	1	1	1	1	1

OPEN ELECTIVES III

EC22783	PCB DESIGN AND FABRICATION	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
• To understand the need for PCB Design and the types of PCBs.					
• To understand the PCB Layout and Routing.					
• To understand the various technology trends in PCB design.					
• To understand the fabrication process of PCB.					
• To understand the PCB production process.					
UNIT I	**INTRODUCTION TO PCB DESIGN AND BASICS OF ELECTRONICS**				**9**
Fundamental electronic components, electronic circuits, Need for PCB, Types of PCBs: Single and Multilayer, PCB Material, Electronic Component packaging.					
UNIT II	**PCB LAYOUT AND ROUTING**				**9**

Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. PCB layout guidelines: trace width, spacing, ground planes, power planes, and thermal considerations, Routing techniques: manual and auto-routing.		
UNIT III	**PCB TECHNOLOGY TRENDS**	**9**
Multilayer PCBs - Multiwire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology.		
UNIT IV	**PCB FABRICATION PROCESS AND ASSEMBLY**	**9**
Overview of fabrication steps: etching, drilling, plating, and solder masking, Assembly Techniques: Plated Through Hole, Surface Mount		
UNIT V	**PCB PROTOTYPING AND PRODUCTION**	**9**
PCB Prototyping: Photo-Lithography process, Screen Printing process and chemical etching. PCB Mass Manufacturing Process: Gerber Generation, CAM, PCB testing.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Explain the need for PCB design and the types of PCBs.	
CO2:	Explain the PCB design process.	
CO3:	Describe the various technology trends in PCB design.	
CO4:	Explain the fabrication process and assembly techniques.	
CO5:	Describe the PCB production process.	
TEXT BOOKS:		
1.	Clyde F. Coombs, Jr, Happy T. Holden, “Printed Circuits Handbook”, Sixth edition, McGraw-Hill Professional, 2016.	
2.	R. S. Khandpur,” Printed circuit board design, fabrication assembly and testing”, Tata McGraw Hill, 2017.	
REFERENCES:		
1.	Cezar Rigo,” Essentials of PCB Design: An Introductory Guide to Printed Circuit Board Engineering”, Kindle edition 2023.	
2.	Elaine Rhodes, Developing Printed Circuit Assemblies: From Specifications to Mass Production, 2008	
3	Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002	
4	Simon Monk, “Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards”, Second Edition, McGraw-Hill Education, 2017.	
5	Roger Hu,”PCB Design and Layout Fundamentals for EMC”, 2019.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-
CO2	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-
CO3	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-
CO4	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-
CO5	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-
CO	2	2	-	-	-	-	-	-	-	1	-	2	2	1	-

EC22784	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
• To familiarize the students with the fundamental concepts of electronics in consumer devices.					
• To know about the working principle of entertainment devices.					
• To understand the function of sensors in smart home technology.					

• To provide the knowledge on the basics of automation in home appliance.		
• To gain knowledge on smart OS and current communication technologies.		
UNIT I	**CONSUMER ELECTRONICS FUNDAMENTALS**	**9**
Overview of Electronics: Vacuum tubes, Transistors, Integrated circuits - Moore's Law, Semiconductor Components: Diodes, Rectifiers, Transistors, Microcontrollers in consumer electronics, energy management, Wiring and Safety instructions.		
UNIT II	**ENTERTAINMENT ELECTRONICS**	**9**
Audio systems: Construction and working principle of Microphone, Loudspeaker, Display systems: CRT, LCD, LED, Video Players: DVD and Blue RAY, Recording Systems: Digital Cameras and Camcorders.		
UNIT III	**SMART HOME - SENSORS**	**9**
Technology involved in Smart home, Home Virtual Assistants: Alexa and Google Home. Home Security Systems: Intruder Detection, Motion Sensors, Thermal Sensors and Water Level Sensors.		
UNIT IV	**HOME APPLIANCES AND AUTOMATION**	**9**
Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics: Microwave, Dishwasher, Induction Stoves.		
UNIT V	**SMART OPERATING SYSTEMS AND COMMUNICATION TECHNOLOGY**	**9**
Introduction to Smart OS- Android and iOS, Internet Enabled Systems: Wi-Fi, IoT, Li-Fi and GPS, Personal devices - Tablets, Smart Phones and Smart Watches.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	Understand the basics of consumer electronics components.	
CO2:	Explain principles of entertainment electronics systems.	
CO3:	Demonstrate the function of smart home sensors and assistants	
CO4:	Describe automation and control in home appliances.	
CO5:	Comprehend the role of smart OS and communication technologies in personal devices**.**	
TEXT BOOKS:		
1.	Nick Vandome, Smart homes in easy steps, - Master smart technology for your home 2018.	
2.	Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.	
REFERENCES:		
1.	Thomas L Floyd "Electronic Devices", Tenth Edition, Pearson Education Asia, 2018.	
2.	Jordan Frith, "Smartphones as Locative Media ", Wiley. 2014.	
3	R. G. Gupta*,"* Audio and Video Systems*:* Principles, Maintenance and Troubleshooting*",* Second Edition , Tata Mc Graw Hill Publisher, 2010.	
4.	Bali S.P., "Consumer Electronics", Pearson Education, 2017.	
5.	Vijay Garg," Wireless Communications & Networking", Elsevier Science & Technology Books, 2019.	

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1
CO2	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1
CO3	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1
CO4	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1
CO5	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1
CO	2	1	1	-	-	1	-	-	-	-	-	2	2	1	1

Mapping of Course Outcomes to Programme Outcomes

EC22785	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the importance, principles of Machine learning
- Study of supervised learning algorithms.
- Study of unsupervised learning algorithms.
- Study of artificial Neural networks
- Understand the performance of machine learning models.

UNIT I	FUNDAMENTALS OF MACHINE LEARNING	9

Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, K-Fold, Concept of over fitting, under fitting, Bias-Variance trade off - Regression: Linear Regression - Logistic Regression.

UNIT II	SUPERVISED LEARNING	9

Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm- ID3 – CART, Random Forest. - Rule based-Classification - Naïve Bayes classification - Support Vector Machines (SVM)- KNN classifier

UNIT III	UNSUPERVISED LEARNING	9

Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm- Cluster Validity. Ensemble Methods: Boosting, Bagging; Instance Based Learning

UNIT IV	NEURAL NETWORKS	9

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps, Deep Learning– Convolution Neural Networks – Recurrent Neural Networks

UNIT V	DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS	9

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1	Describe the learning methods in machine learning
CO2	Solving problem using Supervised learning
CO3	Solving problem using Unsupervised learning
CO4	Describe the types of neural network architectures and activation functions
CO5	Compare different machine learning models

TEXT BOOKS:

1.	Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Second Edition,CRC Press, 2014
2.	S.N.Sivanandam and S.N.Deepa, "Principles of soft computing" ,Third edition, Wiley India.

REFERENCES:

1.	Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018.
3	C. Muller & Sarah Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.
4.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5,	Richard E. Neapolitan, Xia Jiang, "Artificial Intelligence with an Introduction to Machine Learning", Second edition, Chapman and Hall/CRC; 2018
6.	V N Krishnachandran, "Lecture Notes in Machine Learning" Vidya Centre for Artificial Intelligence Research, 2018.
7.	Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Third Edition, Packt publishing, 2019.

Course Outcomes	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

CO1	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO3	3	2	2	1	-	-	1	-	-	-	-	1	1	1	1
CO4	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO5	3	2	2	1	-	-	2	-	-	-	-	1	1	1	1
CO	3	2	2	1	-	-	1	-	-	-	-	1	1	1	1