DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR-621212

REGULATIONS–2023

CHOICE BASED CREDIT SYSTEM

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM & SYLLABI

DEPARTMENTOF ELECTRONICS AND COMMUNICATION ENGINEERING

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

Discussed in BOS-4 meeting Dated: 19.09.2024 / ECE Ratified & Approved in Academic Council

VISION MISSION OF THE INSTITUTUION

Vision:

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

Mission:

- To develop eminent scholar with a lifelong follow up of global standards by offering UG, PG and Doctoral Programmes.
- To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.
- To promote sustained research and training with emphasis on human values and leadership qualities.
- To contribute solutions for the need based issues of our society by proper ways and means as dutiful citizen.

DEPARTMNET OF ELECTRONICS AND COMMUNICATION ENGINEERING

About the Department

The department of Electronics and Communication Engineering was established in the year 2001 during which the undergraduate programme was introduced. Post graduate programme was established in the year 2007 and it offers communication systems.

Under the UG programme, the total sanctioned student strength is 60 and now it is increased 120 to 180 in the Academic Year (2023-2024). Under the PG programme, the total sanctioned student strength is 18 and now it is increased to 36. The department is re-accredited by NBA , received an AICTE fund of Rs: 12,50,000 in the academic year of 2009-2010 and Rs: 5,00,000 in the academic year of 2011-2012 for MODROBS and received an TNSCST fund of Rs: 15,000 in the year of 2018for National Confernece.

Vision:

To be a centre of repute for higher learning and research to cater the knowledge in Electronics and Communication field to the ever growing needs of industries and to facilitate the transformation of students into good human beings.

Mission:

M1: Develop life-long learning skills that allow them to be adaptive and responsive to changes in society, technology and the environment, as well as career demands.

M2: Promote a research activity through constant interaction with research organizations and industries.

M3: Instigate our students to become responsible citizens and competent professionals with high ethical values.

M4: Enable students to develop skills to solve complex technological problems of time and also provide a framework for promoting collaborative and multidisciplinary activities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	An in-depth knowledge and demonstrations related to the core area of Electronics and Communication Engineering, starting from the basics to the level of analysis, synthesis and design of circuits and systems, in addition to the exposure on latest advancements in the field.
PEO 2	Knowledge of recent design trends and adapt to new technologies through lifelong learning.
PEO 3	Technical knowledge, ethical values for professional development of the student to solve complex problems and to work in multi-disciplinary ambience, whose solutions lead to significant societal benefits.
PEO 4	Motivation to pursue higher studies so that they can contribute to the teaching profession, research and development of Electronics and Communication Engineering

PROGRAMOUTCOMES(POs)

PO	GraduateAttribute
PO1	**Engineering knowledge**:Apply the knowledge ofmathematics, science,engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**:Identify, formulate, review research literature,and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,natural sciences,and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety,and thecultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research – based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and teamwork**:Function effectively as an individual, and as a member or leader indiverse teams, and in multi disciplinary settings.

PO10	**Communication:**Communicate effectively on complex engineering activities with theengineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,and give and receive clear instructions.
PO11	**Projectmanagementandfinance:**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 multi disciplinary environments.
PO12	**Life – longlearning**: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.

PROGRAMSPECIFICOUTCOMES(PSOs)

PSO 1	**Fabrication of Electronic Components -** Graduates of the program will design a hardware model in real time applications using embedded technology and fabricate electronic equipments used in communication industries
PSO 2	**Usage of Tools** - Graduates can exploit tools like Xilinx, Tanner, IE3D, Labview, Matlab, ModelSim, Keil and OrCAD to meet desired specifications with realistic constraints such as manufacturability and sustainability.

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.	3	3	2	2	2	2	-	-	-	-	-	3	3	2	3
II.	3	3	3	2	2	-	-	-	2	1	2	3	3	3	3
III.	3	2	3	3	2	-	-	-	2	2	-	3	3	3	3
IV.	3	3	3	2	2	-	-	2	-	-	-	2	2	2	2

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE
(AUTONOMOUS),
PERAMBALUR – 621 212
B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IP3151	Induction Programme		-	-	-	-	0
2	U23HST11	Communicative English	HSMC	3	0	0	3	3
3	U23MAT12	Matrices and Calculus	BSC	3	1	0	4	4
4	U23PHT13	Physics for Engineers & Technologists	BSC	3	0	0	3	3
5	U23CYT14	Chemistry for Engineering & Technology	BSC	3	0	0	3	3
6	U23GET16	Engineering Graphics	ESC	2	0	4	6	4
7	GE3152	Heritage of Tamils/ தமிழர் மரபு	HSMC	1	0	0	1	1
PRACTICAL								
8	U23GEP14	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	U23BSP11	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10	U23HSP12	English Laboratory	EEC	0	0	2	2	1

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23HST21	Professional English	HSMC	2	0	0	2	2
2	U23MAT22	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	U23PHT24	Physics for Electrical and Electronics Engineers	BSC	3	0	0	3	3
4	U23GET15	Problem Solving and Python Programming	ESC	3	0	0	3	3
5	U23ECT21	Electron Devices	PCC	3	0	0	3	3
6	U23EET22	Circuit Analysis	PCC	3	0	0	3	3
7	GE3252	Tamils and Technology/ தமிழரும் தொழில்நுட்பமும்	HSMC	1	0	0	1	1
PRACTICAL								
8	U23GEP23	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2

9	U23ECP21	Devices and Circuits Analysis Laboratory	PCC	0	0	4	4	2
10	U23HSP22	Communication Laboratory	EEC	0	0	4	4	2

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23MAT34	Random Process and Linear Algebra	BSC	3	1	0	4	4
2	U23CST35	C Programming and Data Structures	ESC	3	0	0	3	3
3	U23ECT31	Digital Systems Design	PCC	3	0	0	3	3
4	U23ECT32	Electronic Circuits	PCC	3	0	0	3	3
5	U23ECT33	Signals and Systems	PCC	3	1	0	4	4
6	U23ECT34	Electromagnetic Fields	PCC	3	0	0	3	3
PRACTICAL								
7	U23ECP31	Electronic Circuits and Digital Laboratory	PCC	0	0	4	4	2
8	U23HSP31	Professional Development and life skills Laboratory	EEC	0	0	2	2	1
9	U23CSP33	C Programming and Data Structures Laboratory	PCC	0	0	4	4	2

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECT41	Communication Systems	PCC	3	0	0	3	3
2	U23ECT42	Linear Integrated Circuits	PCC	3	0	0	3	3
3	U23ECT43	Digital Signal Processing	PCC	3	1	0	4	4
4	U23ECT44	Networks and Security	PCC	3	0	0	3	3
5	U23ECT45	Control Systems	PCC	3	0	0	3	3
6	U23GET41	Environmental Sciences and Engineering	BSC	2	0	0	2	2
PRACTICAL								
7	U23ECP41	Communication Systems Laboratory	PCC	0	0	4	4	2
8	U23ECP42	Linear Integrated Circuits Laboratory	PCC	0	0	4	4	2
9	U23ECP43	Signal Processing and Networks Laboratory	PCC	0	0	4	4	2

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECT51	WirelessCommunication	PCC	3	0	0	3	3
2	U23ECT52	VLSI and ChipDesign	PCC	3	0	0	3	3
3	U23ECT53	Transmission lines and RF Systems	PCC	3	0	0	3	3
4	U23ECT54	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
5		Professional Elective I	PEC	3	0	0	3	3
PRACTICAL								
6	U23ECP51	Microprocessors and Microcontrollers Laboratory	PCC	0	0	4	4	2
7	U23ECP52	VLSI Laboratory	PCC	0	0	4	4	2

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECT61	Embedded Systems and IOT Design	PCC	3	0	0	3	3
2	U23ITT62	Artificial Intelligence and Machine Learning	ESC	3	0	0	3	3
3		Open Elective–I	OEC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
5		Professional ElectiveIII	PEC	3	0	0	3	3
PRACTICAL								
6	U23CSP62	Internet Of Things Laboratory	PCC	0	0	4	4	2

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23GET61	Human values and ethics	HSMC	2	0	0	2	2
2	U23ECT71	Cognitive Radio	PCC	3	0	0	3	3
3		ProfessionalElectiveVI	PEC	3	0	0	3	3
4		Elective–Management	HSMC	3	0	0	3	3
5		OpenElective–II	OEC	3	0	0	3	3
PRACTICAL								
6	U23ECP71	Project Phase I / Summer Internship	EEC	0	0	4	4	2

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1		ProfessionalElectiveV	PEC	3	0	0	3	3
2		ProfessionalElectiveVI	PEC	3	0	0	3	3
PRACTICAL								
3	U23ECP81	ProjectWork (Phase II)/Internship	EEC	0	0	20	20	10

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23GET71	Principles of Management	HSMC	3	0	0	3	3
2	U23GET72	Total Quality Management	HSMC	3	0	0	3	3
3	U23GET73	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4	U23GET74	Human Resource Management	HSMC	3	0	0	3	3
5	U23GET75	Knowledge Management	HSMC	3	0	0	3	3
6	U23GET76	Industrial Management	HSMC	3	0	0	3	3

VERTICALS – I (SEMICONDUCTOR CHIP DESIGN AND TESTING)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV11	Wide Band gap Devices	PEC	3	0	0	3	3
2	U23ECV12	Validation and Testing Technology	PEC	3	0	0	3	3
3	U23ECV13	Low Power IC Design	PEC	3	0	0	3	3
4	U23ECV14	VLSI Testing and Design For Testability	PEC	3	0	0	3	3
5	U23ECV15	Mixed Signal IC Design Testing	PEC	3	0	0	3	3
6	U23ECV16	Analog IC Design	PEC	3	0	0	3	3

VERTICALS – II (SIGNAL PROCESSING)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV21	Advanced Digital Signal Processing	PEC	3	0	0	3	3
2	U23ECV22	Image Processing	PEC	3	0	0	3	3
3	U23ECV23	Speech Processing	PEC	3	0	0	3	3
4	U23ECV24	Software Defined Radio	PEC	3	0	0	3	3
5	U23ECV25	DSP Architecture and Programming	PEC	3	0	0	3	3
6	U23CSV17	Computer Vision	PEC	3	0	0	3	3

VERTICALS – III (RF TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV31	RF Transceivers	PEC	3	0	0	3	3
2	U23ECV32	Signal Integrity	PEC	3	0	0	3	3
3	U23ECV33	Antenna Design	PEC	3	0	0	3	3
4	U23ECV34	MICs and RF System Design	PEC	3	0	0	3	3
5	U23ECV35	RF ID System Design & Testing	PEC	3	0	0	3	3
6	U23ECV36	EMI/EMC Pre Compliance Testing	PEC	3	0	0	3	3

VERTICALS – IV (BIO MEDICAL TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23BMV62	Wearable Devices	PEC	3	0	0	3	3
2	U23BMV73	Human Assist Devices	PEC	3	0	0	3	3
3	U23BMV76	Therapeutic Equipment	PEC	3	0	0	3	3
4	U23ECV44	Medical Imaging Systems	PEC	3	0	0	3	3
5	U23BMV55	Brain Computer Interface and Applications	PEC	3	0	0	3	3
6	U23BMV63	Body Area Networks	PEC	3	0	0	3	3

VERTICALS – V (SENSOR AND UNDERWATER TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV51	Underwater Instrumentation System	PEC	3	0	0	3	3
2	U23ECV52	Underwater Imaging Systems and Image Processing	PEC	3	0	0	3	3
3	U23ECV53	Underwater Communication	PEC	3	0	0	3	3
4	U23ECV54	MEMS Design	PEC	3	0	0	3	3
5	U23ECV55	Wireless Sensor Network	PEC	3	0	0	3	3
6	U23ECV56	Fundamentals of Nanoelectronics	PEC	3	0	0	3	3

VERTICALS – VI (IOT AND CYBER TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV61	IoT Processors	PEC	3	0	0	3	3
2	U23ECV62	IoT Based System Design	PEC	3	0	0	3	3
3	U23ECV63	Industrial IoT and Industry 4.0	PEC	3	0	0	3	3
4	U23ECV64	Cyber Physical Systems	PEC	3	0	0	3	3
5	U23ECV65	Information Security Management	PEC	3	0	0	3	3
6	U23ECV66	Cloud and Distributed Computing	PEC	3	0	0	3	3

VERTICALS – VII (SPACE TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV71	Radar Technologies	PEC	3	0	0	3	3
2	U23ECV72	Avionics Systems	PEC	3	0	0	3	3
3	U23ECV73	Positioning and Navigation Systems	PEC	3	0	0	3	3
4	U23ECV74	Satellite Communication	PEC	3	0	0	3	3
5	U23ECV75	Remote Sensing	PEC	3	0	0	3	3
6	U23ECV76	Rocketry and Space Mechanics	PEC	3	0	0	3	3

VERTICALS – VIII (HIGH SPEED COMMUNICATIONS)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECV81	Optical Communication & Networks	PEC	3	0	0	3	3
2	U23ECV82	Wireless Broad Band Networks	PEC	3	0	0	3	3
3	U23ECV83	4G/5G Communication Networks	PEC	3	0	0	3	3
4	U23CSV35	Software Defined Networks	PEC	3	0	0	3	3
5	U23ECV85	Massive MIMO Networks	PEC	3	0	0	3	3
6	U23ECV86	Advanced Wireless Communication Techniques	PEC	3	0	0	3	3

OPEN ELECTIVES -I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECT33	Signals and Systems	OEC	3	1	0	4	4
2	U23ECO12	Fundamentals of Electronic Devices and Circuits	OEC	3	0	0	3	3
3	U23ECO13	VLSI Design	OEC	3	0	0	3	3
4	U23ECT41	Communication Systems	OEC	3	0	0	3	3
5	U23ECT31	Digital Systems Design	OEC	3	0	0	3	3

OPEN ELECTIVES -II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23ECT51	Wireless Communication	OEC	3	0	0	3	3
2	U23ECO22	Wireless Networks	OEC	3	0	0	3	3
3	U23ECT44	Networks and Security	OEC	3	0	0	3	3
4	U23ECV22	Image Processing	OEC	3	0	0	3	3
5	U23ECT54	Microprocessors and Microcontrollers	OEC	3	0	0	3	3

SUMMARY

SL. NO.	SubjectArea	Credits persemester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences	4	3	-	-	-	-	5	-	**12**	**7.23**
2	Basic Sciences	12	7	4	2	-	-	-	-	**25**	**15.15**
3	Engineering Sciences	6	5	3	-	-	3	-	-	**17**	**10.24**
4	Professional Core	-	8	17	22	16	5	3	-	**71**	**42.77**
5	Professional Elective	-	-	-	-	3	6	3	6	**18**	**10.84**
6	Open Elective	-	-	-	-	-	3	3	-	**6**	**3.61**
7	Employability Enhancement Courses	1	2	1	-	-	-	2	10	**16**	**9.64**
Total		**23**	**25**	**25**	**24**	**19**	**17**	**16**	**16**	**165**	**100%**

Vertical I Semiconductor Chip Design and Testing	**Vertical II Signal Processing**	**Vertical III RF Technologies**	**Vertical IV Bio Medical Technologies**	**Vertical V Sensor and Underwater Technologies**	**Vertical VI IoT and Cyber Technologies**	**Vertical VII Space Technologies**	**Vertical VIII High Speed Communications**
Wide Bandgap Devices	Advanced Digital Signal Processing	RF Transceivers	Wearable Devices	Underwater Instrumentation System	IoT Processors	Radar Technologies	Optical Communication & Networks
Validation and Testing Technology	Image Processing	Signal Integrity	Body Area Networks	Underwater Imaging Systems and Image Processing	IoT Based System Design	Avionics Systems	Wireless Broad Band Networks
Low Power IC Design	Speech Processing	Antenna Design	Therapeutic Equipment	Underwater Communication	Industrial IoT and Industry 4.0	Positioning and Navigation Systems	4G/5G Communication Networks
VLSI Testing and Design For Testability	Software Defined Radio	MICs and RF System Design	Medical Imaging Systems	MEMS Design	Cyber Physical Systems	Satellite Communication	Software Defined Networks
Mixed Signal IC Design Testing	DSP Architecture and Programming	RF ID System Design & Testing	Brain Computer Interface and Applications	Wireless Sensor Network	Information Security Management	Remote Sensing	Massive MIMO Networks
Analog IC Design	Computer Vision	EMI/EMC Pre Compliance Testing	Human Assist Devices	Fundamentals of Nanoelectronics	Cloud and Distributed Computing	Rocketry and Space Mechanics	Advanced Wireless Communication Techniques

IP3151	INDUCTION PROGRAMME	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

To train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character".

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering /Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

U23HST11	COMMUNICATIVE ENGLISH (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L 3	T 0	P 0	C 3

COURSE OBJECTIVES

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

1. To enhance students listening ability for academic and Professional purposes.
2. To learn to use basic grammatical structures in suitable contexts
3. To help students acquire the ability to speak effectively in English in real -life situations.
4. To help learners use language effectively in professional contexts.
5. To develop student's ability to read and write complex texts, summaries, articles, definitions, Paragraph user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

Define communication. Kinds of communication. Quintessential of communication in technical progression. Key characteristics of an effective communicator- listening, attitude modification, way of response with appropriate language, tone modulation.

Listening- Listening to TV news, Guest lectures. Speaking- Answering the Questions.

Reading - Reading brochures and technical magazines (technical context), telephone messages / social media messages relevant to technical contexts and emails, **Writing**-Reading comprehension, Parts of Speech.

UNIT II READING QUEST 9

Listening- listening and responding to video lectures/talks. Speaking- Day today conversations. Reading –Edison of India-GD Naidu "The Great Inventor". Writing- Emails / Informal Letters - Inviting, Congratulating & Thanking, Punctuations.

UNIT III LANGUAGE RESOURCE GROWS CRITICAL JUDGEMENT 9

Listening- listening to specific task-focused audio tracks. Speaking- summary of Robert Frost "Stopping by woods on a snowy evening". Reading – Reading advertisements, gadget reviews; user manuals. Writing – Essay Writing: Analytical essay: Narrative Essay, Developing Hints, Usage of tenses in sentence formation. Voices.

UNIT IV LANGUAGE IN LIFE SKILL 9

Listening- Listening to speech of Great Scholars. Speaking- mechanics of presentation. **Reading** – Newspaper articles, power point presentation. **Writing** – Checklist, Jumbled sentences-Rearrange the sentences in correct order, WH-Questions-Form questions by using statements, Prefixes and Suffixes.

UNIT V IMPROVING SPEAKING &READING 9

Listening- listening to situational based dialogues; **Speaking**- Stating intention to do something-Expressing opinion-asking people to repeat themselves. **Reading** – Summary of O.Henry's "The last Leaf". Writing – Dialogue Writing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Remember appropriate words in a situational conversation.

CO2: Gain understanding of basic grammatical structures and use them in right context.

CO3: Read and infer the denotative and connotative meanings of technical texts.

CO4: Write Dialogue, Letter and paragraphs on various topics.

CO5: Make the students prepare effective notes for main sources available.

CO6: Enhance them to give operational talk.

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blacks wan Private Ltd. Department of English, Anna University, (2020 edition).
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. The Gift of the Magi by O.Henry, McClure, Philips and company.

REFERENCE BOOKS:

1. Technical Communication – Principles And Practices By Meenakshi Raman &Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education.
4. Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House.
5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

U23MAT12	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To familiarize the student with functions of several variables
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems

UNIT I MATRICES 12

Introduction – Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton theorem – Diagonalization of the matrices by Orthogonal Transformations – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of a function – Continuity – Derivatives – Differentiation rules – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variable.

UNIT III MULTIVARIABLE CALCULUS 12

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

UNIT IV MULTIPLE INTEGRAL AND THEIR APPLICATIONS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients– Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients – Method of undetermined coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Use the matrix algebra methods for solving practical problems.

CO2 : Use both the limit definition and rules of differentiation to differentiate functions.

CO3: Apply differential calculus tools in solving various application problems.

CO4: Able to use differential calculus ideas on several variable functions.

CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

CO6: Solve the ordinary differential equations using different techniques for that model engineering problems.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44thEdition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCE BOOKS:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, NewDelhi, 5th Edition,2016.
3. Narayanan. S. and Manicavachagom Pillai. T. K.,"Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt.Ltd, New Delhi, 2016
5. Thomas. G. B., Hass. J, and Weir. M.D,"Thomas Calculus", 14thEdition, Pearson India, 2018.

U23PHT13	PHYSICS FOR ENGINEERS AND TECHNOLOGISTS (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to gain the knowledge in elastics and plastic nature of the materials in the presence and absence of load.
2. To understand the students to know the application of the sound waves in different fields.
3. To motivate the students towards the applications of photo electric phenomena.
4. To know the physical principle of LASER, the working of LASER applications.
5. To understand the propagation of light in optical fibers and its applications.

UNIT I ELASTICITY 9

Introduction- Elasticity - plasticity– Hooke's law - relationship between three Modulii of elasticity (Qualitative) – stress & strain diagram and its uses -Poisson's ratio - factors affecting elasticity - twisting ouple of wire - Torsion Pendulum: theory and experiment.

Beam: Internal bending moment – Cantilever: theory and experiment – Young's Modulus: uniform and non – uniform bending (Qualitative) – I-shaped girders- advantages and applications.

UNIT II ULTRASONICS 9

Introduction – classification of sound- properties of infrasonic, audible and ultrasonics - production: Magnetostriction and Piezoelectric methods – determination of velocity of sound in liquid (Acoustic Grating Method) – general applications – industrial application: Non - Destructive Testing: pulse echo system through transmission and reflection modes. Ultrasonic scanning methods – medical application: sonogram.

UNIT III MODERN PHYSICS 9

Introduction –Black Body Radiation – Classical and Quantum Laws of Black Body Radiation - Photon and its Properties - Wave Particle Duality and Matter waves – De - Broglie Wavelength - Schrodinger's Time Independent and Time Dependent Wave Equations - Physical Significance of The Wave Function. Application: Particle in One Dimensional Box - Normalization Process – Photo Electric Effect – Laws Governing the Photoelectric Effect – Einstein's Formula - Derivation – Applications: Solar Cell – Solar Water Heater – Photo resistor (LDR).

UNIT IV LASERS 9

Lasers: Introduction - Properties of Laser-Spontaneous and Stimulated Emission Process - Einstein's Theory of Matter Radiation Interaction & A and B Coefficients; Amplification of Light By Population Inversion – Pumping Methods - Types of Lasers: Solid-State Laser (Homo And Hetero Junction Semiconductor Lasers), Gas Laser (CO_2), Applications: Laser Cutting and Welding, LIDAR and Barcode Scanner.

UNIT V FIBER OPTICS AND APPLICATIONS 9

Optical Fiber: Structure - advantages- Principle [TIR]–Propagation Phenomena in optical fiber - Expression For Acceptance Angle and Numerical Aperture – Relation between Refractive Index of Core, Numerical Aperture and Fractional Index Change – Fabrication: Double Crucible Method -

Types: Material, Mode, Refractive Index - Applications: Optical Fiber Communication System – fiber optic sensors (Displacement and pressure sensors) – Medical Endoscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Differentiate the elastic and plastic nature of the materials.

CO2 : Know the experimental techniques in both production and applications of ultrasonic waves.

CO3: Gain knowledge in the basics of quantum mechanics concepts.

CO4: Develop new devices based on LASER source.

CO5: Understand the advantages of optical fiber than metal wire.

CO6: Demonstrate the some useful experiments based on optical fibre

TEXT BOOKS:

1. Dr. P.Mani, "Engineering Physics", Dhanam Publications, 2013.
2. Dr. G. Senthilkumar, "Engineering Physics", VRB Publishers, 2017.
3. K. Thyagarajan, Ajoy Ghatak, "Lasers Fundamentals and Applications" II nd Edition, Springer, 2010.
4. D.K. Bhattacharya, Poonam Tandon," Engineering Physics", Oxford HED Publishers, 2017.

REFERENCE BOOKS:

1. Marikani, "Engineering Physics", PHI, New Delhi, 2013.
2. Bhattacharya & Bhaskaran, "Engineering Physics", Oxford Publications, 2012.
3. R Murugeshan, Kiruthiga, Sivaprasath S, "Modern Physics", Chand Publishing, 2021.
4. S. Rajivgandhi & A. Ravikumar, " Engineering Physics I", RK Publications, 2023
5. Sathyaprakash, "Quantum Mechanics", Pragati Prakashan, Meerut, 2016.

U23CYT14	CHEMISTRY FOR ENGINEERING & TECHNOLOGY (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To inculcate sound understanding of water quality parameters and water treatment techniques.
2. Impart knowledge on the basic principles and preparatory methods of nanomaterial.
3. To introduce the basic concepts and applications of phase rule and composites.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER TREATMENT 9

Water: Sources, impurities, Parameters. Types of water Hardness of water -types – expression of hardness – units – Estimation of hardness of water by EDTA. Desalination - Reverse Osmosis. Boiler troubles: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II ELECTRO AND NANO CHEMISTRY 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf by Poggendorff's compensation principle. Single electrode potential – Nernst equation – reference electrodes -types–Calomel electrode - electrolysis of water.

Nanomaterials: Basics of Nano Chemistry: Distinction between molecules, nanomaterials and bulk materials. Preparation of nanomaterials- laser ablation method and Chemical Vapour Deposition(CVD). Application of Nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule terms with examples, water system; Reduced phase rule Two component system: lead-silver system – Composites, Need, Constitution: Matrix materials, Applications and Reinforcement and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS & COMBUSTION 9

Fuels –Classification-Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy;

Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles-working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CO2: Apply the basic knowledge of Corrosion and various electrodes.

CO3: Know the economically and new methods of synthesis nanomaterials.

CO4: Apply the knowledge of phase rule and composites for material selection requirements.

CO5: Understand the concepts of suitable fuels for engineering processes and applications.

CO6: Have the knowledge of different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
4. J.Manivel , "Engineering Chemistry" R.K.Publishers, 1st Edition 2022.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.

U23GET16	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

COURSE OBJECTIVES

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

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.
3. Develop proficiency in 2D drafting using drawing tools.
4. Learn sectional views and assembly drawing techniques.
5. Enhance visualization skills for improved problem-solving and communication in engineering.

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 6+12

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimension. Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

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

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

UNIT III PROJECTION OF SOLIDS 6+12

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC PROJECTION 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions-Perspective Projection.

TOTAL: 30+60=90 PERIODS

COURSE OUTCOMES:

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

CO1 : Identify the significance of graphics in engineering applications.

CO2 : Project straight lines inclined to both principal planes and determine true lengths and inclinations.

CO3: Apply orthographic projection techniques to project solids.

CO4: Apply the principles of development to prisms, pyramids, cylinders, and cones.

CO5: Combine two solid objects in simple vertical positions using isometric projection.

CO6: Utilize the isometric scale effectively.

TEXT BOOKS:

1. Natrajan K.V., A text book of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, 2008

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., Engineering Drawing, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., Engineering Drawing (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
6. N S Parthasarathy and Vela Murali, Engineering Graphics, Oxford University, Press, New Delhi, 2015.

GE3152	HERITAGE OF TAMILS/ தமிழர் மரபு (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNITV 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

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு– மக்களும் பண்பாடும்– கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ்– முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி– வைகை நதிக் கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறைவெளியீடு)
4. பொருநை–ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:

International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3152 **தமிழர்மரபு**

L	T	P	C
1	0	0	1

அலகு I மொழி மற்றும் இலக்கியம்: 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

U23GEL14	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common house hold 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;
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.
5. Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.

GROUP – A (CIVIL AND MECHANICAL)

PART I

CIVIL ENGINEERING PRACTICES PLUMBING WORK: 30

a. Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b. Preparing plumbing line sketches.
c. Laying pipe connection to the suction side of a pump
d. Laying pipe connection to the delivery side of a pump.
e. Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WELDING WORK:

a. Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b. Practicing gas welding.

BASIC MACHINING WORK:

a. Turning
b. Drilling
c. Tapping

ASSEMBLY WORK:

a. Assembling a centrifugal pump.
b. Assembling a household mixer.

SHEET METAL WORK:

a. Making of a square tray

WOOD WORK:

a. Sawing,

b. Planing and Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

PART II ELECTRICAL & ELECTRONICS 30

ELECTRICAL

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

ELECTRONICS

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL = 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15Sets.
2. Carpentry vice (fitted to work bench) 15Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5each
5. Power Tools: (a) Rotary Hammer 2 Nos (b) Demolition Hammer 2 Nos (c) Circular Saw 2 Nos (d) Planer 2 Nos (e) Hand Drilling Machine 2 Nos (f) Jigsaw 2Nos.

MECHANICAL

Arc welding transformer with cables and holders 5 Nos.

1. Welding booth with exhaust facility 5Nos.
2. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5Sets.
3. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2Nos.

4. Centre lathe 2Nos.
5. Hearth furnace, anvil and smithy tools 2Sets.
6. Moulding table, foundry tools 2Sets.
7. Power Tool: Angle Grinder 2Nos
8. Study-purpose items: centrifugal pump, air-conditioner One each.

ELECTRICAL

1. Assorted electrical components for house wiring 15Sets
2. Electrical measuring instruments 10Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1No.
5. Power Tools:
   a) Range Finder 2Nos
   b) Digital Live-wire detector 2Nos

ELECTRONICS

1. Soldering guns 10Nos.
2. Assorted electronic components for making circuits 50Nos.
3. Small PCBs 10Nos.
4. Multimeters 10Nos.

Study purpose items: Telephone, FM radio, low-voltage power supply.

COURSE OUTCOMES:

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

CO1 :	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2 :	Wire various electrical joints in common household electrical wire work.
CO3:	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common House hold equipments; Make a tray out of metal sheet using sheet metal work.
CO4:	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
CO5:	Apply fundamental engineering principles to analyze and solve real-world problems.
CO6:	Demonstrate proficiency in using engineering tools and equipment.

U23BSP11	PHYSICS AND CHEMISTRY LABORATORY (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.
6. To inculcate experimental skills to test basic understanding of water quality parameters,as, acidity, alkalinity, chloride.
7. To Induce the students to analyze the hardness of water
8. To induce the students to familiarize with electroanalytical techniques such as, pH metry, conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular disc.
2. Non - Uniform bending–Determination of Young's modulus.
3. Laser – (i) Determination of the wavelength of the laser using grating.
   (ii) Determination of size of the particles using laser source.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor using PN junction kit.
6. To study the V-I Characteristics of Light Dependent Resistor (LDR).
7. Determination of types and amount of alkalinity in water sample.
8. Determination of total, temporary & perma nent hardness of water by EDTA method.
9. Determination of chloride content of water sample by Argentometric method.
10. Determination of strength of given hydrochloric acid using pH meter.
11. Determination of strength of acids in a mixture of acids using conductivity meter.
12. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Torsion pendulum set up (Metal Disc, Symmetrical Mass(2x100g), Stop Clock, Screw Gauge)	5
2.	Non – Uniform bending set up (Travelling Microscope, Knife Edges, Weight Hanger with Mass(5x50g), Screw Gauge, Vernier Caliper, Meter Scale)	5
3.	Laser set up (Semiconductor Laser, Screen, Grating Stand, Wooden Stand With Meter Scale)	5
4.	Air wedge (Air Wedge Set Up, Travelling Microscope, Sodium Vapour Lamp, Transformer)	5
5.	Band gap of a semiconductor (PN Junction Kit, Thermometer, Heater, Beaker, Oil)	5
6.	Light Dependent Resistor (Power Supply, Voltmeter, Ammeter, LDR, Bulb, Resistors)	5
7.	PH meter	5
8.	Conductivity meter	10
9.	Common Apparatus(Pipette, Burette, Conical Flask, Porcelain tile, Dropper)	15

COURSE OUTCOMES:

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

CO1 : Understand the functioning of various physics laboratory equipment.

CO2 : Observe and tabulate experimental data.

CO3: Solve problems individually and collaboratively.

CO4: Analyse the quality of water samples with respect to their acidity, alkalinity

CO5: Determine the amount of hardness in the water

CO6: Analyse quantitatively the impurities in solution by electro analytical techniques

U23HSP12	ENGLISH LABORATORY (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

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

1. To improve the communicative competence of learners.
2. To help learners use language effectively in academic /work contexts.
3. To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4. To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that is relevant to authentic contexts.
5. To use language efficiently in expressing their opinions via various media.

LIST OF EXPERIMENTS

1. Listening for general information-specific details.
2. Conversation: Introduction to classmates.
3. Speaking - making telephone calls-Self Introduction.
4. Talking about current and temporary situations & permanent and regular situations.
5. Listening to podcasts, anecdotes / stories / event narration.
6. Event narration; documentaries and interviews with celebrities.
7. Events-Talking about current and temporary situations & permanent and regular situations.
8. Engaging in small talk.
9. Describing requirements and abilities- Picture description.
10. Discussing and making plans.
11. Talking about tasks- progress- positions -directions of movement.
12. Talking about travel preparations and transportation.
13. Listening to debates/ discussions.
14. Making prediction talking about a given topic.
15. Describing processes.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1

8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

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

CO1: Understand the functioning of various physics laboratory equipment.

CO2 : Observe and tabulate experimental data.

CO3: Solve problems individually and collaboratively.

CO4: Analyse the quality of water samples with respect to their acidity, alkalinity

CO5: Determine the amount of hardness in the water

CO6: Analyse quantitatively the impurities in solution by electro analytical techniques

SEMESTER - II

U23HST21	PROFESSIONAL ENGLISH (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L 2	T 0	P 0	C 2

COURSE OBJECTIVES

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

1. To engage learners in meaningful language activities to improve their reading and writing skills.
2. To learn various reading strategies and apply in comprehending documents in professional context.
3. To help learners understand the purpose, audience, contexts of different types of writing.
4. To enable students write letters and reports effectively in formal and business situations.
5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I PREPARATORY DOCUMENTATIONS 6

Listening- Listening to formal conversations and Participating. **Speaking**- speaking about one's family. Reading – Summary of W.W Jacobs "The monkey's paw". **Writing** – Subject verb Agreement, Numerical -Adjectives, Kinds of sentences, Writing reviews (book / film),writing Instructions, Writing Recommendation.

UNIT II LECTURA ENRICHMENT AND PASSAGE COMPOSE 6

Listening- listening to lectures on academic topics; **Speaking**- Asking for and giving directions. **Reading** - Reading longer technical texts; **Writing** - Compound words, Homophones and Homonyms, Cause and Effect expressions. Essay Writing, Writing Letter to the Editor (complaint, acceptance, Requesting, Thanking).

UNIT III ANALYTICAL SKILL 6

Listening- Watching videos/documentaries and responding to questions based on them. **Speaking** – Speaking about ones favourite place. **Reading** – Summary of the poem – John keats "Ode to a Nightingale". **Writing**- Purpose statement, Extended Definitions. Writing Job/ Internship application – Cover letter & Resume.

UNIT IV REPORT WRITING 6

Listening- Listening to class room lectures/talks on engineering/technology. **Speaking**– Introduction to technical presentations. **Reading** – Newspaper articles; **Writing** – Comparative Adjectives Direct and Indirect speech. Report Writing- Fire Accident Report, Road Accident, Feasibility Report).

UNIT V ENABLING LINGUA IDEALITY & INFORMATION 6

Listening- TED/Ink talks. **Speaking** – Making presentation on a given topic. **Reading** –Company profiles, Statement of Purpose, (SOP), **Writing** – Relative Clauses, If conditions, Cause and Effect. Chart Interpretations - Bar Chart, Pie Chart, Flow Chart & Tables.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Compare and contrast products and ideas in technical texts.

CO2 : Identify cause and effects in events, industrial processes through technical texts.

CO3: Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.

CO4: Motivate students to write reports and winning job applications.

CO5: Recall and comprehend different discourses and genres of texts.

CO6: Making the students to become virtuous presenters.

TEXT BOOKS:

1. English for Engineers & Technologists (2020 edition) Orient Blacks wan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

U23MAT22	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. This course aims at providing the necessary basic concepts of a few statistical tools and give procedures for solving different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of classifications of design of experiments in the field of agriculture.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. 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
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

Introduction – Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 12

Introduction – Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen Value of a matrices by power method and jacobi's method for Symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order differential equations – Multi step methods : Milne's and Adams Bashforth predictor corrector methods for solving first order differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2: Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3: Solve the algebraic and transcendental equations.

CO4: Understand the knowledge of numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO5: Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

CO6: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCE BOOKS:

1. Burden,R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi,12th Edition, 2020.
5. Spiegel.M.R.,Schiller.J and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.

		L	T	P	C
U23PHT24	PHYSICS FOR ELECTRICAL AND ELECTRONICS ENGINEERS (COMMON TO EEE AND ECE PROGRAMMES)	3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to understand the basics of crystallography and its importance in studying materials properties.
2. To expand their knowledge in applications of magnetic and superconducting materials in small scale industries.
3. To make the students to understand the basics of dielectric materials and insulation.
4. To inculcate an idea of significance of new materials, nanostructures ensuing nano device applications.
5. To know the basic building of electronic circuits using gates.

UNIT I CONDENSED MATTER PHYSICS 9

Introduction - Lattice - Unit Cell - Seven Crystal Systems -Bravai's Lattices - Lattice Planes - Calculation of Number of Atoms per Unit Cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP Structures. Miller Indices – Derivation for Inter-Planar Spacing in terms of Miller Indices-Crystal Growth Techniques: Melt Growth Technique (Bridgman and Czochralski Techniques).

UNIT II MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Magnetic Materials: Dia, Para and Ferromagnetic Materials and Its Properties – Ferromagnetic Domains – Wiess Theory of Ferromagnetism – Hysteresis - B-H Curve Studies – Soft and Hard Magnetic Materials- Applications.

Superconducting Materials: Properties – Messiner effect-Type I and Type II Superconductors – London equations – High temperature super conductor – Applications: SQUIDS- Magnetic Levitated Train.

UNIT III DIELECTRIC AND FERRO ELECTRIC MATERIALS 9

Introduction – Basic Definitions - Types of Polarization Mechanisms - Langevin- Debye Equation - Internal Field – Clausius - Mossotti Relation - Dielectric Loss – Dielectric Breakdown– Applications of Dielectric Materials. Ferro Electric Materials: Properties – Ferromagnetic Hysteresis – Properties-Applications.

UNIT IV MODERN ENGINEERING MATERIALS 9

Shape Memory Alloys – Structures – Types – Properties – Applications. Metallic Glasses – Types – Preparation, properties and Applications. Ceramics – Types - Properties and Applications.

UNIT V NANOMATERIALS 9

Nanomaterials – quantum confined nano structures and its derivations – Properties and Applications – Preparation Techniques: Electrodeposition – Pulsed Laser Deposition. Carbon nano tubes – Structure – Types – Properties – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know basics of crystallography and its importance for varied materials properties.

CO2: Gain knowledge on the magnetic and super conductor properties of materials and their applications.

CO3: Use the dielectric and insulating materials in electronic devices.

CO4: Illustrate the SMA and metallic glasses.

CO5: Get knowledge on newly developed materials in micro and nano scale.

CO6: Summarize the different structures of CNT in Nano range

TEXT BOOKS:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2. G.W.Hanson.FundamentalsofNanoelectronics.PearsonEducation(IndianEdition) 2009.
3. Dr. P. Mani, "Physics for Electronics Engineering" Dhanam Publications, 2017.
4. Dr. G. Senthilkumar, "Engineering Physics II" VRB Publishers, 2013.
5. Theraja .B.L., Basic electronics solid state, S.Chand and Company Ltd (2002).

REFERENCE BOOKS:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006.
3. Dr. G. Senthilkumar, A. Ravikumar & S. Rajivgandhi, " Engineering Physics II", VRB Publishers, 2023
4. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
5. Sedha R.S., A text book of applied Electronies, S.Chand & company Ltd (2002).
6. S. O. Pillai, "Solid State Physics", New Age International, New Delhi, 1995

U23GET15	PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics of algorithmic problem solving.
2. To learn to solve problems using Python conditionals and loops.
3. To define Python functions and use function calls to solve problems.
4. To use Python data structures - lists, tuples, dictionaries to represent complex data.
5. To do input/output with files in Python.

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES 9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and loops for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.

CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 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", 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.
6. https://www.python.org/

U23ECT21	ELECTRON DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To observe the concepts of semiconductor diodes through its operation, characteristics and various parameters.
2. To gain insight into the operation, characteristics and functional aspects of BJT in different configurations.
3. To understand in depth about the construction, operation, characteristics and various parameters of JFET and MOSFET.
4. To study the construction, operation and characteristics several special semiconductor devices.
5. To acquaint the various rectifier circuits with filters and IC regulator circuits.

UNIT I SEMICONDUCTOR DIODE 9

Diode: PN Junction Diode, Resistance Levels, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Zener Diodes, Diode Approximations, Clippers, Clampers, Voltage-Multiplier Circuits.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

BJT : Construction and operation of NPN and PNP transistors, Early Effect, Current equations, Input and Output characteristics of CE, CB, CC - Transistor Bias stability Concepts - Fixed bias - Collector to Base bias of BJT - Voltage Divider bias of BJT.

UNIT III FIELD EFFECT TRANSISTORS 9

FET: JFETs, Drain and Transfer characteristics, Current equations - Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET - Source or self bias of FET amplifier- Voltage Divider bias of FET.

UNIT IV SPECIAL SEMICONDUCTOR DIODES 9

Metal-Semiconductor Junction- MESFET, Photo diode, Tunnel diode, LASER diode, UJT, SCR, DIAC, TRIAC, HEMT, TFET.

UNIT V APPLICATIONS OF SEMICONDUCTOR DEVICES 9

Rectifiers and Filters: Half wave, Full wave and bridge rectifier, Ripple factor calculation for C, L, LC and CLC filter. **Regulators:** Voltage regulators, Shunt voltage regulator, Series voltage regulator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts of semiconductor theory concepts.

CO2: Summarize the working principle and characteristics of BJTs.

CO3: Interpret the working principle and characteristics of FETs.
CO4: Explain the characteristic of Special Semiconductor devices.
CO5: Discuss the operations of Rectifiers and Regulators.
CO6: Explain the various applications of Diode.

TEXT BOOKS:

1. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Pearson, 11th edition, 2015
2. David A. Bell," Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
3. Sedra.A and Smith, "Microelectronic Circuits", Oxford University Press, 5th Edition, 2005.

REFERENCE BOOKS:

1. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and Circuits", Third Edition, TataMcGraw- Hill, 2012.
2. Donald A Neaman, "Semiconductor Physics and Devices", 4th edition, McGraw Hill Education India Private Ltd., 2011.
3. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
4. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition.
5. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.

U23EET22	CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce Electric circuits and its analysis
2. To impart knowledge on solving circuit equations using network theorems
3. To introduce the phenomenon of resonance in coupled circuits.
4. To educate on obtaining the transient response of circuits.
5. To analyze the three phase circuits and basic concepts two port networks.

UNIT I BASIC CIRCUITS ANALYSIS 9

Ohm‟s Law - Kirchoff‟s laws - - Mesh current and node voltage method of analysis for DC and AC circuits - Network reduction: voltage and current division, source transformation - star delta conversion.

UNIT II NETWORK THEOREMS 9

Network Theorems - Thevenin‟s and Norton Theorems - Superposition Theorem - Maximum power transfer Theorem - Reciprocity Theorem- Millman‟s Theorem - Power Division Theorem - Applications of network theorems.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance - their frequency response - Quality factor and Bandwidth - Self and mutual inductance–Coefficient of coupling - Tuned circuits - Single tuned and double tuned circuits.

UNIT IV TRANSIENT RESPONSE OF DC AND AC CIRCUITS 9

Natural response - Forced response - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input - Time constant.

UNIT V THREE PHASE CIRCUITS AND TWO PORT NETWORKS 9

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – power and power factor measurement in three phase circuits - Two port networks - π and T networks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the basic electrical circuits
CO2: Understand and apply various circuit theorems
CO3: Analyze various Resonance circuits
CO4: Analyze transient response and know the concepts of coupled circuits
CO5: Verify various two port networks
CO6: Solve the different three phase circuits.

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Chakrabarti A, "Circuit Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 1999.

REFERENCE BOOKS:

1. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum"s series, McGrawHill, New Delhi, 2010.
3. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015.

GE3252	TAMILS AND TECHNOLOGY/ தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archaeological 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

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு– மக்களும் பண்பாடும்– கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ்– முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை–ஆற்றங்கரை நாகரிகம்(தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:

International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

GE3252 **தமிழரும் தொழில்நுட்பமும்**

L	T	P	C
1	0	0	1

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III <u>உற்பத்தித் தொழில் நுட்பம்</u>: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV <u>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</u>: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V <u>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</u>: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL: 15 PERIODS

TEXT-CUM-REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே கே பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

		L	T	P	C
U23GEP23	**PROBLEM SOLVING AND PYTHON PROGRAMMINGLABORATORY (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)**	0	0	4	2

COURSE OBJECTIVES

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

1. To understand the problem solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.

LIST OF EXPERIMENTS (SIGNAL PROCESSING USING MATLAB)

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop PC's with required software	15 Nos.
2.	Any public domain or commercial software	-

COURSE OUTCOMES:

At the end of the course the students would 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 and loops for solving problems.
- **CO4:** Deploy functions to decompose a Python program.
- **CO5:** Process compound data using Python data structures.
- **CO6:** Utilize Python packages in developing software applications.

U23ECP21	DEVICES AND CIRCUIT ANALYSIS 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. To emphasizes the practical, hands-on component of this course.
2. It complements the theoretical material presented in lecture, and as such, is integral and in dispensible to the mastery of the subject.
3. Several items of importance here including proper safety procedures, required tools, and laboratory reports.
4. To gain hand on experience in Thevinin& Norton theorem, KVL & KCL, and Super Position Theorems.
5. Exercise with a section on component identification.

LIST OF EXPERIMENTS (HARDWARE)

1. V-I characteristics of PN junction diode.
2. Diode characteristics and regulator using ZENER diode.
3. V-I characteristics of CE and CC Configurations.
4. V-I characteristics of LED & UJT.
5. Drain and transfer characteristics of FET.
6. Verifications of KVL & KCL
7. Verifications of Thevenin & Norton theorem
8. Verifications of Super Position & Maximum Power Transfer.
9. Observe the waveform for Half-wave and full wave rectifier with and without filter.

LIST OF EXPERIMENTS (Software using Any Public Domain or Commercial Software)

10. Frequency response of CE, CB and CC configurations.
11. Frequency response of CS and CD amplifiers.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	BC 107, 2N2646, LED, BT136, BFW10	25 each
2.	1N4007, Zener diodes	25 each
3.	Resistors, Capacitors, Inductors	sufficient quantities
4.	Bread Boards	15 Nos
5.	CRO (30MHz)	10 Nos.
6.	Function Generators (3MHz)	10 Nos.
7.	Dual Regulated Power Supplies (0-30V)	15 Nos
8.	Voltmeter (0-1), (0-15)	25 each
9.	Ammeter (0-50mA) (0-100mA) (0-500µA)	25 each
10.	Standalone desktop PCs with related software	15 Nos
11.	Multimeter	15 Nos
12.	Step down Transformer (0-12)V	06 Nos

COURSE OUTCOMES:

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

- **CO1:** Analyze the characteristics of diodes.
- **CO2:** Interpret the characteristics of semiconductor devices.
- **CO3:** Apply the basic knowledge on power devices.
- **CO4:** Select a right semiconductor device for a given application.
- **CO5:** Verify and analyze the various electrical theorems.
- **CO6:** Identify and apply the above hardware experiments in modern tools.

U23HSP22	COMMUNICATION LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2. To be able to communicate effectively through writing.
3. Encouraging plan designing and decision making.
4. Understanding and writing technical instruction.
5. To understand the value of letter writing with correct format.

LIST OF EXPERIMENTS (HARDWARE)

1. Speaking-Role Play Exercises Based on Workplace Contexts.
2. Talking about competition.
3. Discussing progress toward goals-talking about experiences.
4. Discussing likes and dislikes.
5. Discussing feelings about experiences.
6. Discussing imaginary scenarios.
7. Writing short essays.
8. Speaking about the natural environment.
9. Describing communication system.
10. Describing position and movement- explaining rules.
11. Understanding technical instructions-Writing: writing instructions.
12. Speaking: describing things relatively-describing clothing.
13. Discussing safety issues (making recommendations) talking about electrical devices.
14. Describing controlling actions.
15. Writing a job application (Cover letter + Resume).

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1
8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

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

CO1: Distinguish their technical competency through language skill.

CO2: Predict context effectively in-group discussions held in a formal / semi-formal discussions.

CO3: Understanding candidates' key characteristics.

CO4: Finding personality traits by sharing and comparing thoughts and ability.

CO5: Understanding the value of ethics.(rules and regulations).

CO6: Construct emails and effective job applications.

SEMESTER – III

U23MAT34	RANDOM PROCESSES A ND LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. To understand the basic concepts of probability, one and two Dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
2. To introduce the basic concepts of two dimensional random variables
3. To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
4. To introduce the basic notions of vector spaces which will then be used to solve related problems
5. To introduce the basic concept of linear transformation, inner product space and orthogonalization.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) -Limiting distributions.

UNIT IV VECTOR SPACES 12

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT V LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 12

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of linear transformations - Inner product - Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations – Least square approximation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.

CO2: Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.

CO3: Apply the concept of random processes in engineering disciplines.

CO4: Understand the concept of Vector spaces, subspaces, bases and dimensions.

CO5: Understand the relationship between a linear transformation and its matrix representation.

CO6: Understand Least square approximation method allow the analyst to determine the way of fitting a curve of a chart of data points.

TEXT BOOKS:

1. Gross,D., Shortle, J.F, Thompson ,J.M an d Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCE BOOKS:

1. Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Yates, R.D. and Goodman. D.J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
3. Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi,First Reprint, 2009.
4. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice Hall of India, New Delhi, Reprint, 2010.
5. Strang. G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.

U23CST35	C PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I C PROGRAMMING FUNDAMENTALS 9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – 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

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Develop C programs for any real world/technical application.

CO2 : Apply advanced features of C in solving problems.

CO3: Write functions to implement linear and non–linear data structure operations.

CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.

CO5: Appropriately use sort and search algorithms for a given application.

CO6: Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 1997.
2. ReemaThareja, “Program ming in C”, Second Edition, Oxford University Press, 2016.

REFERENCE BOOKS:

1. Brian W. Kernighan, Rob Pike, “The Practice of Programming”, Pearson Education, 1999.
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 and Algorithms”, Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, “Fundamentals of Data Structures”, Galgotia, 2008.

U23ECT31	DIGITAL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To present the fundamentals of digital circuits and simplification methods.
2. To practice the design of various combinational digital circuits using logic gates.
3. To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits.
4. To learn integrated circuit families.
5. To introduce semiconductor memories and related technology.

UNIT I NUMBER SYSTEMS AND CODE CONVERSIONS 9

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, Implementation of Boolean expressions using universal gates, Tabulation methods.

UNIT II COMBINATIONAL LOGIC CIRCUIT AND DESIGN 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, **Case study:** Parity Generator/Checker, Seven Segment display decoder

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 9

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

UNIT V MEMORY AND PROGRAMMABLE LOGIC 9

RAM and ROM – Memory Decoding – Error Detection and Correction – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Application Specific Integrated Circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Use Boolean algebra and simplification procedures relevant to digital logic.
- **CO2:** Design various combinational digital circuits using logic gates.
- **CO3:** Analyse and design synchronous sequential circuits.
- **CO4:** Analyse and design asynchronous sequential circuits.
- **CO5:** Build logic gates and use programmable devices.
- **CO6:** Understand the concepts of memory devices

TEXT BOOKS:

1. M.Morris Mano, Michael D Ciletti, "Digital Design" 4th edition Pearson, 2011.
2. Thomas L.Floyd, "Digital Fundamentals", Prentice Hall, 11th Edition, 2015.
3. Floyd and Jain, "Digital Fundamentals", Pearsons Publication, 10th Edition, 2015.

REFERENCE BOOKS:

1. Anand Kumar, "Fundamentals of Digital Circuits", 4th Edition PHI Learning Private Limited, 2016.
2. Donald P Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications", 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2008.
3. Tocci R J, "Digital systems: Principles and Applications", PHI learning, New Delhi, 10th Edition, 2006.
4. Charles H. Roth, Larry L. Kinney "Fundamentals of Logic Design", Cengage Learning, 2015.
5. R.P.Jain, "Modern Digital Electronics", 4thEdition, Tata McGraw-Hill Education, 2009.

U23ECT32	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study the working methods of biasing in transistors.
2. To understand mid band analysis of amplifier circuits using small - signal equivalent circuit to determine gain input impedance and output impedance.
3. To design and analyze Oscillator circuits.
4. To understand the concept of feedback amplifiers and study about the tuned amplifier circuits.
5. To understand the analysis of multi vibrator circuits and concepts of blocking Oscillators and time base circuits.

UNIT I TRANSISTORS AND COMPENSATION TECHNIQUE 9

h-parameter model, Mid-band Analysis of a BJT, single stage amplifiers, Analysis using Simplified Hybrid Model. - Bias Compensation, Diode compensation - Thermistor & Sensistor compensation.

UNIT II SMALL SIGNAL ANALYSIS OF FET 9

Small signal model of FET - High input resistance Transistor Circuits - Bootstrapping circuit - Darlington Circuit - Step response of Multistage amplifiers - Emitter coupled differential amplifier circuit - Comparison of BJT and FET model.

UNIT III OSCILLATORS 9

Classification of Oscillator, Condition for Oscillation- General form of LC Oscillator circuit- Analysis of LC oscillators: Hartley, Colpitts and Clapp oscillators- RC oscillators: Phase shift oscillator, Wein bridge oscillator- Crystals Oscillator.

UNIT IV FEEDBACK AND TUNED AMPLIFIERS 9

Classification of basic amplifiers- General Characteristics of Negative feedback amplifier-Effects of negative feedback. Single tuned amplifier- Double tuned amplifier- Effect of cascading single tuned and double tuned amplifiers on bandwidth - Stagger tuned amplifiers - Class C tuned amplifier.

UNIT V MULTIVIBRATOR CIRCUITS AND TIMEBASE GENERATORS 9

Collector coupled and Emitter coupled Astable multivibrator - Monostable multivibrator – Bistable multivibrator, Triggering methods for Bistable multivibrator -Schmitt trigger circuit - UJT Sawtooth waveform generator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Discuss the stability factors of various biasing techniques used in BJT.
- **CO2:** Compute the hybrid model for different amplifiers.
- **CO3:** Manipulate the high frequency analysis of single and multi stage amplifiers.
- **CO4:** Illustrate the concept of oscillators in Electronic Circuits.
- **CO5:** Illustrate the concept of Feedback amplifiers and tuned amplifier.
- **CO6:** Demonstrate the working of multivibrator and time base circuits.

TEXT BOOKS:

1. Millman J and Halkias.C, "Integrated Electronics", TMH, 2007.
2. Albert Malvino and David Bates, "Electronic Principles", 7th edition, McGraw Hill, 2015.
3. A. Sedra / Smith, "Micro Electronic Circuits", Oxford University Press, 2004.

REFERENCE BOOKS:

1. David A. Bell, "Electronic Devices & Circuits", 4th Edition, PHI, 2007.
2. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd, 2012.
3. Floyd, "Electronic Devices", Sixth Edition, Pearson Education, 2002.

U23ECT33	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. Understand about various types of signals and systems, classify them, analyze them and perform various operations on them.
2. Realize use of transforms in analysis of signals and system.
3. Characterize LTI systems in the Time domain and various Transform domains.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & 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.

UNIT II ANALYSIS OF CONTINOUS TIME SIGNALS 12

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

UNIT III ANALYSIS OF DISCRETE TIME SIGNALS 12

DTFT- Properties of DTFT- Z Transform - Convergence of Z-Transform - Properties of Z-Transform - Inverse Z-Transform and solving difference equation using Z-Transform - Baseband signal Sampling.

UNIT IV LINEAR TIME INVARIANT - CT SYSTEMS 12

Impulse response characterization and convolution integral for CT-LTI system - Properties of convolution - Fourier and Laplace transforms in analysis of CT systems - Block diagram representation.

UNIT V LINEAR TIME INVARIANT - DT SYSTEMS 12

Impulse response characterization and convolution sum – DTFT and Z transform analysis of recursive and non-recursive systems - Block diagram representation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze the properties of signals & systems.

CO2: Analyze CT and DT signal.

CO3: Apply Fourier transform, Laplace transform and Z transform in signal analysis.

CO4: Analyze continuous time LTI systems using Fourier and Laplace Transforms.

CO5: Analyze discrete time LTI systems using Z transform.

CO6: Analyze the Different signals in other fields.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson limited, 2013.
2. Tarun Kumar Rawat, "Signals and Systems", Oxford University press, 2010.

REFERENCE BOOKS:

1. John Alan Stuller, "An Introduction to Signals and Systems", Nelson, 2007.
2. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill.2011
3. B.P Lathi Roger Green "Signal processing and Linear Systems", Oxford University, press 2021.

U23ECT34	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To Gain basic knowledge of static electric and magnetic field principles and related laws governing them.
2. To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
3. To understand wave propagation in lossless and in lossy media
4. To derive wave equations for Electromagnetic wave propagation in free space and media.

UNIT I STEADY ELECTRIC FIELDS 9

Vector analysis- Co-ordinate systems-Coulomb's Law-Electric field intensity-Field due to continuous Volume charge distribution-Field due to line charge-Field due to sheet of charge-Electric flux-Gauss law-Application of Gauss law- Divergence theorem-Electric scalar potential-Equi-potential surface-Boundary conditions- Helmholtz theorem.

UNIT II STEADY MAGNETIC FIELDS 9

Biot-Savart's Law - Ampere's circuital law-Stokes Theorem - Magnetic flux and flux density - Scalar and Vector potential – Magnetic Materials - Lorentz Force Equations - Force on a moving charge and differential current element – Magnetic Forces and Toques - Magnetic Boundary conditions.

UNIT III ELECTRIC AND MAGNETIC FIELDS IN MATERIALS 9

Poisson's and Laplace equations - Capacitance of parallel plate-Capacitance of Coaxial cable-Parallel wire capacitance - Energy stored in electric field-Energy density - Inductance of transmission line-Faraday's law of electromagnetic inductance-Inductance and Mutual inductance – Energy stored in magnetic field-Energy density.

UNIT IV TIME VARYING ELECTRIC AND MAGNETIC FIELDS 9

Displacement current - Equation of continuity - Maxwell's equations – point form and Integral form - Poynting Theorem- power loss in a plane conductor – Instantaneous Average and complex Poynting Vector – Electromagnetic boundary conditions – Time harmonic fields.

UNIT V ELECTROMAGNETIC WAVES 9

Derivation of Wave equations – Uniform plane waves – wave equation in a phasor form – Plane waves in a lossless medium – Plane waves in a lossy medium (low loss dielectric and good conductors) – Group velocity – skin effect – Reflection of plane waves by a perfect dielectric – normal and oblique incidence – Brewster angle.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Apply the concepts of electric and magnetic fields to practical engineering problems
- **CO2:** Apply elementary solution techniques for electrostatics and magneto statics equations.
- **CO3:** Interpret Maxwell's equations for time dependent electromagnetic fields.
- **CO4:** Determine parameters such as frequency, phase constant, velocity, skin depth and associated intrinsic impedance for different media.
- **CO5:** Distinguish among linear polarization, circular polarization, and elliptical polarization, with right-hand/left-hand orientation.
- **CO6:** Ability to derive wave equations for electromagnetic wave propagation in free space and media.

TEXT BOOKS:

1. William H.Hayt, Jr and John A. Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 9th Edition, 2018.
2. Edward.C.Jordan & Keith.G.Balmain, "Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 1995.

REFERENCE BOOKS:

1. David K.Cheng, Field and Wave Electromagnetics, 2nd Edition, Pearson Edition, 2013.
2. M.N.O. Sadiku and S.V. Kulkarni, Principles of Electromagnetics, 6th ed., Oxford (Asian Edition), 2015.
3. Kraus and Fleisch, "Electromagnetics with Applications", McGraw Hill International Editions, Fifth Edition, 2010.

U23ECP31	ELECTRONIC CIRCUITS AND DIGITAL 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. Study the Frequency response of CE, CB Amplifier.
2. Study the Transfer characteristics of differential amplifier.
3. Perform SPICE simulation of Electronic Circuits.
4. Design oscillators and multivibrators.

LIST OF EXPERIMENTS

1. Frequency Response of CE amplifier.
2. Differential Amplifiers - Transfer characteristics, CMRR Measurement.
3. Non-sinusoidal Waveform generators and converters (Astable, Monostable)
4. Design of Integrator & Differentiator.

LIST OF EXPERIMENTS (Software using Any Public Domain or Commercial Software)

5. Analysis of FET, MOSFET with self-bias and voltage divider bias using simulation software.
6. Design of RC Phase shift oscillator, Colpitt Oscillator and Wien Bridge Oscillators

LIST OF EXPERIMENTS (DIGITAL)

7. Design of Half adder and Full adder using basic gates
8. Design of Multiplexers/Demultiplexers using gates
9. Design of Code Converters (Binary to Gray and Vice versa)
10. Design of Synchronous ripple counters

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	CRO / DSO – 30 MHz	15 Nos
2.	Signal Generator / Function Generator – 3 MHz	15 Nos
3.	Dual Regulated Power Supplies – 0 to 30 V /Single mode power supply	15 Nos
4.	Standalone Desktop PC‟s with SPICE software	15 Nos
5.	Transistor / FET (BJT / NPN / PNP and NMOS /PMOS)	15 Nos.
6.	Components and accessories: Resistors, Capacitors, Inductors, Diodes, Zener diodes, Bread board	As required
7.	Any public domain or commercial software	-
8.	IC‟s: 7400, 7402, 7404, 7486, 7408, 7432, 7483, 7476, 7485, 7473, 7411, 7474	30 Each
9.	IC trainer kit	15 Nos.

COURSE OUTCOMES:

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

CO1: Design and Test the frequency response of Transistors

CO2: Design and Test BJT/JFET amplifiers.

CO3: Measure CMRR in differential amplifier.

CO4: Simulate and analyze amplifier and Oscillator circuits using Simulation Software.

CO5: Demonstrate various combinational circuits like Adder, Subtractor, and Code convertors.

CO6: Demonstrate various combinational and Sequential circuits.

		L	T	P	C
U23HSP31	**PROFESSIONAL DEVELOPMENT AND LIFE SKILLS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

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

1. Making effective presentations.
2. Participating confidently in Group Discussions.
3. Attending job interviews and be successful in them.
4. Developing adequate Soft Skills required for the workplace.
5. Nurturing out ward look.
6. Impressing the listener by positive body language.

LIST OF EXPERIMENTS

1. Introduction to Soft Skills.
2. Employability and career Skills.
3. Grooming as a professional with values.
4. Time Management.
5. General awareness of Current Affairs.
6. Self-Introduction.
7. Introducing oneself to the audience.
8. Introducing the topic.
9. Individual presentation practice.
10. Participating in group discussions.
11. GD strategies- activities to improve GD skills.
12. Interview etiquette.
13. Telephone/skype interview -one to one interview &panel interview.
14. The International English Language Testing System (IELTS).
15. Test of English as a foreign Language (TOFEL)-Verbal Ability.

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1
8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

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

CO1 : Organize an effective group discussion.

CO2 : Develop confidence to attend job interviews.

CO3: Explain their opinion effectively in oral medium of communication

CO4: Prove as technical managers and problem solvers.

CO5: Motivate themselves to move smartly in professional society.

CO6: Build hope to prove their entrepreneurial ship.

U23CSP33	C PROGRAMMING AND DATA STRUCTURES 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. To develop applications in C
2. To implement linear and non-linear data structures
3. To understand the different operations of search trees
4. To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

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

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop PC's with required software	15 Nos.
2.	Any public domain or commercial software	-

COURSE OUTCOMES:

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

CO1: Use different constructs of C and develop applications

CO2: Write functions to implement linear and non-linear data structure operations

CO3: Suggest and use the appropriate linear / non-linear data structure operations for a given problem

CO4: Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval

CO5: Implement Sorting algorithms for a given application

CO6: Implement searching algorithms for a given application

SEMESTER - IV

U23ECT41	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce Analog Modulation Schemes
2. To impart knowledge in random process
3. To study various Digital techniques
4. To introduce the importance of sampling & quantization
5. To impart knowledge in demodulation techniques
6. To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION 9

Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver.

UNIT II RANDOM PROCESS & SAMPLING 9

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation. Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

UNIT III DIGITAL TECHNIQUES 9

Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK

UNIT V DEMODULATION TECHNIQUES 9

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Gain knowledge in amplitude modulation techniques
- **CO2:** Understand the concepts of Random Process to the design of communication systems
- **CO3:** Gain knowledge in digital techniques
- **CO4:** Understand the concepts of Digital modulation techniques
- **CO5:** Gain knowledge in sampling and quantization
- **CO6:** Understand the importance of demodulation techniques

TEXT BOOKS:

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V)
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCE BOOKS:

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.
3. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007

U23ECT42	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the basic building blocks of linear integrated circuits
2. To learn the linear and non-linear applications of operational amplifiers
3. To introduce the theory and applications of Timer IC and PLL
4. To learn the theory of ADC and DAC
5. To introduce the concepts of waveform generation and introduce some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Voltage Follower, V-to-I and 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 TIMER CIRCUITS, VCO AND PLL 9

IC 555 Timer– Astable and Monostable Multivibrators using IC555, Operation of the basic PLL, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type .K).

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators and Triangular wave generator, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out (LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Power amplifier, Isolation Amplifier, Opto couplers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design linear and nonlinear applications of OP – AMPS

CO2 : Design Various op-amp applications

CO3: Design applications using Timer ICs and PLL
CO4: Design ADC and DAC using OP – AMPS
CO5: Generate waveforms using OP – AMP Circuits
CO6: Analyze special function ICs

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

U23ECT43	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. To learn discrete Fourier transform and its properties
2. To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse response filters for filtering undesired signals
3. To understand Finite word length effects
4. To study the concept of Multi rate and adaptive filters

UNIT I DISCRETE FOURIER TRANSFORM 12

Sampling Theorem, concept of frequency in discrete-time signals, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. 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).

UNIT II FIR FILTER DESIGN 12

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 - linear phase structure, direct form realizations

UNIT III IIR FILTER DESIGN 12

Introduction of IIR – Analog filter design - Butterworth filters, Chebyshev filters. – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations

UNIT IV FINITE WORDLENGTH EFFECTS 12

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

UNIT V DIGITAL SIGNAL PROCESSORS 12

Architectural Features – Harvard, Von-Neumann, VLIW architecture – MAC Unit - ALU – Pipelining Architecture of TMS320C5x- instruction set - Addressing Modes - Application of DSP – Model of Speech Wave Form, Vocoders.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Apply DFT for the analysis of digital signals & systems

CO2 : Design FIR filters

CO3: Design IIR filters

CO4: Characterize finite Word length effect on filters

CO5: Understand the Concepts of Digital Signal Processors

CO6: Understand the applications of DSP

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006

REFERENCE BOOKS:

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", Tata Mc Graw Hill, 2007.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

U23ECT44	NETWORKS AND SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn the Network Model sand data link layer functions.
2. To understand routing in the Network Layer.
3. To explore methods of communication and congestion control by the Transport Layer.
4. To study the Network Security Mechanisms.
5. To learn various hardware security attacks and their countermeasures.

UNIT I NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks– Network Models – OSI, TCP/IP, Addressing – Introduction to Data link Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11, Bluetooth– Flow and Error Control Protocols–HDLC-PPP.

UNIT II NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols (IP,ICMP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 –Datagram Format -TransitionfromIPv4 toIPv6.

UNIT III TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram – Congestion Control and Avoidance (DEC bit, RED) -Application Layer Paradigms – Client – Server Programming–Domain Name System–World Wide Web, HTTP, Electronic mail.

UNIT IV NETWORK SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – AdvancedEncryptionStandard–PublicKeyCryptosystems–RSAAlgorithm–HashFunctions– Secure Hash Algorithm – Digital Signature Algorithm.

UNIT V HARDWARE SECURITY 9

Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the Network Models, layers and functions.
CO2 : Categorize and classify the routing protocols.
CO3: List the functions of the transport and application layer.
CO4: Evaluate and choose the network security mechanisms.
CO5: Explain the various algorithms.
CO6: Discuss the hardware security attacks and counter measures.

TEXT BOOKS:

1. Behrouz. A.Forouzan, “Data Communication and Networking”, Fifth Edition, TMH, 2017.
2. William Stallings, “Cryptography and Network Security”, Seventh Edition, Pearson Education,2017

REFERENCE BOOKS:

1. James. F.Kurosea Keith. W.Ross, “Computer Networking–Atop Down Approach”, Sixth Edition, Pearson,2017.
2. Bhunia Swarup, “Hardware Security– A Hands On Approach”, Morgan Kaufmann, First edition, 2018.
3. Doughlas. E.Comer, “ Computer Networks and Internets with Internet Applications”, Fourth Edition, Pearson Education, 2008.

U23ECT45	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

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

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

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

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

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

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Compute the transfer function of different physical systems

CO2 : Analyse the time domain specification and calculate the steady state error.

CO3: Illustrate the frequency response characteristics of open loop and closed loop system response.

CO4: Analyse the stability using Routh and root locus techniques.

CO5: Illustrate the state space model of a physical system and discuss the concepts of sampled data control system.

CO6: Gain the knowledge on state variable representations

TEXT BOOKS:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
2. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.

REFERENCE BOOKS:

1. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2012.
2. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
3. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition, 1995.

U23GET41	ENVIRONMENTAL SCIENCES AND ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

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

1. To the study of nature and the facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste Management.

UNIT I ECOSYSTEM AND BIODIVERSITY 6

Definition, Scope and importance of environment – Need for public awareness. Ecosystem Types and Energy flow– Ecological succession. Types of biodiversity: genetic, species and eco system diversity –values of bio diversity, India as a mega-diversity nation–hot-spots of biodiversity–threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts endangered and end emic species of India–conservation of bio diversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal.

UNIT IV ENVIRONMENTAL ISSUES 6

Social Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Population growth, variation among nations population explosion – family welfare programme – human rights – value education – HIV / AIDS – women and child welfare.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Development, GDP, Sustainability- Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economic and technological change.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.

CO2: Discover knowledge in ecological perspective and value of environment

CO3: Categorize different types of pollutions and their control measures.

CO4: Understand the significance of various natural resources and its management.

CO5: Analyse global environmental problems and come out with best possible solutions.

CO6: Understand environmental laws and sustainable development.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, NewDelhi,2016.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3. Allen, D.T. and Shonnard, D.R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
4. J. Manivel and A. Arunkumar, "Environmental Science & Engineering" R.K.Publishers, 1st Edition 2023

REFERENCE BOOKS:

1. R.K.Trivedi, 'Hand book of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, EnviroMedia.38.
2. Cunningham, W.P.Cooper, T.H.Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai,2001.
3. Rajagopalan.R, 'Environmental Studies-From Crisisto Cure', Oxford UniversityPress,2005.
4. Erach Bharuch "Text book of Environmental Studies for Undergraduate Courses" Orient BlackswanPvt.Ltd.2013.

U23ECP41	COMMUNICATION SYSTEMS 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. To study the AM & FM Modulation and Demodulation.
2. To learn and realize the effects of sampling and TDM.
3. To understand the PCM & Digital Modulation.
4. To Simulate Digital Modulation Schemes.
5. To Implement Equalization Algorithms and Error Control Coding Schemes.

LIST OF EXPERIMENTS

1. Signal Sampling and reconstruction
2. Amplitude Modulation and Demodulation
3. Frequency Modulation and Demodulation
4. Pulse Code Modulation and Demodulation
5. Delta Modulation and Adaptive delta modulation
6. TDM and FDM
7. Line coding schemes
8. Simulation of BFSK Modulation and Demodulation
9. Simulation of BPSK Modulation and Demodulation
10. Simulation of FSK, QPSK and DPSK Schemes
11. Simulation of error control coding schemes
12. Communication link simulation

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Kits for signal sampling, TDM, FDM, AM, FM, PCM, DM and line coding schemes	As required
2.	CRO's / DSO's	15 Nos.
3.	Function generators	15 Nos.
4.	MATLAB or equivalent software package for simulation experiments	-
5.	PC's	15 Nos.

COURSE OUTCOMES:

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

CO1: Design of AM, FM & Digital Modulators for specific applications.

CO2: Compute the sampling frequency for digital modulation.

CO3: Simulate & validate the various functional modules of Communication system.

CO4: Demonstrate their knowledge in base band signalling schemes through implementation of digital modulation schemes.

CO5: Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.

CO6: Simulate various Coherent and Non Coherent Modulation Schemes

U23ECP42	LINEAR INTEGRATED CIRCUITS 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. To gain hands on experience in designing electronic circuits
2. To learn simulation software used in circuit design
3. To learn the fundamental principles of amplifier circuits
4. To differentiate feedback amplifiers and oscillators.
5. To differentiate the operation of various multivibrators

LIST OF EXPERIMENTS(HARDWARE)

1. Inverting and Non inverting amplifier.
2. RC Phase shift oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. RC Integrator and Differentiator circuits using Op-Amp
5. Clippers and Clampers
6. Instrumentation amplifier
7. Active low-pass, High pass & Band pass filters

LIST OF EXPERIMENTS (Software using Any Public Domain or Commercial Software)

8. Tuned Collector Oscillator
9. Twin -T Oscillator / Wein Bridge Oscillator
10. Double and Stagger tuned Amplifiers
11. Bistable Multivibrator
12. Schmitt Trigger circuit with Predictable hysteresis

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	CRO / DSO – 30 MHz	15 Nos.
2.	Signal Generator / Function Generator – 2 MHz	15 Nos.
3.	Dual Regulated Power Supplies – 0 to 30 V	15 Nos.
4.	Standalone Desktop PC's with required software	15 Nos.
5.	Components and accessories: Resistors, Capacitors, Inductors, Diodes, Zener diodes, Bread board	As required
6.	Any public domain or commercial software	-
7.	Digital Multimeter	15 Nos.
8.	Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used	As required

COURSE OUTCOMES:

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

CO1: Design various basic op-amp circuits.

CO2: Analyze various types of feedback amplifiers

CO3: Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators

CO4: Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators, filters using Software Tool.

CO5: Design amplifiers, oscillators, D-A converters using operational amplifiers.

CO6: Design filters using op-amp and perform an experiment on frequency response.

U23ECP43	SIGNAL PROCESSING AND NETWORKS 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. To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB.
2. To design FIR and IIR filters in MATLAB.
3. Learn to communicate between two desktop computers.
4. Learn to implement the different protocols.
5. Be familiar with IP Configuration, the various routing algorithms and with simulation tools.

LIST OF EXPERIMENTS (SIGNAL PROCESSING USING MATLAB)

1. Generation of elementary Discrete-Time sequences.
2. Linear and Circular convolutions.
3. Autocorrelation 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) and demonstrate the filtering operations.

LIST OF EXPERIMENTS (NETWORKING)

7. Implementation of Error Detection/ Error Correction Techniques.
8. Implementation of Stop and Wait Protocol and sliding window.
9. Implementation of IP address configuration.
10. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
11. Network Topology - Star, Bus, Ring.
12. Implementation of Link state routing algorithm.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop PC's with required software	15 Nos.
2.	Any public domain or commercial software	-

COURSE OUTCOMES:

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

CO1: Carryout basic signal processing operations.
CO2: Analyse the frequency response of IIR and FIR filters.
CO3: Simulate& validate the various functional modules of a communication system.
CO4: Analyze the Error Control and Coding Schemes
CO5: Simulate end-to-end communication Link.
CO6: Know the procedures of cipher

SEMESTER V

U23ECT51	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study and understand the concepts and design of a Cellular System.
2. To Study and Understand Mobile Radio Propagation and Various Digital Modulation Techniques.
3. To Understand the Concepts Of Multiple Access Techniques And Wireless Networks.

UNIT I THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS 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 MODULATION TECHNIQUES AND EQUALIZATION 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 Performance In Fading And Multipath Channels - **Equalization, Diversity And Channel Coding:** Introduction-Fundamentals Of Equalization

UNIT IV 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 V WIRELESS NETWORKING 9

Introduction: Difference Between Wireless And Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), Development Of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing In Wireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/ Networks(PCS/PCNs):Packet Vs Circuit Switching For PCN, Cellular Packet.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand The Concept And Design of A Cellular System.
CO2: Understand Mobile Radio Propagation and Various Digital Modulation Techniques.
CO3: Understand The Concepts of Multiple Access Techniques And Wireless Network.
CO4: Characterize a wireless channel and evolve the system design specifications.
CO5: Design a cellular system based on resource availability and traffic demands.
CO6: Summarize the principles and applications of wireless systems and standards

TEXT BOOKS:

1. Rappaport, T.S., "Wireless communications", Pearson Education, Second Edition, 2010
2. A.F.Molisch, "Wireless Communications", Wiley, 2005

REFERENCE BOOKS:

1. Andrea Goldsmith, "Wireless Communication", 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, 2005.
4. Upena Dalal, "Wireless Communication", Oxford University Press, 2009.
5. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006.
6. William Stallings, "Wireless Communication and Networks", Pearson Education, Second Edition 2002

U23ECT52	VLSI AND CHIP DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the fundamentals of IC technology components and their characteristics.
2. Understand combinational logic circuits and design principles.
3. Understand sequential logic circuits and clocking strategies.
4. Understand ASIC Design functioning and design.
5. Understand Memory Architecture and building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non Ideal I-V Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Non bistable Sequential Circuits. Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data paths, Adder, Multipliers, Shifters, ALUs, Power and Speed Trade-offs, **Case Study:** Design as a trade-off, Designing Memory and Array Structures: Memory Architectures and Building Blocks, Memory core, Memory Peripheral Circuitry.

UNIT V ASIC DESIGN AND TESTING 9

Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test and verification of complex chips, embedded cores and SOCs, Fault models, Test coding. ASIC Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL, Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: In depth knowledge of MOS technology

CO2: Understand Combinational Logic Circuits and Design Principles

CO3: Understand Sequential Logic Circuits and Clocking Strategies

CO4: Understand Memory architecture and building blocks

CO5: Understand the HDL

CO6: Understand the ASIC Design Process and Testing.

TEXT BOOKS:

1. Jan M Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016. (Units II, III and IV).
2. Neil H E Weste, Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009. (Units - I, IV).
3. Michael J Smith , "Application Specific Integrated Circuits", Addison Wesley, (Unit - V)
4. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis", Second Edition, Pearson Education, 2003. (Unit - V)
5. Parag K.Lala, "Digital Circuit Testing and Testability", Academic Press, 1997, (Unit - V)

REFERENCE BOOKS:

1. D.A. Hodges and H.G. Jackson, "Analysis and Design of Digital Integrated Circuits", International Student Edition, McGraw Hill 1983
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001.
3. Samiha Mourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley 2000.
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.

U23ECT53 TRANSMISSION LINES AND RF SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the various types of transmission lines and its characteristics.
2. To give thorough understanding about high frequency line, power and impedance measurements.
3. To impart technical knowledge in impedance matching using smith chart.
4. To introduce passive filters and basic knowledge of active RF components.
5. To get acquaintance with RF system transceiver design.

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z_0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines.

UNIT II HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching: Quarter wave transformer, Half wave line, $1/8^{th}$ wave line - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Single and double stub matching using Smith chart.

UNIT IV WAVEGUIDES & FILTERS 9

Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE waves in Circular waveguides. Need for filters and practical applications. Design of LPF, HPF, BPF and BSF (Constant K).

UNIT V RF SYSTEM DESIGN CONCEPTS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the characteristics of transmission lines and its losses

CO2: Write about the standing wave ratio and input impedance in high frequency transmission lines

CO3: Analyze impedance matching by stubs using smith charts

CO4: Analyze the characteristics of TE and TM waves

CO5: Design a RF transceiver system for wireless communication.

CO6: Design RF Passive components using filters.

TEXT BOOK:

1. William H.Hayt, Jr and John A. Buck, Engineering Electromagnetics, Tata McGraw-Hill, 9th Edition, 2018.
2. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015

REFERENCE BOOK:

1. Reinhold Ludwig and Pavel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition, 2001.
2. David M Pozar: Microwave and RF design of wireless systems, John Wiley & Sons, 2001.
3. Les Besser and Rowan Gilmore, "Practical RF circuit Design for Modern Wireless Systems-Passive circuits and Systems", Vol.1, Artech House Publishers, Boston, London 2008

U23ECT54 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To study the architecture and addressing modes of 8085 and to write assembly language programs of 8085.
2. To study the architecture and addressing modes of 8086 and to write assembly language programs of 8086.
3. To know the importance of different peripheral devices and their interfacing to 8085/8086.
4. To study the architecture and addressing modes of 8051 and to write assembly language programs of 8051.
5. To study multiprocessor and high end processor configurations.

UNIT I 8086 MICRO PROCESSOR 9

Introduction to 8086 Microprocessors – Architecture – Addressing modes – Memory organization – Instruction set – Assembler directives & Operations – Assembly language programming – Procedures – Macros – Interrupts & Interrupt Service Routines – Applications of 8086.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III PERIPHERAL INTERFACING WITH 8086 MICRO PROCESSOR 9

Programmable devices – Parallel & Serial I/O and Data Communication – Timer - Keyboard /Display controller – Interrupt controller – DMA controller – Applications: Traffic Light control, LED display, LCD display.

UNIT IV 8051 MICRO CONTROLLER 9

Introduction to 8051 Microcontroller – Architecture - Pin diagram - Special Function Registers - External Memory Interface with 8051 – Counter and Timers in 8051 - Interrupts - Addressing modes - Instruction set - Assembly language programming of 8051 – Applications of 8051.

UNIT V INTRODUCTION TO ARM PROCESSORS 9

Acron RISC Machine – Architectural Inheritance – Core & Architectures - The ARM Programmer's model -Registers – Pipeline- ARM processor family - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	Understand the architecture of microprocessor/ microcontroller and their operation.
CO2:	To study the addressing modes for Processors and Controllers.
CO3:	To study the Interrupts and Interrupt Service Routines for Processors and Controllers.
CO4:	Demonstrate programming skills in assembly language for Processors and Controllers.
CO5:	Analyze various interfacing techniques and apply them for the design of processor / Controller based systems.
CO6:	To study multiprocessor and high end processor configurations.

TEXT BOOK:

1. Ramesh S. Gaonkar, "Microprocessor – Architecture, Programming and Applications with the 8085", Penram International Publisher, 6th Edition, 2013.
2. Ray.A.K. & Bhurchandi.K.M, "Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing", Tata Mc Graw Hill,3rd Edition, 2017
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, "The 8051 microcontroller and embedded systems using Assembly and C", 2ndedition, Pearson education /Prentice hall of India, 2007.
4. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", 2nd Edition, Pearson 2011.

REFERENCE BOOK:

1. Douglas V.Hall, "Microprocessors and Interfacing: Programming and Hardware", 3rd edition, Tata Mc Graw Hill, 2017.
2. Mazidi M. A.McKinley R. D., Causey D. Smith, "PIC Microcontroller and Embedded Systems", Pearson Education International, 2008
3. Martin Bates, "PIC Microcontrollers", 3 rd Edition, Elsevier 2012
4. Yn-cheng Liu, Glenn A.Gibson, "Microcomputer systems: The 8086 / 8088 Family architecture, Programming and Design", 2ndedition, Pearson, 2015.

		L	T	P	C
U23ECP51	**MICROPROCESSORS AND MICROCONTROLLERS LABORATORY**	**0**	**0**	**4**	**2**

COURSE OBJECTIVES

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

1. Introduce Assembly Language Programming concepts and features.
2. Write ALP for arithmetic and logical operations in 8086 and 8051.
3. Understand Serial and Parallel Interface.
4. Interface different I/Os with Microprocessors.

BASED ON 8086 PROCESSOR

1. Programs for 16 bit Arithmetic operations
2. Programs for Sorting and Searching
3. Programs for String manipulation operations.
4. Programs for Digital clock.
5. Interfacing ADC and DAC.
6. Interfacing and Programming Keyboard and Display.
7. Interfacing and Programming of Stepper Motor.
8. Finding number of and number of in a given 8-bit number using 8051.

SIMULATION USING KEIL

9. Programming using Arithmetic, Logical instructions of 8051 Micro controller.
10. Programming and verifying Timer operation in 8051 Micro controller.

TOTAL: 60 PERIODS

LAB REQUIREMENTS :

1. 8086, 8051 development kits
2. Interfacing units: ADC, DAC, 8279, Stepper motor kit.
3. Intel desktop systems with KEIL simulation Tool.

COURSE OUTCOMES:

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

CO1:	Explain and Implement 8086 instructions for ALU operations.
CO2:	Interface the ADC / DAC Display using 8051 Trainer kit.
CO3:	Interface sensors to 8051 trainer kit using ADC and DAC.
CO4:	Interface and control the operations of stepper motor.
CO5:	Explain and Implement 8051 instructions for ALU operations
CO6:	Simulate the 8051 micro controller based operations.

U23ECP52	VLSI 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. To learn Hardware Descriptive Language (Verilog /VHDL).
2. To learn the fundamental principles of Digital System Design using HDL and FPGA.
3. To learn the fundamental principles of VLSI circuit design in digital domain
4. To learn the fundamental principles of VLSI circuit design in analog domain
5. To provide hands on design experience with EDA platforms.

LIST OF EXPERIMENTS:

1. Design of basic combinational and sequential (Flip-flops) circuits using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design an Adder; Multiplier (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design and implement Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software
4. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design 3-bit synchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
7. Design 4-bit Asynchronous up/down counter using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
8. Design and simulate a CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout.
9. Design and simulate a 4-bit synchronous counter using a Flip-flop. Generate Manual/Automatic Layout
10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.
12. Design and simulate simple 5 transistor differential amplifier.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S.NO	NAME OF THE EQUIPMENT	QUANTITY
1	Standalone Desktop PC's with required software	15 Nos
2	Any public domain or commercial software	-

COURSE OUTCOMES:

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

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

CO2: Import the logic modules into FPGA Boards.

CO3:	Synthesize Place and Route the digital ICs.
CO4:	Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools.
CO5:	Test and Verification of IC design.
CO6:	Simulate various IC design.

SEMESTER VI

U23ECT61	EMBEDDED SYSTEMS AND IOT DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn the architecture and features of 8051.
2. Study the design process of an embedded system.
3. Understand the real – time processing in an embedded system.
4. Learn the architecture and design flow of IoT.
5. Build an IoT based system.

UNIT I 8051 MICRO CONTROLLER 9

Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

UNIT II EMBEDDED SYSTEMS 9

Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.

UNIT III PROCESSES AND OPERATING SYSTEMS 9

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multi-rate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Inter-process Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.

UNIT IV IOT ARCHITECTURE AND PROTOCOLS 9

Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT System Management with NETCONF – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

UNIT V IOT SYSTEM DESIGN 9

Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the architecture and features of 8051.

CO2: Develop a model of an embedded system.

CO3: List the concepts of real time operating systems.

CO4: Learn the architecture and protocols of IoT.

CO5: Design an IoT based system for any application

CO6: Able to understand the application areas of IOT

TEXT BOOK:

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Second Edition, Pearson Education, 2008. (Unit – I)
2. Marilyn Wolf, "Computers as Components – Principles of Embedded Computing System Design", Third Edition, Morgan Kaufmann, 2012. (Unit – II,III)
3. Arshdeep Bahga, Vijay Madisetti, "Internet of Things A Hands on Approach", Universities Press, 2015. (Unit – IV,V)

REFERENCE BOOK:

1. Mayur Ramgir, "Internet of Things, Architecture, Implementation and Security", First Edition, Pearson Education, 2020.
2. Lyla B.Das, "Embedded Systems: An Integrated Approach", Pearson Education 2013.
3. Jane.W.S .Liu, "Real Time Systems", Pearson Education, 2003.

U23ITT62	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To Study about un informed and Heuristic search techniques.
2. To learn techniques for reasoning under uncertainty.
3. To learn about Machine Learning and supervised learning algorithms.
4. To study about ensembling and un supervised learning algorithms.
5. To learn the basics of deep learning using neural networks.

UNIT I PROBLEM SOLVING 9

Introduction to AI - AI Applications -Problem solving agents – search algorithms – uninformedsearchstrategies–Heuristicsearchstrategies–Localsearchandoptimizationproblems– adversarialsearch– constraint satisfaction problems(CSP).

UNIT II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – naïve bayes models. Probabilistic reasoning – Bayesian networks –exact inference in BN –approximate inference in BN –causal networks.

UNIT III SUPERVISED LEARNING 9

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier– Support vector machine, Decision Tree, Random forests.

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT V NEURAL NETWORKS 9

Perceptron- Multilayer perceptron, activation functions, network training–gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Use appropriate search algorithms for problem solving.

CO2: Apply reasoning under uncertainty.

CO3: Build supervised learning models.

CO4: Build ensembling and unsupervised models.

CO5: Build deep learning neural network models.

CO6: Explain the concept of batch normalization and regularization.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.

REFERENCE BOOKS:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2007.
3. Deepak Khemani, "Artificial Intelligence", Tata Mc Graw Hill Education, 2013 (http://nptel.ac.in/).
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
5. Tom Mitchell, "Machine Learning", Mc Graw Hill, 3rd Edition, 1997.
6. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.
7. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

U23CSP62	INTERNET OF THINGS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To connect Arduino board with internet.
2. To Deploy an IoT application using Arduino / Raspberry Pi and appropriate sensor and actuator.
3. To Demonstrate the working of simple IoT task of LED control.
4. To Design a simple Internet of Things (IoT) application using Arduino / Raspberry Pi, sensors and actuators.
5. To Build an IoT system using mobile app as a mini project.

LIST OF EXPERIMENTS

1. Introduction to Arduino platform and programming.
2. Introduction to Raspberry Pi platform and python programming.
3. Turn ON and OFF the LEDs.
4. Identify the objects using IR and PIR sensor.
5. Measure the moisture level of soil using soil moisture sensor.
6. Measure the distance between the ultra-sonic sensor and the obstacle.
7. Identify the leakage of gas /smoke in the environment.
8. Measure the humidity and moisture value of the environment.
9. Control a LED using relay switch.
10. Identify the rain in the environment using rain sensor.
11. Explore different communication methods with IoT devices (Zigbee, GSM, Bluetooth)

MINI PROJECT

1. Line follower robot
2. Smart weather monitoring system
3. Smart lighting system
4. Smart waste management system
5. Smart parking system

TOTAL: 60 PERIODS

LIST OF EQUIPMENT/SOFTWARE FOR BATCH OF 30 STUDENTS

SI.NO	NAME OF THE EQUIPMENT/SOFTWARE REQUIREMENTS	QUANTITY
1	INTEL/HP 280G3MT, Processor-Intel(R) Core i7-7700 @3.00 GHz RAM- 8GB RAM, HDD-ITB, Keyboard, Mouse, Monitor OS: Windows 10 Pro and CentOS 6.	30
2.	Arduino board and peripherals, Raspberry Pi, Zigbee Interface, LORA Interface computer with relevant simulation software, access to IoT cloud service like Thing Speaks, Sensors etc. and high speed internet.	30

COURSE OUTCOMES:

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

CO1: Understand the concept of Internet of Things.

CO2: Implement interfacing of various sensors with Arduino / Raspberry Pi.

CO3: Demonstrate the ability to transmit data wirelessly between different devices.

CO4: Show an ability to upload/ download sensor data on cloud an server.

CO5: Implement IoT based street light control system.

CO6: Implement IoT based weather monitoring system.

SEMESTER VII

U23GET61	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

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

- To create awareness about values and ethics enshrined in the Constitution of India.
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To in still the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES 6

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.

Reading Text: Excerpts from John Stuart Mills' *On Liberty*.

UNIT II SECULAR VALUES 6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani.

UNIT III SCIENTIFIC VALUES 6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R.

UNIT IV SOCIAL ETHICS 6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari.

UNIT V SCIENTIFIC ETHICS 6

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

Reading Text*:* Excerpt from *American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the importance of democratic, secular and scientific values in harmonious functioning of social life.

CO2: Practice democratic and scientific values in both their personal and professional life.

CO3: Find rational solutions to social problems.

CO4: Behave in an ethical manner in society.

CO5: Practice critical thinking and the pursuit of truth.

CO6: Describe the responsibility and duties of citizen.

REFERENCE BOOK:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

U23ECT71 **COGNITIVE RADIO**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

- Know the basics of the software defined radios.
- Learn the design of the wireless networks based on the cognitive radios
- Understand the concepts of wireless networks and next generation networks.

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the basics of the software defined radios.

CO2: Understand the fundamental concepts of cognitive radio networks.

CO3: Design the wireless networks based on the cognitive radios

CO4: Explain the concepts behind the wireless networks and next generation networks

CO5: Recognize the concepts of cooperative spectrum sensing and handoff process

CO6: Analyze the concept of next generation wireless networks.

TEXT BOOK:

1. Joseph Mitola III, “Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering”, John Wiley & Sons Ltd. 2000.

2. Thomas W.Rondeau, Charles W. Bostain, “Artificial Intelligence in Wireless communication”, ARTECH HOUSE .2009.
3. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation /dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006.

REFERENCE BOOK:

1. Simon Haykin, “Cognitive Radio: Brain –Empowered Wireless Communications”, IEEE Journal on selected areas in communications, Feb 2005.
2. Hasari Celebi, Huseyin Arslan, “Enabling Location and Environment Awareness in Cognitive Radios”, Elsevier Computer Communications , Jan 2008.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio”, John Wiley, 2003.
4. Huseyin Arslan, “Cognitive Radio, SDR and Adaptive System”, Springer, 2007.
5. Alexander M. Wyglinski, Maziarneko vee, Y. Thomas Hu, “Cognitive Radio Communication and Networks”, Elsevier, 2010

ELECTIVE – MANAGEMENT

U23GET71	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Sketch the Evolution of Management.
2. Extract the functions and principles of management.
3. Learn the application of the principles in an organization.
4. Study the various HR related activities.
5. Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers- managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company- public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO2: Have same basic knowledge on international aspect of management.

CO3: Ability to understand management concept of organizing..

CO4: Ability to understand management concept of directing

CO5: Ability to understand management concept of controlling.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Robert Kreitner and Mamata Mohapatra, " Management", Biztantra, 2008.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
3. Tripathy PC and Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

U23GET72 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM frame work, Barriers and Benefits of TQM.
2. Explain the TQM Principles for application.
3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
4. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
5. Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to apply TQM concepts in a selected enterprise.

CO2: Ability to apply TQM principles in a selected enterprise.

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, Hemant Urdh wareshe and Rashmi Urdh wareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCES:

1. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3. Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .

U23GET73 ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING L T P C
3 0 0 3

COURSE OBJECTIVES:

1. Understanding the concept of Engineering Economics.
2. Implement various micro economics concept in real life.
3. Gaining knowledge in the field of macro economics to enable the students to have better
4. understanding of various components of macro economics.
5. Understanding the different procedures of pricing.
6. Learn the various cost related concepts in micro economics.

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization - Least cost input - Isoquants -Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9

Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Students able to

CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2: Evaluate the economic theories, cost concepts and pricing policies

CO3: Understand the market structures and integration concepts

CO4: Understand the measures of national income, the functions of banks and concepts of Globalization.

CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

REFERENCES:

1. Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009.

U23GET74 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVE:

1. To provide knowledge about management issues related to staffing,
2. To provide knowledge about management issues related to training,
3. To provide knowledge about management issues related to performance
4. To provide knowledge about management issues related to compensation
5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 9

Compensation plan – Reward – Motivation – Career Development - Mentor – Protege relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS:

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013, New Delhi.

REFERENCES:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

U23GET75 KNOWLEDGE MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

1. Learn the Evolution of Knowledge management.
2. Be familiar with tools.
3. Be exposed to Applications.
4. Be familiar with some case studies.

UNIT I INTRODUCTION 9

Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING 9

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS 9

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION 9

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES 9

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

CO1: Understand the process of acquiry knowledge from experts

CO2: Understand the learning organization.

CO3: Use the knowledge management tools.

CO4: Develop knowledge management Applications.

CO5: Design and develop enterprise applications.

TEXT BOOK:

1. Srikantaiah, T.K., Koenig, M., "Knowledge Management for the Information Professional" Information Today, Inc., 2000.

REFERENCE:

1. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.

U23GET76	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain basic concepts of management; approaches to management; contributors management studies; various forms of business organization and trade unions function professional organizations

CO2:Discuss the planning; organizing and staffing functions of management in profession organization.

CO3:Apply the leading; controlling and decision making functions of management in profession organization.

CO4:Discuss the organizational theory in professional organization.

CO5:Apply principles of productivity and modern concepts in management in profession organization.

TEXTBOOKS:

1.M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delh 2009.

2.Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.

2.Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.

3.S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.

4.Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.

5.S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

VERTICALS – I (SEMICONDUCTOR CHIP DESIGN AND TESTING)

		L	T	P	C
U23ECV11	**WIDE BANDGAP DEVICES**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. Introduce the concept of wide band gap (WBG) devices and its application in real world.
2. Advantages and disadvantages of WBG devices
3. Provide an introduction to basic operation of WBG power devices
4. Learn Design principles of modern power devices
5. Ability to deal high frequency design complexity

UNIT I WBG DEVICES AND THEIR APPLICATION IN REAL WORLD **9**

Review of semiconductor basics, Operation and characteristics of the SiC Schottky Barrier Diode, SiC DMOSFET and GaN HEMT, Review of Wide bandgap semiconductor technology - Advantages and disadvantages.

UNIT II SWITCHING CHARACTERIZATION OF WBG **9**

Turn-on and Turn-off characteristics of the device, Hard switching loss analysis, Double pulse test set-up.

UNIT III DRIVERS FOR WIDE BAND GAP DEVICES **9**

Gate driver, Impact of gate resistance, Gate drivers for wide bandgap power devices , Transient immunity integrated gate drivers.

UNIT IV HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING **9**

Effects of parasitic inductance, Effects of parasitic capacitance , EMI filter design for high frequency power converters High frequency PCB design, Conventional power loop design, High frequency power loop optimization, Separation of power from signal PCB.

UNIT V APPLICATIONS OF WIDE BANDGAP DEVICES **9**

Consumer electronics applications, Wireless power transfer applications, Electric vehicle applications, Renewable energy sources applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Students master design principles of power devices.

CO2: Students become familiar with reliability issues and testing methods.

CO3: An ability to design and conduct experiments, as well as to analyze and interpret data.

CO4: Student to get real life experience and to know practical applications of WBG.

CO5: Indepth knowledge on practical usage of this technology.

TEXT BOOKS:

1. A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Convertion, Wiley, 2014, ISBN-13: 978-1118844762.
2. G. Meneghesso, M. Meneghini, E. Zanoni, "Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion," Springer International Publishing, 2018, ISBN: 978-3- 319-77993-5.

REFERENCE BOOKS:

1. F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018).
2. B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific Publishing Company (3 Feb. 2017).
3. L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of High Frequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015).

U23ECV12	VALIDATION AND TESTING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Getting familiar with various IC technology.
2. Learn MOS theory and testing
3. Learn CMOS circuit theory and testing.
4. Getting expertise on CMOS characterization.
5. Explore circuit and device level testing methods .

UNIT I TECHNOLOGY INTRODUCTION 9

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

UNIT II MOS THEORY ANALYSIS-I 9

Basic Electrical Properties of MOS Circuits: Ids-Vds Relationships, MOS Transistor Threshold Voltage Vth, gm, gds, Figure of Merit ωo, Short Channel and Narrow Channel Width Effects.

UNIT III MOS THEORY ANALYSIS-II 9

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT IV CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 9

Impulse response characterization and convolution integral for CT-LTI system - Properties of convolution - Fourier and Laplace transforms in analysis of CT systems - Block diagram representation.

UNIT V LINEAR TIME INVARIANT - DT SYSTEMS 9

Impulse response characterization and convolution sum – DTFT and Z transform analysis of recursive and non-recursive systems - Block diagram representation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Complete overview to CMOS fabrication process.

CO2: Understand the fundamental concept of MOS FET and testing.

CO3: Explain the concept of MOS theory and analysis.

CO4: To give the student an understanding of CMOS performance testing and estimation.

CO5: Explain the basics of Testing and Fault Modeling

CO6: Complete overview to CMOS fabrication process.

TEXT BOOKS:

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, “CMOS VLSI Design” - Pearson Education, 1999.

REFERENCE BOOKS:

1. M.L. Bushnell and V.D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwer Academic Publishers, 2004.
2. N.K. Jha and S.G. Gupta, “Testing of Digital Systems”, Cambridge University Press, 2003
3. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005

U23ECV13	LOW POWER IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn the fundamentals of low power low voltage VLSI design.
2. To understand the impact of power on system performances.
3. To understand the different design approaches.
4. To develop the low power low voltage memories

UNIT I FUNDAMENTALS OF LOW POWER CIRCUITS 9

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 9

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 9

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 9

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 9

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-Refres Circuit, Future Trend and Development of DRAM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of Low power circuit design.
CO2: Attain the knowledge of architectural approaches.
CO3: Analyze and design Low-Voltage Low-Power combinational circuits.
CO4: Learn the design of Low-Voltage Low-Power Memories

CO5: Design and develop Low Power, Low Voltage Circuits

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004

REFERENCE BOOKS:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012.
2. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998
3. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002
5. Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press, 1995.
6. Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer.

U23ECV14	VLSI TESTING AND DESIGN FOR TESTABILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce logic and fault simulation and testability measures.
2. To study the design for testability.
3. To know about interfacing and testing of memory
4. To introduce power management techniques in testing
5. To study testability in analog circuits.

UNIT I TEST REQUIREMENTS AND METRICS 9

Validation platforms- SOC design methodology, IP components, Integration, Clocking, I/Os and interfaces, Device modes, Logic, memories, analog, I/Os, power management; Test requirements- Test handoffs, Testers Where DUT and DFT fit into design / framework; Test- ATPG, DFT, BIST, COF, TTR; Test cost metrics and test economics; Logic fault models- SAF, TDF, PDF, Iddq, St-BDG, Dy-BDG, SDD; Basics of test generation and fault simulation- Combinational circuits, Sequential; Specific algorithmic approaches, CAD framework, Optimisations.

UNIT II SCAN DESIGN AND BIST 9

Scan Design- Scan design requirements, Types of scan and control mechanisms, Test pattern construction for scan, Managing scan in IPs and SOCs, Scan design optimisations, Partitioning, Clocking requirements for scan and delay fault testing, Speed of operation; BIST – Framework, Controller configurations, FSMs, LFSRs, STUMPS architecture, Scan compression and bounds, Test per cycle, Test per scan, Self-testing and self-checking circuits, Online test.

UNIT III MEMORY TEST AND TEST INTERFACES 9

Memory Test -Memory fault models, Functional architecture as applicable to test, Test of memories, Test of logic around memories, BIST controller configuration, Test of logic around memories, DFT and architecture enhancements, Algorithmic optimisations; Test Interfaces-Test control requirements, Test interfaces - 1500, JTAG, Hierarchical, serial control, Module / IP test, SOC test, Board test, System test, Boundary scan.

UNIT IV DESIGN CONSIDERATIONS AND POWER MANAGEMENT DURING TEST 9

Design Considerations- Design considerations, Physical design congestion, Partitioning, Clocks, Test modes, Pins, Test scheduling, Embedded test, Architecture improvements, Test in the presence of security; Power management during test- Methods for low power test, ATPG methods, DFT methods, Scan methods, Low power compression, Test of power management, Implications of power excursions, Optimisations.

UNIT V ANALOG TEST 9

Test requirements. DFT methods. BIST methods. Test versus measurement. Defect tests versus performance tests. Tests for specific modules - PLL, I/Os, ADC, DAC, SerDes, etc. RF test requirements Basics of DRAM, Self-Refres Circuit, Future Trend and Development of DRAM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand logic and fault simulation requirements and testability measures.

CO2: Understand the Design for Testability.

CO3: Develop interfacing and memory testing.

CO4: Perform testing with power management techniques

CO5: Carry-out fault Detection in analog circuits.

TEXT BOOKS:

1. Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Vishwani Agrawal and Michael Bushnell, Springer, 2002.

U23ECV15	MIXED SIGNAL IC DESIGN TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To know about mixed-signal devices and the need for testing these devices.
2. To study the various techniques for testing.
3. To learn about ADC and DAC based testing.
4. To understand the Clock and Serial Data Communications Channels
5. To study the general purpose measuring devices

UNIT I MIXED – SIGNAL TESTING 9

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits - Post- Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature.

UNIT II YIELD, MEASUREMENT ACCURACY, AND TEST TIME 9

Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guard bands - Effects of Measurement Variability on Test Yield - Effects of Reproducibilty and Process Variation on Yield - Statistical Process Control.

UNIT III DAC TESTING 9

Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications.

UNIT IV ADC TESTING 9

ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications.

UNIT V CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL MEASUREME 9

Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Learn the fundamentals of mixed signal circuits.

CO2: Define the various measurement terminologies.

CO3: Acquire knowledge of Analog to Digital Converters..

CO4: Learn testing of Analog to Digital Converters.

CO5: Comprehend the attributes of a clock signal.

TEXT BOOKS:

1. Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012 (Unit I - V)
2. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002. (Unit - III)
3. BapirajuVinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.(Unit - II)
4. Digital and Analogue Instrumentation: Testing and Measurement by Nihal Kularatna.

U23ECV16	ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study the basics of MOS Circuits.
2. To analyse the noise characteristics of amplifiers.
3. To study the performance parameters of amplifiers.
4. To comprehend the compensation techniques
5. To understand the detection and testing of faults.

UNIT I SINGLE STAGE AMPLIFIERS 9

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 9

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 SINGLE STAGE OPERATIONAL AMPLIFIERS 9

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, FREQUENCY COMPENSATION 9

Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT V LOGIC CIRCUIT TESTING 9

Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design amplifiers to meet user specifications.

CO2: Analyse the frequency and noise performance of amplifiers.

CO3: Design and analyse feedback amplifiers and one stage op amps .

CO4: Analyse stability of op amp.

CO5: Testing experience of logic circuits

TEXT BOOKS:

1. Behzad Razavi, "Design Of Analog Cmos Integrated Circuits", Tata Mcgraw Hill, 2001.(Unit –I,II,III,IV)
2. Parag K.Lala, "An Introduction to Logic Circuit Testing",Morgan & Claypool Publishers,2009.(Unit V)

REFERENCE BOOKS:

1. Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006.
2. Grebene, "Bipolar And Mos Analog Integrated Circuit Design", John Wiley & Sons,Inc.,2003. Phillip E.Allen, Douglas R .Holberg, "Cmos Analog Circuit Design", Oxford University Press, 2nd Edition, 2002.
3. Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start
4. Jacob Baker "CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

VERTICALS – II (SIGNAL PROCESSING)

U23ECV21 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts of discrete time random signal processing
- To know about multirate signal processing and its applications
- To understand the spectrum estimation techniques
- To learn the concept of prediction theory and filtering

UNIT I MULTIRATE SIGNAL PROCESSING 9

Review of Convolution, DFT and ZT, Multirate Signal Processing - Decimation, Interpolation, Sampling Rate Conversion by a rational factor – digital filter banks, sub band coding, Quadrature Mirror Filter.

UNIT II DISCRETE TIME RANDOM PROCESSES 9

Stationary random processes, Autocorrelation, Rational Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – relationship between autocorrelation and the filter parameters.

UNIT III LINEAR PREDICTION AND FILTERING 9

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT IV ADAPTIVE FILTERING 9

FIR adaptive filters – adaptive filters based on steepest descent method – LMS algorithm – Variants of LMS algorithm – adaptive echo cancellation – adaptive channel equalization – RLS Algorithm.

UNIT V SPECTRUM ESTIMATION 9

Estimation of power spectra from finite duration observations of signals – Non parametric methods of spectrum estimation – the Bartlett and the Welch method – Parametric spectrum estimation – AR, MA and ARMA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Comprehend multirate signal processing and demonstrate its applications
CO2:Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems
CO3: Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation.
CO4: Analyze adaptive filtering problems and demonstrate its application
CO5: Apply power spectrum estimation techniques to random signals.

TEXT BOOKS :

1. John G. Proakis & Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCES :

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
3. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.

U23ECV22 **IMAGE PROCESSING** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

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

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

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

UNIT II IMAGE ENHANCEMENT 9

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

UNIT III IMAGE RESTORATION 9

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

UNIT IV IMAGE SEGMENTATION 9

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

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

CO1 :Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3:Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

CO5:Comprehend image compression concepts.

TEXT BOOKS:

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

REFERENCES

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

U23ECV23 **SPEECH PROCESSING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Study the fundamentals of speech signal and extracts various speech features
- Understand different speech coding techniques for speech compression applications
- Learn to build speech enhancement, text-to-speech synthesis system

UNIT I FUNDAMENTALS OF SPEECH 9

The Human speech production mechanism, Discrete-Time model of speech production, Speech perception - human auditory system, Phonetics - articulatory phonetics, acoustic phonetics, and auditory phonetics, Categorization of speech sounds, Spectrographic analysis of speech sounds, Pitch frequency, Pitch period measurement using spectral and cepstral domain, Formants, Evaluation of Formants for voiced and unvoiced speech.

UNIT II SPEECH FEATURES AND DISTORTION MEASURES 9

Significance of speech features in speech-based applications, Speech Features – Cepstral Coefficients, Mel Frequency Cepstral Coefficients (MFCCs), Perceptual Linear Prediction (PLP), Log Frequency Power Coefficients (LFPCs), Speech distortion measures–Simplified distance measure, LPC-based distance measure, Spectral distortion measure, Perceptual distortion measure.

UNIT III SPEECH CODING 9

Need for speech coding, Waveform coding of speech – PCM, Adaptive PCM, DPCM, ADPCM, Delta Modulation, Adaptive Delta Modulation, G.726 Standard for ADPCM, Parametric Speech Coding – Channel Vocoders, Linear Prediction Based Vocoders, Code Excited Linear Prediction (CELP) based Vocoders, Sinusoidal speech coding techniques, Hybrid coder, Transform domain coding of speech.

UNIT IV SPEECH ENHANCEMENT 9

Classes of Speech Enhancement Algorithms, **Spectral-Subtractive Algorithms -** Multiband Spectral Subtraction, MMSE Spectral Subtraction Algorithm, Spectral Subtraction Based on Perceptual Properties, **Wiener Filtering -** Wiener Filters in the Time Domain, Wiener Filters in the Frequency Domain, Wiener Filters for Noise Reduction, Maximum-Likelihood Estimators, Bayesian Estimators, MMSE and Log-MMSE Estimator, **Subspace Algorithms.**

UNIT V SPEECH SYNTHESIS AND APPLICATION 9

A Text-to-Speech systems (TTS), Synthesizers technologies – Concatenative synthesis, Use of Formants for concatenative synthesis, Use of LPC for concatenative synthesis, HMM-based synthesis, Sinewave synthesis, Speech transformations, Watermarking for authentication of a speech, Emotion recognition from speech.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of speech.
CO2: Extract various speech features for speech related applications
CO3: Choose an appropriate speech coder for a given application.
CO4: Build a speech enhancement system.
CO5: Build a text-to-speech synthesis system for various applications

TEXT BOOKS :

1. Shaila D. Apte, Speech and Audio Processing, Wiley India (P) Ltd, New Delhi, 2012
2. Philipos C. Loizou, Speech Enhancement Theory and Practice, Second Edition, CRC Press, Inc., United States, 2013.

REFERENCES:

1. Rabiner L. R. and Juang B. H, Fundamentals of speech recognition, Pearson Education, 2003
2. Thomas F. Quatieri, Discrete-time speech signal processing - Principles and practice, Pearson,2012.

U23ECV24	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the concepts of software radios
2. To know about RF implementation challenges for software defined radios
3. To understand the digital generation of signals
4. To learn the software and hardware requirements for software defined radios.

UNIT I INTRODUCTION TO SOFTWARE RADIO 9

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

UNIT II RF IMPLEMENTATION 9

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems, Applications of Direct Digital Synthesis.

UNIT III DIGITAL GENERATION OF SIGNALS 9

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT IV SMART ANTENNAS 9

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNITV HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 9

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 Demonstrate an understanding in the evolving paradigm of Software defined radio and technologies for its implementation.

CO2 Analyse Radio frequency implementation issues

CO3 Implement Smart antenna techniques for software defined radio.

CO4 Compare various digital synthesis procedures.

CO5 Comprehend various hardware and software requirements for software defined radios.

TEXT BOOKS:

1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering,” Prentice Hall Professional, 2002.
2. Tony J Rouphael, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.

REFERENCE BOOKS:

1. P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House, 2005.
2. Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002.
3. Behrouz. F. Bourjney “Signal Processing for Software defined Radios”, Lulu 2008.

U23ECV25 DSP ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- Study the architecture of programmable DSP processors
- Learn to implement various standard DSP algorithms in DSP Processors
- Use the Programmable DSP Processors to build real-time DSP systems

UNIT I ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS 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 II TMS320C5X PROGRAMMABLE DSP PROCESSOR 9

Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit

UNIT III TMS320C6X PROGRAMMABLE DSP PROCESSOR 9

Commercial TI DSP processors, 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 DSP ALGORITHMS 9

DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.

UNIT V APPLICATIONS OF DSP PROCESSORS 9

Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the architectural features of DSP Processors.
CO2: Comprehend the organization of TMS320C54xx DSP processors
CO3: Build solutions using TMS320C6x DSP Processor
CO4: Implement DSP Algorithms
CO5: Study the applications of DSP Processors.

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. RulphChassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008

REFERENCES

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. TMS320C5416/6713 DSK user manual at https://www.ti.com

U23CSV17 **COMPUTER VISION** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV 3D RECONSTRUCTION 9

Shape from X - Active rangefinding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: To understand basic knowledge, theories and methods in image processing and computer vision.

CO2: To implement basic and some advanced image processing techniques in Open CV.

CO3: To apply 2D a feature-based based image alignment, segmentation and motion estimations.

CO4: To apply 3D image reconstruction techniques

CO5: To design and develop innovative image processing and computer vision applications.

TEXT BOOKS:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

VERTICALS – III (RF TECHNOLOGIES)

U23ECV31 RF TRANSCEIVERS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of RF system design
- To acquaint with the various components of RF system for wireless communications
- To know the basic techniques needed for analysis of RF systems
- To enable the students to verify the basic principles and design aspects involved in RF systems components
- To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes

UNIT II IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS 9

Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric.

UNIT IV FILTERS, OSCILLATORS AND MIXERS 9

Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers.

UNIT V PLL AND FREQUENCY SYNTHESIZERS 9

PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Interpret the nonlinear effects in RF circuits

CO2: Design RF circuits

CO3: Analyze the performance of RF circuits

CO4: Apply knowledge to identify a suitable architecture and systematically design an RF System

CO5: Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions

TEXTBOOKS

1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012

REFERENCES

1. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000
2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015

U23ECV32	SIGNAL INTEGRITY	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- Understand characteristic impedance of transmission line and impedance matching techniques.
- Understand plain signal reflection and cross talk noise in the transmission line, and also explain the mathematical analysis method.
- Understand Eye diagram and related measurement to test quality of Signal
- Learn Jitter analysis and jitter decomposition
- Work with high frequency differential signal and its applications

UNIT I SIGNAL REFLECTION AND IMPEDANCE MATCHING TECHNIQUE 9

Phenomenon of signal reflection. Signal reflection at transmitting end. Signal reflection at branch point. Multiple reflection in transmission line. Prevention of signal reflection by using impedance matching technique.

UNIT II CROSSTALK NOISE 9

Crosstalk definition and classification. Crosstalk mechanism. Analysis of crosstalk noise in transmission line. Main factor of causing crosstalk noise.

UNIT III DIFFERENTIAL SIGNAL TRANSMISSION CIRCUIT. 9

Pros and cons of using differential signaling compared with that of single-ended signaling. High speed differential interfaces. Theory of differential signaling. Differential signal termination techniques.

UNIT IV FREQUENCY RESPONSE OF A CIRCUIT 9

Frequency response of transmission line and circuit. Inter-symbol interference (ISI) and eye-pattern. Deterioration of a signal waveform due to ISI. Circuit techniques to prevent the deterioration. Linear time-invariant systems. Frequency response of pulse.

UNIT V EYE DIAGRAM AND JITTER 9

Jitter Definition and Types of Jitter; Jitter decomposition; Eye diagram analysis and related measurement.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Familiarity with High speed design and related issues
CO2: Understanding on critical design aspect
CO3: Know about Jitter and related measurements which is critical for design
CO4: Practical application of high speed differential signals
CO5: Measurement expertise up to industry expectations

TEXT BOOKS

1. Signal and Power integrity Simplified -Eric Bogatin, Pearson, 3rd Edition
2. High Speed Digital Design by Howard Johnson and Martin Graham, Prentice Hall,1st Edition.

REFERENCES

1. High Speed Signal Propagation and Howard Johnson,Prentice Hall,1st Edition

U23ECV33 **ANTENNA DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of antenna arrays for smart antenna design
- To discuss the random variables and processes for angle of arrival (AOA) estimation
- To describe different algorithms used for AOA estimation
- To introduce the concepts of fixed weight beamforming
- To introduce the concept of adaptive beamforming

UNIT I ANTENNA ARRAY FUNDAMENTALS 9

Linear arrays: Two element and Uniform N element array – Array weighting: Beam steered and weighted arrays – Circular arrays – Rectangular planar arrays – Fixed beam arrays – Butler Matrices – Fixed sidelobe cancelling – Retrodirective arrays: Passive and active retrodirective arrays.

UNIT II PRINCIPLES OF RANDOM VARIABLES AND PROCESSES 9

Definition of Random Variables - Probability Density Functions - Expectation and Moment - Common Probability Density Functions - Stationarity and Ergodicity - Autocorrelation and Power Spectral Density - Correlation Matrix

UNIT III ANGLE OF ARRIVAL ESTIMATION 9

Fundamentals of Matrix Algebra: Vector basics - Matrix basics - Array Correlation Matrix - AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate,maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate

UNIT IV SMART ANTENNAS: FIXED WEIGHT BEAMFORMING 9

Introduction - Historical Development of Smart Antennas - Fixed Weight Beamforming Basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance

UNIT V SMART ANTENNAS: ADAPTIVE BEAMFORMING 9

Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method, Spreading sequence array weights, Description of the new SDMA receiver.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the basics of phased array antennas
CO2: Understand random process and its application in Smart antennas
CO3: Estimate the weights of the antenna array based on the angle of arrival
CO4: Analyze the fixed weight beamforming in smart antennas
CO5: Analyze adaptive beamforming in smart antennas

TEXT BOOKS

1. Frank Gross, Smart antennas for wireless communications, McGra-Hill, 2006.
2. S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2009.

REFERENCES

1. T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 1998.
2. Robert A.Monzingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011.
3. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005.

U23ECV34 MICS AND RF SYSTEM DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the characteristics of Active components and applications.
- To design the RF filter and analyze the circuits operated at millimeter wavelength
- To understand the basics of Microwave integrated circuits
- To learn the concepts of non reciprocal components for MICs
- To design the antenna and analyze its performance using measurement techniques

UNIT I ACTIVE RF COMPONENTS AND APPLICATIONS 9

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks-impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

UNIT II RF FILTER DESIGN 9

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

UNIT III INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS 9

Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstrip line- Active Device Technologies- Design Approaches Multichip Module Technology- Substrates

UNIT IV NON RECIPROCAL COMPONENTS FOR MICs 9

Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.

UNIT V INTEGRATED ANTENNA DESIGN AND MEASUREMENTS 9

Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements - Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course the student will be able to

CO1: Apply knowledge of S parameter theory to any RF active component design circuit for obtaining performance measure.

CO2: Analyze microwave circuits for filters design.

CO3: Evaluate the performance of any practical Microwave integrated circuits

CO4: Create communication circuits and subsystems with practical design parameters fornon- reciprocal components in MICs.

CO5: Design microwave integrated antenna design circuit for the required Performance using professional software tools.

TEXTBOOKS

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.(Unit – I, II)
2. Bharathi Bhat, Shiban K. Koul, "Stripline-like Transmission Lines for Microwave

Integrated Circuits", New Age International Pvt Ltd Publishers, 2007.(Unit –III ,V)

3. Gupta KC and Amarjit Singh, "Microwave Integrated circuits", Wiley Eastern, 1974.(Unit – IV)

REFERENCES

1. MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
2. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
3. RolandE. Best, Phase – Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003
4. David Pozar ,Microwave Engineering, Addison Wesley 3rd Edition
5. Ravender Goyal, "Monolithic MIC; Technology & Design", Artech House, First Edition 1989.

U23ECV35 RFID SYSTEM DESIGN AND TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To discuss the fundamentals of near field and far field RFID communications
- To articulate the standards and protocols used in RFID systems
- To describe the operating principles of RFID tag and reader
- To introduce the security aspects and system architecture of RFID systems
- To illustrate the industrial and scientific applications of RFID systems

UNIT I INTRODUCTION 9

RFID Principles: Near-field based RFID – Properties of Magnetic field – Far-field based RFID – Properties of Backscatter RF Systems – Modulation techniques – Frequency based property comparison of RFID Systems

UNIT II RFID STANDARDS AND PROTOCOLS 9

RFID Industry standards: EPC global – ISO15693 Vicinity cards and RFID – ISO14443 Proximity cards and RFID – The NFC forum – Reading collocated RFID tags: Query Tree protocol – Query Slot protocol

UNIT III OPERATING PRINCIPLES 9

RFID Tag components: RFID tag types – the 1-Bit Transponder and Chipless Tags – RFID readers and middleware component – Communication fundamentals: Coupling, Data encoding, multi-path effect – Tag, Reader and sensor communication.

UNIT IV DATA INTEGRITY AND SECURITY 9

The checksum procedure – Multiaccess procedures – Attacks on RFID Systems – Protection by Cryptographic measures

UNIT V RFID ENABLED SENSORS AND APPLICATIONS 9

RFID enabled Sensors: Antenna design challenges – IC design – Integration of sensors and RFID – Power consumption and Link budget. Applications: Contactless smart cards – Access control – Electronic passport – Industrial Automation – Medical applications – Challenges and opportunities.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Classify RFID systems based on frequency, architecture and performance
CO2: Define standards for RFID technology
CO3: Illustrate the operation of various components of RFID systems
CO4: Describe the privacy and security issues in RFID Systems
CO5: Discuss the construction and applications of RFID enabled sensor.

TEXTBOOKS

1. Roy Want, RFID Explained, Springer 2022.
2. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010

REFERENCES

1. Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010
2. Syed Ahson, Mohammad Ilyas, RFID Handbook, CRC Press, 2008
3. Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.

U23ECV36 EMI / EMC PRE COMPLIANCE TESTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference
- To teach the importance of measurement device for EMI.
- To explain the EMI coupling & control principles
- To understand receivers & Analyzer functionalities
- To impart knowledge on design issues in EMI/EMC

UNIT I NATURE AND ORIGINS OF ELECTROMAGNETIC COMPATIBILITY 9

Introduction-Visualisiong the EMI problem-Source of EMI,EMI coupling to victim equipment, Intersystem and Intra system EMI, EMC standards and specifications.

UNIT II TYPES of EMI COUPLING 9

Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling, Near field cable to cable coupling; Field to cable coupling, Power mains and Power supply coupling; Transient EMI

UNIT III MEASUREMENT DEVICES FOR EMI 9

Introduction – Measurement by direct connection, Inductively coupled devices, EMC antennas – Basic antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing.

UNIT IV RECEIVERS, ANALYSERS AND MEASUREMENT EQUIPMENT 9

EMI receiver, Spectrum Analyzers, RF power meter Frequency meters. Standards requiring immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal, ESD-electrostatic discharge

UNIT V PRE-COMPLIANCE TESTING TO AVOID EMC PROBLEMS 9

Need for Pre-Compliance Testing; Intersystem and Intrasystem EMC - Developing an approach to EMC design - Process flow chart, - EMC strategy – Self certification; Solutions to avoid EMC: ESD Shielding, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Perceive the various types and mechanisms of Electromagnetic Interference
CO2: Propose a suitable EMI mitigation technique.
CO3: Evaluate EMI coupling & control principles
CO4: Explain the importance receivers & Analyzer functionalities
CO5: Inspect the design issues in EMI/EMC

TEXTBOOKS

1. David Morgan , "A Handbook for EMC Testing and Measurement", IET Electrical Measurement, 2012
2. Tim Williams , "EMC for Product Designers", 5th Edition, Newnes Elsevier, 2017.

REFERENCES

1. 1.V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996
2. Paul, C.R., “Introduction to Electromagnetic Compatibility”, 2nd ed., Wiley (2010)
3. David K. Cheng, “Field and Wave Electromagnetics”, 2nd ed. Pearson Education, 2009

VERTICALS – IV (BIO MEDICAL TECHNOLOGIES)

U23BMV62 WEARABLE DEVICES L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know 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. 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:

On successful completion of this course, the student will be able to

CO1: Describe the concepts of wearable system.

CO2: Explain the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

REFERENCES

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

U23BMV73 **HUMAN ASSIST DEVICES** **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 help a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications

UNIT I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, 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, Implanting Type.

UNIT IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

CO1:Explain the principles and construction of artificial heart

CO2:Understand various mechanical techniques that improve therapeutic technology

CO3:Explain the functioning of the membrane or filter that cleanses the blood.

CO4:Describe the tests to assess the hearing loss and development of wearable devices for the same.

CO5:Analyze and research on electrical stimulation and biofeedback techniques in rehabilitation and physiotherapy.

TEXT BOOKS:

1. Gray E Wnek, Gray L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering –Marcel Dekker Inc New York 2004.
2. John. G . Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd - 2004
3. Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006

REFERENCES:

1. Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.
2. Gray E Wnek, Gray L Browlin, "Encyclopedia of Biomaterials and Biomedical Engineering" Marcel Dekker Inc New York 2004.
3. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.

U23BMV76 THERAPEUTIC EQUIPMENT L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the principles of cardiac assist devices.
- To understand the need and use of extracorporeal devices, and the use of lasers in medicine.
- To enable the students to gain knowledge on the working of therapeutic clinical equipment.

UNIT I CARDIAC AND RESPIRATORY THERAPY EQUIPMENT 9

Cardiac Pacemaker: Internal and External Pacemaker– Programmable pacemakers. Cardiac Defibrillators: AC and DC Defibrillator- Internal and External Defibrillators - Protection Circuit, Defibrillator analyzers. Cardiac ablation catheter.

Types of Ventilators – Pressure, Volume, and Time controlled. Basic principles of electromechanical, pneumatic and electronic ventilators, Patient Cycle Ventilators, Ventilator testing. Humidifiers, Nebulizers, Inhalators.

UNIT II BIOMECHANICAL THERAPEUTIC EQUIPMENT 9

Electrodiagnosis, Therapeutic radiation, Electrotherapy, Electrodes, Stimulators for Nerve and Muscle, Functional Electrical Stimulation. peripheral nerve stimulator, ultrasonic stimulators, Stimulators for pain and relief - Inferential Therapy Unit, TENS. GAIT Assessment and Therapy. Continuous Passive Motion unit, Cervical / Lumber Traction Machine -Traction Table.

UNIT III BODY CARE EQUIPMENT 9

Skin Treatment: Ultrasonic spot remove, vacuum therapy unit, Skin tightening, Wrinkle Reduction, Facial and Rejuvenation. Laser hair therapy machine. Body Slimmer/Shaper – Deep Heat Therapy, Massager, Fitness – Treadmill, Bike.

UNIT IV DENTAL CARE EQUIPMENT 9

Dental Chair - Dental Hand pieces and Accessories: Evolution of rotary equipment, Low-speed handpiece, High-speed handpiece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum tecniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.

UNIT V HEAT & PHOTON THERAPY EQUIPMENT 9

High frequency heat therapy, Principle, Short wave diathermy, Microwave diathermy, Ultrasonic therapy, Lithotripsy. Therapeutic UV and IR Lamps. Basic principles of Biomedical LASERS: Applications of lasers in medicine, CO2laser, He-Ne laser, Nd-YAG and Ruby laser.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Suggest suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology, etc

CO2: Comprehend the principles of bodycare equipment

CO3: Understand the operation of dental care equipment.

CO4: Analyze the different types of therapies for suitable applications.

CO5: Appreciate the application of lasers in biomedical applications.

TEXT BOOKS

1. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition. Tata McGrawHill Pub. Co., Ltd. 2003.
2. John.G.Webster. "Medical Instrumentation, Application and Design". Fourth Edition.Wiley &s ons, Inc., NewYork. 2009.

REFERENCES

1. Leslie Cromwell, Fred. J. Weibell & Erich. A.Pfeiffer. "Biomedical Instrumentation and Measurements". Second Edition. Prentice Hall Inc.2000.
2. John Low & Ann Reed. "Electrotherapy Explained, Principles and Practice". Second Edition. Butterworth Heinemann Ltd. 2000.
3. Joseph. J. Carr, John Michael Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall and Technology, 2008.

U23BMV44 MEDICAL IMAGING SYSTEMS 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.

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 student will be able to:

CO1: Describe the working principle of the X-ray machine and its application.

CO2: Illustrate the principle computed tomography

CO3: Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.

CO4: Demonstrate the applications of radionuclide imaging.

CO5: Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety.

TEXT BOOKS:

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis(Biomedical Engineering),Academic Press,2000.
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000
3. Khin Wee Lai, DyahEkashantiOctorinaDewi "Medical Imaging Technology", Springer Singapore, 2015

REFERENCE BOOKS

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ",Springer-Verlag New York, 2011

U23BMV55 BRAIN COMPUTER INTERFACE AND APPLICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- To understand the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in 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:

On successful completion of this course, the student will be able to

CO1: Describe BCI system and its potential applications.
CO2: Analyze event related potentials and sensory motor rhythms.
CO3: Compute features suitable for BCI.
CO4: Design classifier for a BCI system.
CO5: Implement BCI for various applications.

TEXT BOOKS

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.

REFERENCES

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
3. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 1995.

U23BMV63 **BODY AREA NETWORKS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

The student should be made to:

- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

UNIT I INTRODUCTION 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction.

UNIT II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes.

UNIT III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee.

UNIT IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Comprehend and appreciate the significance and role of this course in the present contemporary world.

CO2: Design a BAN for appropriate application in medicine.

CO3: Assess the efficiency of communication and the security parameters.

CO4: Understand the need for medical device regulation and regulations followed in various regions

CO5: Extend the concepts of BAN for medical applications.

TEXT BOOKS

1. Sandeep K.S. Gupta,Tridib Mukherjee, Krishna Kumar Venkata Subramanian, “Body Area Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013
2. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation, and Applications”, Pan Stanford Publishing Pte. Ltd., Singapore, 2012

REFERENCES

1. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems’’, Springer, 2013.
2. Guang-Zhong Yang(Ed.), “Body Sensor Networks’’, Springer, 2006.
3. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.

VERTICALS – V (SENSOR AND UNDERWATER TECHNOLOGIES)

U23ECV51 UNDERWATER INSTRUMENTATION SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn basics of underwater vehicle control system
- To know the basic sensors and transducers used in underwater vehicles
- To learn the types of communication systems
- To learn different types of underwater vehicles and their applications.
- To learn about subsea battery and power management system

UNIT I INTRODUCTION ON DATA ACQUISITION AND CONTROL SYSTEM9

Introduction on PLC& various Input / Output modules, SCADA and HMI, Real time Controller, Signal conditioning circuits and associated components: Ethernet Modem, SMPS, Media converters, Ethernet switches, Fuses & Fuse holders, Power supply units, Power management system, Pressure Compensator, Pressure compensated batteries, Volve amplifiers, Actuators, Types of valves- proportional valves and solenoid valves, Types of relays- Solid State Relay and Electromagnetic relay, Pressure casing for underwater DACS,

UNIT II UNDERWATER SENSORS AND TRANSDUCERS 9

Navigation and Auxiliary sensors and Transducers

Inertial Navigation System, FOG/RLG, GPS, DGPS, Gyroscope, Motion Reference Unit, Doppler Velocity Log, Acoustic Transponder, Beacon, Positioning System- LBL, SBL, SSBL, Underwater Encoder, Proximity switches, Conductivity sensor, Temperature sensor, Depth sensor, Accelerometer, Tilt sensor, LVDT, Vaccum sensor, Current meters.

Scientific Instruments

Acoustic Doppler Current Profiler, Echosounder, Hydrophones, SONAR- Forward looking SONAR, Bottom Looking SONAR, Altimeter, Swell and wave sensor, PH sensor, Turbidity sensor, Oxygen sensor, Water samplers, Nitrogen sensor, CTD

UNIT III TELEMETRY SYSTEM 9

Telemetry system for tethered vehicles, Fiber optic communication, Single mode fiber, Multimode fiber, Fiber optics in oceanographic applications, Basis of optical fiber transmission, Fiber losses and signal attenuation, Slip rings, Umbilical cables, Underwater cables and connectors, Field installable Termination Assembly

Acoustic communication: Acoustic wave propagation, Optical communication, Satellite communication- Iridium, Inmarsat, Argos for surface Tracking.

UNIT IV TYPES OF UNDERWATER VEHICLES 9

Type of vehicles, manned and unmanned vehicles, Tethered and untethered vehicles, Remotely Operable Vehicle (ROV), Autonomous Underwater vehicle (AUV), Gliders, Solar powered Gliders, Manned submersible, Submarines, Deep Sea Rescue vehicle (DSRV), Various Propulsion systems.

UNIT V CASE STUDY **9**

Design of low power DAC system for portable instrument,
Design of power module for autonomous system,
Design consideration on wireless sensor network and its important,
MEMS systems used in underwater systems and its merits and demerits.

TOTAL: 45 PERIODS

C**OURSE OUTCOMES:**

On successful completion of this course, the student will be able to

CO1: Design of DAC system for various underwater Applications
CO2: Knowledge about sensors used underwater and their working principle
CO3: Underwater communication system and their application
CO4: Knowledge about different types of underwater vehicles
CO5: Subsea battery and Battery Management System

BOOK REFERENCES

1. The Ocean engineering Handbook, Ferial El- Hawary
2. Guidance and control of Ocean Vehicles, Thor I Fossen
3. Instrumentation and metrology in Oceanography by Marc Le mann
4. Jane's Underwater technology,, Technology and applications of AUV by Gwyn Griffiths
5. Fundamentals of Marine Vehicle Control, Karl Von Ellenrieder
6. Instrumentation & control G J Roy
7. Handbook of ocean and underwater engineering, Myers, J J; Holm, C H; McAllister, R F
8. Underwater communication and Network, Yi Lou, Niaz Ahmed.

U23ECV52 UNDERWATER IMAGING SYSTEMS AND IMAGE PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamental components of optical imaging
- To understand the challenges involved in Underwater imaging
- To understand the fundamental of Ocean Acoustics
- To Understand the principle of image processing techniques
- To Learn the SONAR Systems and various applications

UNIT I FUNDAMENTAL COMPONENTS OF OPTICAL IMAGE PROCESSING SYSTEM 9

Fundamentals and application of image processing, Human and Computer Vision, Introduction on Digital Camera: Focal length, Aperture, Shutter Speed, Spatial Resolution, Underwater lights and its importance, Halogen, LED, Colour Temperature, lumens, Beam angle. Image File format: JPEG, PNG, TIFF, BMP, GIF.

UNIT II OPTICAL IMAGE PROCESSING 9

Image Formation, Digitization, Sampling and Quantization, Geometric Transformation, Interpolation, Image Reconstruction, Spatial Filtering, Histogram, Binary Image, Color Fundamentals, Color transformations, Color Interpolation, Morphology, Image segmentation, Pattern Recognition. Challenges involved in underwater optical imaging.

UNIT III FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

Acoustic waves, Acoustic pressure, Velocity and density, Frequency and wavelength, Intensity and power, Logarithmic notation- Decibels, absolute references and levels, Source Level, Basics of propagation losses, Target Strength, Back scattering, Acoustic noise, Multiple paths, Doppler effect, Time characteristics of echoes, Active and passive sonar equations, Underwater electro acoustic transducers- projectors and hydrophones, General Structure of SONAR systems

UNIT IV SONAR SIGNAL PROCESSING 9

Spatial signals-Signals in space and time, Co-ordinate systems, Propagating waves, Wave number-frequency space, Finite continuous apertures, Spatial sampling, Directivity, Beamforming, Time and frequency domain beamforming, Array gain, Angular resolution, Transmitting signals-Narrowband Vs Chirp, Matched filtering, Range resolution, Time Varying Gain (TVG), Signal intensity to image conversion

UNIT V DIFFERENT TYPES OF SONAR SYSTEMS 9

Passive and active sonars, Single beam echo sounder, Multi beam echo sounder, Sub-bottom profiler, Sediment profiler, Side scan sonar, Synthetic aperture sonar, Forward looking sonar.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Understand the techniques for underwater imaging

CO2: Understand the fundamentals of underwater acoustics and ambient noise

CO3: Exposer for array processing techniques for underwater imaging applications

CO4: Design of Filter and impedance matching circuits

CO5: Know about SONAR system and its applications

TEXT BOOKS

1. Bernd Jahne, "Digital Image processing, Sixth Edition, Springer,2005
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB, Third Edition, Gatesmark Publishing,2020
3. P.K. Thiruvikraman,"A Course on Digital Image processing with MATLAB, First Edition, IOP Publishing,2020

REFERENCES

1. Tinku & Ajoy K. Ray,"Image Processing principles & Applications, First Edition, Wiley- Interscience,2005
2. Xavier Lurton,"An Introduction to Underwater Acoustics (Principles and applications), Second Edition, Springer,2010
3. Don H. Johnson and Dan E. Dudgeon,"Array Signal Processing: Concepts and Techniques, First Edition, Prentice Hall,1993
4. Harry L. Van Trees,"Optimum Array Processing, First Edition, Wiley-Interscience,2002
5. Richard O. Nielsen,"Sonar Signal Processing, First Edition, Artech House,1991
6. A. D. Waite,"SONAR for Practicing Engineers, Third Edition, Wiley,2002.

U23ECV53 UNDERWATER COMMUNICATION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about fiber optic communication for underwater application
- To learn underwater MI communication and sensor networking
- To understand underwater acoustic communication
- To understand the challenges in underwater communication
- To learn underwater cables and handing system for various application

UNIT I UNDERWATER FIBRE OPTICS COMMUNICATION 9

Basics of Fibre Optics communication**:** Working Principle, Single Mode, Multi-Mode, Effect on Fibre bending, Standard FO Connectors, Cable Requirement for Underwater Application, Cable Characteristics, Basic design for Electro-Optical(E-O) Underwater Cable, Handling system for E-O cables, Optical slip ring and its application, An insight into Fibre Optic Telemetry.

UNIT II UNDERWATER OPTICAL COMMUNICATION 9

Introduction, Classification of Underwater Wireless Optical Communication Links, Underwater Optical Communication (UWOC) System: Modulation, Coding, Light Source Technology, Common Lasers in UWOC, Signal Detectors and its merits and demerits, Alignment and Compensation, UWC Network, Absorption and Scattering Losses, UWOC Channel Modeling, UWOC Link Turbulence, Noise in the UWOC Channel. UWOC Networks.

UNIT III UNDERWATER MI COMMUNICATION & SENSOR NETWORKS 9

Fundamental Principles of Magnetic Induction, Basic Element of Magnetism, Magnetic Induction, Lenz's Law, Mutual and Self Induction, Inductive and Capacitive Reactance of the coil, MI Communication System: MI Coil, Matching Network, Communication Block:
MI Wireless Sensor Networks: UW sensor network Application and Its Architecture, Localization, Medium Access protocols, Routing Protocols, Cross-layer Protocols, Recent trend on MI communication.

UNIT IV BASIC PRINCIPLES OF UNDERWATER ACOUSTIC COMMUNICATION 9

Ocean Acoustic environment; Measuring sound levels and relevant units; Sound propagation in the ocean – sound velocity profiles in the deep water and shallow water Speed of underwater sound, Underwater Sound Transmission Loss, Acoustic Field Model: Ray Theory Model, Structure and Performance of UWAC System: Basic Structure of UWAC System, Performance Indicators of UWAC System, Characteristics of the UWA Channel.

UNIT V UNDERWATER ACOUSTIC NETWORK TECHNOLOGY

Basics on Underwater Acoustic Modem and its construction, Bandwidth and its limitations, Characteristics of UWA Network, Topology of UWA Network, Network Protocol Architecture of UWA Network, UWAC Challenges and Research Trends, Comparison study on RF, Optical and Acoustic Communication in Underwater. Underwater telephone, Acoustic Positioning System, Underwater beacon.

TOTAL:45PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: To get an explore to different underwater communication system

CO2: Design of MI coil for

CO3: To know the important of underwater communication and its challenges

CO4: To understand the strength of Underwater acoustic communication

CO5: To understand the sensor network concepts and its application

TEXTBOOKS

1. Yi Lou, Niax Ahmed, Underwater Communications and Networks, First Edition, Springer,2021

REFERENCES

1. Ferial El-Hawary, The Ocean Engineering Hand book, First Edition, CRC Press, 2001
2. L.M. Brekhovskikh and Yu. P. Lysanov, Fundamentals of ocean acoustics, Third Edition, Springer,2003
3. Robert J Urick, Principles of underwater sound, Third Edition, Peninsula Publishing,2013
4. Rahul Sharma, Deep Sea Mining Handbook, First Edition, Springer,2017.

U23ECV54	MEMS DESIGN	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the basic electrical and mechanical concepts of MEMS design
- To understand the design aspects of electrostatic sensors and actuators
- To understand the design aspects of thermal sensors and actuators
- To understand the design aspects of piezoelectric sensors and actuators
- To understand the design aspects of magnetic sensors and actuators

UNIT I ESSENTIAL ELECTRIC AND MECHANICAL CONCEPTS 9

Conductivity of semiconductors, Crystal planes and orientations, stress and strain, flexural beam bending analysis under simple loading conditions, Dynamic system, resonant frequency and quality factor

UNIT II ELECTRO STATIC SESNING AND ACTUATION 9

Parallel plate capacitor, Applications of parallel plate capacitors- inertial sensor, pressure sensor, flow sensor, tactile sensor, parallel plate actuators, interdigitated finger capacitors, applications of comb drive devices.

UNIT III THERMAL SENSING AND ACTUATION 9

Fundamentals of thermal transfer, Sensors and actuators based on thermal expansion, Themal couples, Thermal resistors, Applications- Infrared sensors, flow sensors, Inertial sensors, other sensors

UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9

Mathematical description of piezoelectric effects, Cantilever piezoelectric actuator model, properties of piezoelectric materials –Quartz, PZT,PVDF, ZnO , Applications – Acoustic sensors, Tactile sensors

UNIT V MAGNETIC SENSING AND ACTUATION 9

Concepts and principles- magnetization and nomenclatures, principles of micromagnetic actuators, fabrication of micro magnetic components- deposition, design and fabrication of magnetic coil, MEMS magnetic actuators

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of MEMS design aspects.

CO2: Apply the knowledge in the development of electro static sensors and actuators.

CO3: Apply the knowledge in the development of thermal sensors and actuators.

CO4: Apply the knowledge in the development of piezoelectric sensors and actuators.

CO5: Apply the knowledge in the development of magnetic sensors and actuators.

TEXTBOOKS

1. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006.

REFERENCES

1. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013.
2. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002
3. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002
4. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press,2012.

U23ECV55	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Study the functions of different wireless architectures.
2. Learn the various aspects of MAC protocols.
3. Know the concept of Infrastructure Establishment.

UNIT I AD-HOC AND SENSOR NETWORKS

Introduction to Wireless communication Technology, characteristics features, applications, constraints and challenges, required mechanisms, difference between ad-hoc and sensor networks, enabling technologies, Characteristics of Wireless channel, Adhoc Mobility Models:-entity and group Models

UNIT II ARCHITECTURES

Single Node Architecture -Hardware Components -Energy Consumption of Sensor -Nodes -Operating Systems and Execution Environments -Network Architecture-Sensor Network Scenarios -Optimization Goals and Figures of Merit-Gateway Concepts.

UNIT III NETWORKING SENSORS

Physical Layer and Transceiver Design Considerations -MAC Protocols for Wireless Sensor Networks -Low Duty Cycle Protocols and Wakeup Concepts -S-MAC -The Mediation Device Protocol -Wakeup Radio Concepts-Address and Name Management–Assignment of MAC Addresses-Routing Protocols Of sensor networks.

UNITIV SENSOR NETWORK MANAGEMENT

Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols – Time synchronization-Localization and positioning Operating system sand Sensor Network programming–Sensor Network Simulators.

UNITV SENSOR NETWORK PLATFORMS AND TOOLS

Operating Systems for Wireless Sensor Networks-Sensor Node Hardware -Berkeley Motes Programming Challenges -Node level software platforms -Node level Simulators — NS2 and its extension to sensor networks-State centric programming.

TOTAL:45 PERIODS

COURSE OUTCOMES:

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

CO1: Examine the various wireless sensor networking strategies.

CO2: Evaluate the different types of architecture used in sensor networks.

CO3: Analyze the technical issues related to networking of sensors.

CO4: Synthesize knowledge to control the sensor network.

CO5: Design and build a wireless sensor network using simulators.

TEXT BOOKS:

1. Holger Karl& Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, JohnWiley-2005.
2. Feng Zhao& Leonidas J.Guibas, Wireless Sensor Networks-An Information Processing Approach,Elsevier-2007.

REFERENCE BOOKS:

1. Kazem Sohra by-Daniel Minoli and Taieb Znati, Wireless Sensor Networks-Technology Protocols and Applications, John Wiley-2007.
2. Anna Hac, Wireless Sensor Network Designs, JohnWiley-2003. Bhaskar Krishna machari,

U23ECV56 FUNDAMENTALS OF NANO ELECTRONICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of nano electronics and quantum electronics
- To understand the concepts of nano electronic devices, transistors, tunneling devices and superconducting devices
- To understand the basics of nanotube devices

UNITI INTRODUCTION TO NANO ELECTRONICS 9

Scaling to nano - Light as a wave and particle- Electrons as waves and particles- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum

UNIT II QUANTUM ELECTRONICS 9

Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata - Quantum dot array, Quantum memory.

UNIT III NANO ELECTRONIC TRANSISTORS 9

Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.

UNIT IV NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES 9

Tunnel effect -Tunneling element -Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron- Josephson tunneling device.

UNIT V NANOTUBES AND NANOSTRUCTURE DEVICES 9

Carbon Nanotube - Fullerenes - Types of nanotubes – Formation of nanotubes –Assemblies – Purification of carbon nanotubes – Electronic properties – Synthesis of carbon nanotubes – Carbon nanotube interconnects – Carbon nanotube FETs and SETs –Nanotube for memory applications- Nano structures and nano structured devices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to
CO1: Understand the basics of nano electronics including quantum wires, dots and wells
CO2: Use the mechanism behind quantum electronic devices
CO3 : Analyze the key performance aspects of tunneling and superconducting nano electronic devices
CO4: Apply the knowledge in the development of nanotubes and nanostructure devices.

TEXTBOOKS

1. Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009.

REFERENCES

1. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004.

2. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.

3. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.

4. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018.

VERTICALS – VI (IOT AND CYBER TECHNOLOGIES)

U23ECV61 IOT PROCESSORS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Learn the architecture and features of ARM.
- Study the exception handling and interrupts in CORTEX M3
- Program the CORTEX M3
- Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller.
- Understand the concepts of System – On – Chip(SoC)

UNIT I OVERVIEW OF ARM AND CORTEX-M3 9

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence , CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram. Bus Interfaces, I – Code Bus, D – Code Bus, System Bus- External PPB and DAP Bus.

UNIT II CORTEX EXCEPTION HANDLING AND INTERRUPTS 9

Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Overview, Basic Interrupts, SYSTICK Time, Interrupt Behaviourm Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

UNIT III CORTEX M3/M4 PROGRAMMING 9

Cortex M3/M4 Programming: Overview, Typical Development Flow, Using C, CMSIS Using Assembly, Excepiton Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit and other CORTEX M3 Features, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.

UNIT IV STM32L15XXX ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS 9

STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools like Cross Assemblerm Compiler, Debugger, Simulator, In – Circuit Emulator(ICE), Logic Analyser.

UNIT V INTRODUCTION TO SYSTEM – ON – CHIP 9

System Architecture: An Overview, Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Area, Power and Time Trade – Offs in Processor Design – Reliability and Configurability – SOC Design Approach – Application Studies – AES, 3D Graphics Processor. Image Compression and Video Compression.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

CO1: Explain the architecture and features of ARM.

CO2: List the concepts of exception handling.

CO3: Write a program using ARM CORTEX M3/M4.

CO4: Learn the architecture of STM32L15XXX ARM CORTEX M3/M4.

CO5: Design an SoC for any application.

TEXTBOOKS

1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010.(Unit – I, II)
2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV)
3. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011.(Unit – V)

REFERENCES

1. Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015. CORTEX M Series ARM Reference Manual CORTEX M3 Technical Reference Manual STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97.

U23ECV62 IOT BASED SYSTEMS DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of IoT.
- To get knowledge about the various services provided by IoT.
- To familiarize themselves with various communication techniques and networking.
- To know the implementation of IoT with different tools.
- To understand the various applications in IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects - IoT levels and deployment templates – A panaromic view of IoT applications.

UNIT II MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID,WSN,SCADA,M2M –Interoperability challenges of IoT-Protocols for RFID,WSN,SCADA,M2M- Zigbee, KNX,BACNet,MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT III COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition –Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.

UNIT IV IOT IMPLEMENTATION TOOLS 9

Introduction to Python, Introduction to different IoTtools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT V APPLICATIONS AND CASE STUDIES: 9

Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style – Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key technologies, strength and limitations of IoT.

CO2: Identify the architecture, infrastructure models of IoT.

CO3: Analyze the networking and how the sensors are communicated in IoT .

CO4: Analyze and design different models for IoT implementation.
CO5: Identify and design the new models for market strategic interaction.

TEXT BOOKS:

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.

REFERENCES:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, “Internet of Things (IoT) in 5G Mobile Technologies” Springer International Publishing Switzerland 2016.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, “Architecting the Internet of Things” Springer-Verlag Berlin Heidelberg, 2011.

U23ECV63	INDUSTRIAL IOT AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. IoT Nodes & Sensors
2. IoT Gateways
3. IoT Cloud Systems
4. IoT Cloud Dashboards
5. Challenges in Iot system Design – Hardware & Software

UNIT I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM **9**

IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics

UNIT II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM **9**

UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow

UNIT III IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROL HARDWARE AND SENSORS **9**

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors,Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT IV CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM **9**

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services

UNIT V CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE **9**

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the building blocks of IoT technology and explore the vast spectrum of IoT applications

CO2: Use processors & peripherals to design & build IoT hardware

CO3: Assess, select and customize technologies for IoT applications

CO4: Connect numerous IOT applications with the physical world of humans and real life problem solving.

CO5: Design and implement IOT applications that manage big data

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCE BOOKS:

1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan.

U23ECV64	CYBER PHYSICAL SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Obtain cyber-physical systems fundamentals and principles knowledge as building blocks to promote further design and implementation of more complex real time systems.
2. Understand cyber physical systems design for synchronous model with specific case study for arm processor.
3. In what way cyber physical systems are crucial for the optimal performance of asynchronous model.
4. Comprehend the cyber physical systems design and implementation in dynamical models.
5. Hybridization of cyber physical systems which will help the students to anticipate upcoming technologies

UNIT I INTRODUCTION TO CYBER PHYSICAL SYSTEMS 9

Introduction To Cyber-Physical Systems, Cyber-Physical System Requirements, Interoperability, Survivability, Real Time System, Internet of Things (IOT), Radio Frequency Identification Technology and its use in CPS, Wireless Sensor Networks Technology and its application in CPS, Powerline Communication, Smart Cities And Internet Of Everything, Ubiquitous Computing Fundamentals, Autonomous Systems In Ubiquitous Computing, Cyber Physical Vehicle Tracking System (A case study).

UNIT II SYNCHRONOUS MODEL 9

Synchronous model overview, Reactive Components, Variables, Valuations, Expression and Execution, Extended-State Machines, Properties of Components, Various Types of components, Task Graphs and Await Dependencies, Composing Components, Output Hiding, Synchronous Designs (Synchronous Circuits, Cruise Control Systems, Synchronous Networks).

UNIT III ASYNCHRONOUS MODEL 9

Asynchronous Process overview, States, Internal Actions, Executions, Extended State Machines, Operations On Process, Blocking Vs Non-Blocking Synchronization, Deadlocks, Shared Memory, Fairness Assumptions, Asynchronous Coordination Protocols, Leader Election, Reliable Transmission, Wait Fee Consensus, Safety Specifications, Invariants Of Transition Systems, Safety Monitors

UNIT IV DYNAMICAL SYSTEM 9

Overview of dynamic systems, Continuous Time Model, Continuously Evolving Inputs and Outputs, Models with Disturbance, Composing Components Stability, Linear Systems Linearity, Solutions of Linear Differential Equations and stability, Designing Controllers, Open Loop Vs Feedback Controller, PID Controllers, Analysis Techniques, Barrier Certificates.

UNIT V HYBRID SYSTEM 9

Hybrid Dynamical Model, Zeno Behavior, Designing Hybrid Systems, Automated Guided Vehicle, Obstacle Avoidance with Multi Robot Coordination, Multi Hop Control Networks, Linear Hybrid Automata, Pursuit Game problem, Timed Automata, Model of Timed Automata.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of cyber physical systems.

CO2: Design synchronous models for Real Time applications.

CO3: Design Asynchronous models for Real Time applications.

CO4: Develop Deep Understanding on selection of hardware and software's for designing dynamical systems.

CO5: Come up with cost effective, reliable, robust and feasible designs for real world problem.

TEXT BOOKS:

1. Rajeev Alur, "Principles of Cyber Physical Systems", 1st Edition, MIT Press 2015.
2. Raj Rajkumar , "Cyber Physical Systems," 2nd Edition, Elsevier 2015

REFERENCE BOOKS:

1. Edward D Lamie, "Computing Fundamentals of Cyber Physical Systems", 2nd Edition, Newnes Elsevier Publication.

U23ECV65	INFORMATION SECURITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics of Information Security
2. To know the legal, ethical and professional issues in Information Security
3. To know the aspects of risk management
4. To become aware of various standards in this area
5. To know the technological aspects of Information Security

UNIT I INTRODUCTION 9

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC.

UNIT II SECURITY INVESTIGATION 9

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies,

UNIT III SECURITY ANALYSIS 9

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms, Information Flow and Confinement Problem..

UNIT IV LOGICAL DESIGN 9

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity.

UNIT V HYBRID SYSTEM 9

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss the basics of information security

CO2: Illustrate the legal, ethical and professional issues in information security

CO3: Demonstrate the aspects of risk management.

CO4: Become aware of various standards in the Information Security System

CO5: Design and implementation of Security Techniques.

TEXT BOOKS:

1. Michael E Whitman and Herbert J Mattord, “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003

REFERENCE BOOKS:

1. Micki Krause, Harold F. Tipton, “ Handbook of Information Security Management”, Vol 1-3 CRCPress LLC, 2004.
2. Stuart McClure, Joel Scrambray, George Kurtz, “Hacking Exposed”, Tata McGrawHill, 2003
3. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002 Edward D Lamie, “Computing Fundamentals of Cyber Physical Systems”, 2nd Edition, Newnes Elsevier Publication.

U23ECV66	CLOUD AND DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges
2. Learn about AWS IoT Analytics
3. Understand the fundamental ideas behind AWS IoT Analytics Commands.
4. Explore distributed system models and computer clusters for scalable parallel computing.
5. Learn about parallel processing for data intensive computing

UNIT I INTRODUCTION TO CLOUD COMPUTING 9

Basics of Avionics-Basics of Cockpits – 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 – Requirements and Importance of illities of Avionic Systems.

UNIT II AWS IOT ANALYTICS 9

What Is AWS IoT Analytics? - Why Use AWS IoT Analytics? -How to Use AWS IoT Analytics - AWS IoT Analytics Message Payload Restrictions- Getting Started with AWS IoT Analytics- Pipeline Activities -Pipeline Activities -Automating Your Workflow -SQL Support -Visualizing AWS IoT Analytics Data with Quick Sight-Logging AWS IoT Analytics API Calls with CloudTrail.

UNIT III AWS IOT ANALYTICS COMMANDS 9

Batch Put Message-Cancel Pipeline Reprocessing -Create Channel -Create Data set Content - Create Data store -Create Pipeline -Delete Channel -Delete Data set- Delete Data set Content - Delete Datastore -Delete Pipeline -Describe Channel -Describe Dataset -Describe Datastore - Describe Logging Options-Describe Pipeline – Get Data set Content -List Channels-List Data set Contents -List Datasets -ListDatastores-ListPipelinesListTagsForResource-PutLoggingOptions- Run Pipeline Activity Sample Channel Data-Start Pipeline Reprocessing-Tag Resource -Untag Resource -Update Channel-Update Dataset-Update Datastore-Update Pipeline .

UNIT IV DISTRIBUTED CLOUD COMPUTING 9

System Models for Distributed and Cloud Computing: Clusters of Cooperative computers-Grid Computing Infrastructures-Peer-to-Peer Network families- Software Environments for Distributed Systems and clouds: Service Oriented Architecture(SOA)-Trends towards distributed operating systems-Parallel and distributed programming models-Cluster Development trends-Design Objectives of Computer Clusters, Fundamental Cluster Design Issues-n Design Principles of Computer Clusters Single System Image features--High availability through redundancy, fault tolerant cluster configurations.

UNIT V TECHNOLOGIES AND TECHNIQUES 9

Load balancing techniques for Data Intensive computing – Resource Management for Data Intensive Clouds – SALT - Parallel Processing, Multiprocessors and Virtualization in Data intensive Computing - Challenges in Data Intensive Analysis and Visualization - Large-Scale Data Analytics Using Ensemble Clustering - Ensemble Feature Ranking Methods for Data Intensive Computing Application - Record Linkage Methodology and Applications- Semantic Wrapper.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the fundamental ideas behind cloud computing, cloud models and current trends.

CO2: Comprehend AWS IoT analytics

CO3: Interpret commands of AWS IoT analytics

CO4: Apply distributed system model and understand the design principles of computer clusters

CO5: Illustrate the fundamental concepts parallel processing

TEXT BOOKS:

1. Dan C. Marinescu, Cloud Computing Theory and Practice, 2nd Edition, Elsevier Inc., 2018
2. Hwang, K., Dongarra, J. and Fox, G.C., 2013. Distributed and cloud computing: from parallel processing to the internet of things. Morgan ufmann.
3. Furht, Borko, Escalante, Armando, “Handbook of Data Intensive Computing”, Springer 2011.

REFERENCE BOOKS:

1. Rajkumar Buyya, James Broberg, Andrzej Go scinski, Cloud Computing Principles and Paradigms, Wiley Publications, 2017.
2. Bahga, A. and Madisetti, V., 2013. Cloud computing: A hands-on approach. CreateSpace Independent Publishing Platform. AWS IoT Analytics User Guide

VERTICALS – VII (SPACE TECHNOLOGIES)

		L	T	P	C
U23ECV71	**RADAR TECHNOLOGIES**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. Understand the basics of Radar and Radar equation
2. Understand the types of Radar
3. understand tracking Radar
4. Understand the various signal processing in Radar
5. Understand the Subsystems in Radar

UNIT I INTRODUCTION TO RADAR EQUATION 9

The Origins of Radar ,Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

UNIT II CW, MTI AND PULSE DOPPLER RADAR 9

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT III TRACKING RADAR 9

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction , state estimation, Measurement models, alpha – beta tracker, Kalman Filtering, Extended Kalman filtering.

UNIT IV RADAR SIGNAL PROCESSING 9

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non fluctuating target in noise, Doppler spectrum of fluctuating targets, Range Doppler spectrum of stationary and moving radar

UNIT V RADAR TRANSMITTERS AND RECEIVERS 9

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver ,Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors- Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Identify the Radar parameters
- **CO2:** Differentiate various radar types
- **CO3:** Evaluate different tracking and filtering schemes
- **CO4:** Apply signal processing in target detection
- **CO5:** Design Radar transmitter and receiver blocks

TEXT BOOKS:

1. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.
2. M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012

REFERENCE BOOKS:

1. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition,2007.
2. M.I.Skolnik , "Introduction to Radar Systems", Tata McGraw Hill 2006.
3. Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.

U23ECV72	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To impart knowledge on the needs for avionics for both Civil and military aircraft.
2. To impart knowledge on avionics architecture and Avionics data bus.
3. To impart knowledge understand the various cockpit displays and human interfaces.
4. To impart knowledge on the concepts of flight control systems, FMS and their importance
5. To impart knowledge on different navigation aids and need for certification

UNIT I INTRODUCTION TO AVIONICS 9

Basics of Avionics-Basics of Cockpits – 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 – Requirements and Importance of illities of Avionic Systems.

UNIT II DIGITAL AVIONICS BUS ARCHITECTURE 9

Evolution of Avionics architecture– Avionics Data buses MIL-STD-1553, MIL-STD-1773, ARINC- 429, 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 FLIGHT CONTROL SYSTEMS 9

Introduction to Flight control systems and FMS– Longitudinal control – Lateral Control –Autopilot – Flight planning – Radar Electronic Warfare - Certification-Military and civil aircrafts

UNIT V NAVIGATION SYSTEMS 9

Overview of navigation systems - Communication Systems – Radio navigation – Types & Principles – Fundamentals of Inertial Sensors – INS – GNSS -- GPS – Approach and Landing Aids – ILS & MLS – Hybrid Navigation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Explain the different of Avionics Systems and its need for civil and military aircrafts considering the reliability and safety aspects

CO2: Select a suitable architecture and data bus based on the requirements

CO3: Compare the different display technologies used in cockpit

CO4: Explain the principles of flight control systems and the importance of FMS

CO5: Explain the communication and navigation techniques used in aircrafts

TEXT BOOKS:

1. R.P.G. Collinson, "Introduction to Avionics", Springer Publications, Third Edition, 2011.

REFERENCE BOOKS:

1. Cary R .Spitzer, "The Avionics Handbook", CRC Press, 2000.
2. Middleton, D.H. "Avionics Systems", Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice Hall, Englewood Cliffs, N.J., U.S.A., 1987.
4. Myron Kayton , Walter R. Fried "Avionics Navigation Systems" 2nd Edition, Wiley Publication, 2008.
5. Jim Curren, "Trend in Advanced Avionics", IOWA State University, 1992.

U23ECV73	POSITIONING AND NAVIGATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To explain the fundamentals of navigation systems.
2. To understand the inertial navigation systems
3. To acquire knowledge on radio navigation.
4. To have an overview of global positioning systems
5. To learn the hybrid navigation systems.

UNIT I NAVIGATION CONCEPTS 9

Fundamentals of navigation systems and Position Fixing – Categories of navigation - Geometric concepts of Navigation – The Earth in inertial space - Different Coordinate Systems – Coordinate Transformation - Euler angle formulations - Direction cosine matrices formulation - Quaternion formulation.

UNIT II INERTIAL NAVIGATION SYSTEMS 9

Inertial sensors - Gyroscopes -Types - Mechanical - Electromechanical-Optical Gyro -Ring Laser gyro- Fiber optic gyro- Accelerometers – Pendulous type – Force Balance type – MEMs - Basic Principles of Inertial Navigation – Types - Platform and Strap down - Mechanization INS system - Rate Corrections - Acceleration errors – Schuler Tuning.

UNIT III RADIO NAVIGATION & AIR TRAFFIC MANAGEMENT 9

Different types of radio navigation- ADF, VOR, DME, TACAN,VORTAC - Doppler – Hyperbolic Navigations – Air Traffic Management – RADAR Surveillance - Airborne Collision Avoidance Systems

UNIT IV GLOBAL POSITIONING SYSTEM 9

Overview of GPS: Basic concept, system architecture, , GPS Signals Signal structure, anti-spoofing (AS), selective availability, GPS for position and velocity determination, GPS aided Geo-augmented navigation (GAGAN) architecture -GPS error sources-clock error, ionospheric error, tropospheric error, multipath, ionospheric error estimation using dual frequency GPS receiver

UNIT V HYBRID NAVIGATION & RELATIVE NAVIGATION SYSTEMS 9

Hybrid Navigation - Introduction to Kalman filtering – Case Studies -Integration of GPS and INS using Kalman Filter - Relative Navigation – fundamentals – Equations of Relative Motion for circular orbits (Clohessy_Wiltshire Equations) - Sensors for Rendezvous Navigation - Relative positioning - Point positioning and differential positioning - Differential GPS (DGPS) and Space based Augmentation system (SBAS)- Concepts - Relative GPS -Formation Flying - Figure of Merit (FOM)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the advanced concepts of Positioning and Navigation systems and exposure on various Navigation systems

CO2: Know about Gyroscopes and accelerometers and Inertial Navigation systems and its types and Mechanisation

CO3: Explain the different Radio Navigation aids and its usage for civil and military aircrafts and satellites

CO4: Explain the Satellite Navigation – GPS and its usage in aircraft and spacecraft applications.

CO5: Deploy these skills effectively in the analysis and understanding of hybrid navigation systems and Relative navigation in a spacecraft.

TEXT BOOKS:

1. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons,2 edition,1997.
2. Nagaraja, N.S. "Elements of Electronic Navigation", Tata McGraw-Hill Pub. Co., New Delhi, 2nd edition, 1975.

REFERENCE BOOKS:

1. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
2. Albert Helfrick, 'Practical Aircraft Electronic Systems', Prentice Hall Education, Career & Technology, 1995.
3. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994.
4. Paul. D. Groves. 'Principles of GNSS, Inertial, and Multisensor Integrated Navigation Systems', Artech House, 2013.
5. Maxwell Noton, "Spacecraft navigation and guidance", Springer (London, New York), 1998

U23ECV74	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the basics of satellite orbits
2. Understand the satellite segment and earth segment
3. Understand Link Power budget calculation
4. Understand the various satellite access and coding technology
5. Understand the applications of satellite

UNIT I SATELLITE ORBITS 9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse- Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT II SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.

UNIT IV SATELLITE ACCESS AND CODING TECHNIQUES 9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, PAMA and DAMA Assignment Methods, compression – encryption, Coding Schemes.

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, LEO, MEO, Satellite Navigational System. GPS-Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the satellite orbits
CO2: Analyze the satellite subsystems
CO3: Evaluate the satellite link power budget
CO4: Identify access technology for satellite
CO5: Design various satellite applications

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017.
2. Timothy Pratt, Charles, W.Bostain, Jeremy E.Allnutt, "Satellite Communication”, 3rd Edition, Wiley Publications,2021.

REFERENCE BOOKS:

1. Tri T. Ha, “Digital Satellite Communications”, 2nd edition, Mc Graw Hill education, 2017.
2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communications Systems Engineering”, 2nd edition , Prentice Hall/Pearson , 2013.
3. M.Richharia, “Satellite Communication Systems-Design Principles”, Macmillan, 1999.
4. Brian Ackroyd, “World Satellite Communication and earth station Design”, BSP professional Books, 1990.
5. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 2003.

U23ECV75	REMOTE SENSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the principles of remote sensing
2. To learn the atmospheric radiation interactions
3. Understand the laws of planetary motion.
4. To Study about different types of remote sensing sensors.
5. Understand the concepts of digital interpretation

UNIT I REMOTE SENSING AND ELECTROMAGNETIC RADIATION **9**

Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchoff‘s law – Radiation sources: active & passive – Radiation Quantities.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL **9**

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III ORBITS AND PLATFORMS **9**

Motions of planets and satellites – Newton ‘s law of gravitation – Gravitational field and potential - Escape velocity - Kepler ‘s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit

UNIT IV SENSING TECHNIQUES **9**

Classification of remote sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors – High Resolution Sensors - LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT V DATA PRODUCTS AND INTERPRETATION **9**

Photographic and digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: To understand the principles of electromagnetic radiation.

CO2: To learn the atmospheric radiation interactions.

CO3: To study the laws of planetary motion.

CO4: To classify the different types of resolution.

CO5: To know the concepts of digital interpretation..

TEXT BOOKS:

1. Thomas M. Lillesand, Ralph W. Kieferand Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018.

REFERENCE BOOKS:

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA,2019, 4th edition
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press,2022 first edition.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 2021 Edition3, Wiley Publication.
5. BasudebBhatta, Remote Sensing and GIS, Oxford University Press, 2020 third edition.

U23ECV76	ROCKETRY AND SPACE MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. This course presents the fundamental aspects of rocket motion along with detailed estimation of rocket trajectories.
2. This course also imparts knowledge on optimization of multistage rockets.
3. This course provides the basics of space mechanics required for an aeronautical student
4. This course helps students to provide with the basics of orbit transfer of satellites.
5. This course will help students to gain knowledge on various control methods of rockets

UNIT I ORBITAL MECHANICS 9

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, Librations points – Estimation of orbital and escape velocities.

UNIT II SATELLITE DYNAMICS 9

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – orbit transfer and examples –Hohmann orbits – calculation of orbit parameters– Determination of satellite rectangular coordinates from orbital elements.

UNIT III ROCKET MOTION 9

Principle of operation of rocket motor – thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories – determinations of range and altitude – simple approximations to burnout velocity.

UNIT IV ROCKET AERODYNAMICS 9

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – rocket stability – rocket dispersion – launching problems.

UNIT V STAGING AND CONTROL OF ROCKET VEHICLES 9

Need for multi staging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles – SITVC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: To knowledge on the fundamental laws of orbital mechanics with particular emphasis on interplanetary trajectories.

CO2: To calculate orbital parameters and perform conceptual trajectory designs for geocentric or interplanetary missions.

CO3: To familiarize themselves with trajectory calculations for planar motion of rockets.

CO4: To determine forces and moments acting on airframe of a missile.

CO5: To acquire knowledge on the need for staging and stage separation dynamics of rocket vehicles.

TEXT BOOKS:

1. Cornelisse,JW, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982.
2. Parker,ER, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.

REFERENCE BOOKS:

1. Suresh. B N & Sivan. K, "Integrated Design for Space Transportation System", Springer India, 2015.
2. Sutton,GP, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 8th Edition, 2010.
3. Van de Kamp, "Elements of Astromechanics", Pitman Publishing Co., Ltd., London, 1980.

VERTICALS – VIII (HIGH SPEED COMMUNICATIONS

		L	T	P	C
U23ECV81	**OPTICAL COMMUNICATION & NETWORKS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. To study about the various optical fiber modes, configuration of optical fibers
2. To study transmission characteristics of optical fibers.
3. To learn about the various optical sources, detectors and transmission techniques.
4. To explore various idea about optical fiber measurements and various coupling techniques.
5. 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: Cutoff wavelength.

UNIT II OPTICAL SOURCES AND OPTICAL DETECTORS **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, Threshold condition for 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, Resposivity, P-N Photodiode ,P-I-N Photo Diode and Avalanche Photodiode.

UNIT IV OPTICAL FIBER MEASUREMENTS **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, Field Measurements.

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 System Interconnection Reference Model, Optical Transport Network, Internet Protocol- Wavelength Routing Networks: Routing And Wavelength Assignment- Optical Switching Networks: Optical Circuit Switched Networks, Optical Packet Switched Networks, Multiprotocol Label Switching, Optical Burst Switching Networks- Optical Network Deployment : Long Haul Networks, Metropolitan area networks, Access networks, Local Area Networks- Optical Ethernet: Network protection, restoration and survivability

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Realize Basic Elements In Optical Fibers, Different Modes And Configurations.

CO2: Analyze The Transmission Characteristics Associated With Dispersion And Polarization Techniques.

CO3: Design Optical Sources And Detectors With Their Use In Optical Communication System.

CO4: Construct Fiber Optic Receiver Systems, Measurements And Techniques.

CO5: Design Optical Communication Systems And Its Networks.

TEXT BOOKS:

1. John M.Senior, “Optical Fiber Communication”, Pearson Education, Fouth Edition.2010.

REFERENCE BOOKS:

1. Gred Keiser,"Optical Fiber Communication”, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.
2. Govind P. Agrawal, “Fiber-Optic Communication Systems”, Third Edition, John Wiley & Sons, 2004.
3. J.Gower, “Optical Communication System”, Prentice Hall Of India, 2001
4. Rajiv Ramaswami, “Optical Networks “ , Second Edition, Elsevier , 2004.
5. P Chakrabarti, "Optical Fiber Communication”, McGraw Hill Education (India)Private Limited**,** 2016

U23ECV82	WIRELESS BROAD BAND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study the various network layer and transport layer protocols for wireless networks
2. To study the architecture and interference mitigation techniques in 3G standards
3. To learn about 4G technologies and LTE-A in mobile cellular network.
4. To learn about the layer level functionalities in interconnecting networks.
5. To study the emerging techniques in 5G network

UNIT I WIRELESS PROTOCOLS 9

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements-Indirect TCP, snooping TCP, Mobile TCP.

UNIT II 3G EVOLUTION 9

IMT-2000 - W-CDMA, CDMA 2000 - radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.

UNIT III 4G EVOLUTION 9

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT IV LAYER-LEVEL FUNCTIONS 9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation – CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

UNIT V 5G EVOLUTION 9

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - emerging approach for resource over provisioning, Small cells for 5G mobile networks- capacity limits and achievable gains with densification - Mobile data demand, Demand Vs Capacity, Small cell challenges, conclusion and future directions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design and implement the various protocols in wireless networks.

CO2: Analyze the architecture of 3G network standards.

CO3: Analyze the difference of LTE-A network design from 4G standard.

CO4: Design the interconnecting network functionalities by layer level functions.

CO5: Explore the current generation (5G) network architecture

TEXT BOOKS:

1. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008

REFERENCE BOOKS:

1. Vijay K.Garg, “Wireless Network Evolution - 2G & 3G”. Prentice Hall, 2008.
2. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” Tata McGraw- Hill, 2nd Edition, 2011.
3. Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.
4. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015

U23ECV83	4G / 5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn the evolution of wireless networks.
2. To get acquainted with the fundamentals of 5G networks.
3. To study the processes associated with 5G architecture.
4. To study spectrum sharing and spectrum trading.
5. To learn the security features in 5G networks

UNIT I EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 2G,3G,4G, evolution of radio access networks, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC).

UNIT II 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT III NETWORK ARCHITECTURE AND THE PROCESSES 9

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC, and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.

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 would be able to

CO1: To understand the evolution of wireless networks.

CO2: To learn the concepts of 5G networks.

CO3: To comprehend the 5G architecture and protocols.

CO4: To understand the dynamic spectrum management

CO5: To learn the security aspects in 5G networks.

TEXT BOOKS:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copy righted Material.
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019.

REFERENCE BOOKS:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen,Copyrighted Material.
2. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019

U23ECV84	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the need for SDN and its data plane operations
2. To understand the functions of control plane
3. To comprehend the migration of networking functions to SDN environment
4. To explore various techniques of network function virtualization
5. To comprehend the concepts behind network virtualization

UNIT I SDN: BACKGROUND AND DATA PLANE 9

Evolving Network Requirements – The SDN Approach – SDN and NFV-Related Standards – SDN Data Plane – OpenFlow Logical Network Device – OpenFlow Protocol.

UNIT II SDN CONTROL PLANE 9

SDN Control Plane Architecture: Southbound Interface, Northbound Interface – Control Plane Functions – ITU-T Model – OpenDaylight – REST – Cooperation and Coordination among Controllers.

UNIT III SDN NETWORKING ARCHITECTURE 9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking -- -Mobility and Wireless – Information-centric Networking.

UNIT IV NETWORK FUNCTION VIRTUALIZATION 9

NFV Concepts – Benefits and Requirements – Reference Architecture – NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV.

UNIT V NETWORK VIRTUALIZATION 9

Virtual LANs – OpenFlow VLAN Support – Virtual Private Networks – Network Virtualization – OpenDaylight's Virtual Tenant Network – CoSoftware-Defined Infrastructure.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Describe the motivation behind SDN and its data plane
CO2: Identify the functions of control plane
CO3: Apply SDN to networking applications
CO4: Apply various operations of network function virtualization
CO5: Explain various use cases of SDN.

TEXT BOOKS:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud", Pearson Education, 1st Edition, 2015.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.

REFERENCE BOOKS:

1. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
2. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
3. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017

U23ECV85	MASSIVE MIMO NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To gain knowledge about massive MIMO networks.
2. To understand the massive MIMO propagation channels.
3. To learn about channel estimation in single cell and multicell massive MIMO systems.
4. To comprehend the concepts of massive MIMO deployment in the context of single cell and multicell deployment.
5. To gain knowledge about massive MIMO networks.

UNIT I MASSIVE MIMO NETWORKS 9

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Favourable Propagation, Local Scattering Spatial Correlation Model

UNIT II THE MASSIVE MIMO PROPAGATION CHANNEL 9

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels

UNIT III SINGLE-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding-Zero-Forcing-Maximum-Ratio, Discussion- Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility.

UNIT IV MULTI-CELL SYSTEMS 9

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT V CASE STUDIES 9

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access - Dense Urban Scenario - Suburban Scenario - Minimum Per-Terminal Throughput Performance -Additional Observations - Comparison of Power Control Policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and explain massive MIMO networks.

CO2: Analyze massive MIMO propagation channels and their capacity bounds

CO3: Examine channel estimation techniques for single cell system.

CO4: Analyze channel estimation techniques for multi cell system.

CO5: Explain the concepts underlining the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, "Fundamentals of Massive MIMO", Cambridge University Press 2016. (UNITS II-V)
2. Emil Björnson, Jakob Hoydis and Luca Sanguinetti (2017), "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency", Foundations and Trends, Now, 2017. (UNIT I)

REFERENCE BOOKS:

1. Long Zhao, Hui Zhao, Kan Zheng, "Wei Xiang Massive MIMO in 5G Networks: Selected Applications", Springer 2018.
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, "Massive MIMO Detection Algorithm and VLSI Architecture", Springer 2019.
3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, "mmWave Massive MIMO A Paradigm for 5G", Elsevier, 2017.

U23ECV86	ADVANCED WIRELESS COMMUNICATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the evolving paradigm of cooperative communication
2. To understand concepts related to green wireless communication
3. To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
4. To expose the student to the energy saving techniques adopted in existing wireless components
5. To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS **9**

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT II COOPERATIVE TECHNIQUES **9**

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS **9**

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT IV GREEN RADIO NETWORKS **9**

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS **9**

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: The student would be able to appreciate the necessity and the design aspects of cooperative communication

CO2: The student would be able to appreciate the necessity and the design aspects of green wireless communication.

CO3: The student would be able to evolve new techniques in wireless communication

CO4: The students would be able to demonstrate the feasibility of using mathematical models using simulation tools.

CO5: The student would be able to demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context.

TEXT BOOKS:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , "Cooperative Cellular Wireless Networks",Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), "Green Radio Communication Networks", Cambridge University Press, 2012.

REFERENCE BOOKS:

1. F. Richard Yu, Yu, Zhang and Victor C. M. Leung "Green Communications and Networking", CRC press, 2012.
2. Ramjee Prasad and Shingo Ohmori, Dina Simunic, "Towards Green ICT", River Publishers,2010.
3. Jinsong Wu, Sundeep Rangan and Honggang Zhang, "Green Communications: Theoretical Fundamentals, Algorithms and Applications", CRC Press, 2012.

OPEN ELECTIVES -I

U23ECT33	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. Understand about various types of signals and systems, classify them, analyze them and perform various operations on them.
2. Realize use of transforms in analysis of signals and system.
3. Characterize LTI systems in the Time domain and various Transform domains.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & 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.

UNIT II ANALYSIS OF CONTINOUS TIME SIGNALS 12

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

UNIT III ANALYSIS OF DISCRETE TIME SIGNALS 12

DTFT- Properties of DTFT- Z Transform - Convergence of Z-Transform - Properties of Z-Transform - Inverse Z-Transform and solving difference equation using Z-Transform - Baseband signal Sampling.

UNIT IV LINEAR TIME INVARIANT - CT SYSTEMS 12

Impulse response characterization and convolution integral for CT-LTI system - Properties of convolution - Fourier and Laplace transforms in analysis of CT systems - Block diagram representation.

UNIT V LINEAR TIME INVARIANT - DT SYSTEMS 12

Impulse response characterization and convolution sum – DTFT and Z transform analysis of recursive and non-recursive systems - Block diagram representation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 : Analyze the properties of signals & systems.

CO2 : Analyze CT and DT signal.

CO3: Apply Fourier transform, Laplace transform and Z transform in signal analysis.

CO4: Analyze continuous time LTI systems using Fourier and Laplace Transforms.

CO5: Analyze discrete time LTI systems using Z transform.

CO6: Analyze the Different signals in other fields.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson limited, 2013.
2. Tarun Kumar Rawat, "Signals and Systems", Oxford University press, 2010.

REFERENCE BOOKS:

1. John Alan Stuller, "An Introduction to Signals and Systems", Nelson, 2007.
2. M.J.Roberts, "Signals & Systems Analysis using Transform Methods & MATLAB", Tata McGraw Hill.2011
3. B.P Lathi Roger Green "Signal processing and Linear Systems", Oxford University, press 2021.

U23ECO12	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To observe the concepts of semiconductor diodes through its operation, characteristics and various parameters.
2. To gain insight into the operation, characteristics and functional aspects of BJT in different configurations.
3. To understand in depth about the construction, operation, characteristics and various parameters of JFET and MOSFET.
4. To study the construction, operation and characteristics several special semiconductor devices.
5. To acquaint the various rectifier circuits with filters and IC regulator circuits.

UNIT I SEMICONDUCTOR DIODE 9

Diode: PN Junction Diode, Resistance Levels, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Zener Diodes, Diode Approximations, Clippers, Clampers, Voltage-Multiplier Circuits.

UNIT II BIPOLAR JUNCTION TRANSISTORS 9

BJT : Construction and operation of NPN and PNP transistors, Early Effect, Current equations, Input and Output characteristics of CE, CB, CC - Transistor Bias stability Concepts - Fixed bias - Collector to Base bias of BJT - Voltage Divider bias of BJT.

UNIT III FIELD EFFECT TRANSISTORS 9

FET: JFETs, Drain and Transfer characteristics, Current equations - Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET - Source or self bias of FET amplifier- Voltage Divider bias of FET.

UNIT IV SPECIAL SEMICONDUCTOR DIODES 9

Metal-Semiconductor Junction- MESFET, Photo diode, Tunnel diode, LASER diode, UJT, SCR, DIAC, TRIAC, HEMT, TFET.

UNIT V APPLICATIONS OF SEMICONDUCTOR DEVICES 9

Rectifiers and Filters: Half wave, Full wave and bridge rectifier, Ripple factor calculation for C, L, LC and CLC filter. **Regulators:** Voltage regulators, Shunt voltage regulator, Series voltage regulator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the concepts of semiconductor theory concepts.

CO2: Summarize the working principle and characteristics of BJTs.

CO3: Interpret the working principle and characteristics of FETs.

CO4: Explain the characteristic of Special Semiconductor devices.

CO5: Discuss the operations of Rectifiers and Regulators.

CO6: Explain the various applications of Diode.

TEXT BOOKS:

1. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Pearson, 11th edition, 2015
2. David A. Bell," Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
3. Sedra.A and Smith, "Microelectronic Circuits", Oxford University Press, 5th Edition, 2005.

REFERENCE BOOKS:

1. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and Circuits", Third Edition, TataMcGraw- Hill, 2012.
2. Donald A Neaman, "Semiconductor Physics and Devices", 4th edition, McGraw Hill Education India Private Ltd., 2011.
3. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
4. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition.
5. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.

U23ECO14	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce Analog Modulation Schemes
2. To impart knowledge in random process
3. To study various Digital techniques
4. To introduce the importance of sampling & quantization
5. To impart knowledge in demodulation techniques
6. To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION 9

Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver.

UNIT II RANDOM PROCESS & SAMPLING 9

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation. Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

UNIT III DIGITAL TECHNIQUES 9

Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK

UNIT V DEMODULATION TECHNIQUES 9

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Gain knowledge in amplitude modulation techniques

CO2: Understand the concepts of Random Process to the design of communication

systems

CO3: Gain knowledge in digital techniques

CO4: Understand the concepts of Digital modulation techniques

CO5: Gain knowledge in sampling and quantization

CO6: Understand the importance of demodulation techniques

TEXT BOOKS:

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V)
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCE BOOKS:

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.
3. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007.

U23ECO13	VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand the fundamentals of IC technology components and their characteristics.
2. Understand combinational logic circuits and design principles.
3. Understand sequential logic circuits and clocking strategies.
4. Understand ASIC Design functioning and design.
5. Understand Memory Architecture and building blocks.

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non Ideal I-V Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT III SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Non bistable Sequential Circuits. Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data paths, Adder, Multipliers, Shifters, ALUs, Power and Speed Trade-offs, **Case Study:** Design as a trade-off, Designing Memory and Array Structures: Memory Architectures and Building Blocks, Memory core, Memory Peripheral Circuitry.

UNIT V ASIC DESIGN AND TESTING 9

Introduction to wafer to chip fabrication process flow. Microchip design process & issues in test and verification of complex chips, embedded cores and SOCs, Fault models, Test coding. ASIC Design Flow, Introduction to ASICs, Introduction to test benches, Writing test benches in Verilog HDL, Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: In depth knowledge of MOS technology

CO2: Understand Combinational Logic Circuits and Design Principles

CO3: Understand Sequential Logic Circuits and Clocking Strategies

CO4: Understand Memory architecture and building blocks

CO5: Understand the HDL

CO6: Understand the ASIC Design Process and Testing.

TEXT BOOKS:

1. Jan M Rabaey, Anantha Chandrakasan, “Digital Integrated Circuits: A Design Perspective”, PHI, 2016. (Units II, III and IV).
2. Neil H E Weste, Kamran Eshranghian, “Principles of CMOS VLSI Design: A System Perspective,” Addison Wesley, 2009. (Units - I, IV).
3. Michael J Smith , “Application Specific Integrated Circuits”, Addison Wesley, (Unit - V)
4. Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Second Edition, Pearson Education, 2003. (Unit - V)
5. Parag K.Lala, “Digital Circuit Testing and Testability”, Academic Press, 1997, (Unit - V)

REFERENCE BOOKS:

1. D.A. Hodges and H.G. Jackson, “Analysis and Design of Digital Integrated Circuits”, International Student Edition, McGraw Hill 1983
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001.
3. Samiha Mourad and Yervant Zorian, “Principles of Testing Electronic Systems”, Wiley 2000.
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.

U23ECT31	DIGITAL SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To present the fundamentals of digital circuits and simplification methods.
2. To practice the design of various combinational digital circuits using logic gates.
3. To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits.
4. To learn integrated circuit families.
5. To introduce semiconductor memories and related technology.

UNIT I NUMBER SYSTEMS AND CODE CONVERSIONS 9

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, Implementation of Boolean expressions using universal gates, Tabulation methods.

UNIT II COMBINATIONAL LOGIC CIRCUIT AND DESIGN 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, **Case study:** Parity Generator/Checker, Seven Segment display decoder

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 9

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

UNIT V MEMORY AND PROGRAMMABLE LOGIC 9

RAM and ROM – Memory Decoding – Error Detection and Correction – Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices – Application Specific Integrated Circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Use Boolean algebra and simplification procedures relevant to digital logic.
CO2: Design various combinational digital circuits using logic gates.
CO3: Analyse and design synchronous sequential circuits.
CO4: Analyse and design asynchronous sequential circuits.
CO5: Build logic gates and use programmable devices.
CO6: Understand the concepts of memory devices

TEXT BOOKS:

1. M.Morris Mano, Michael D Ciletti, “Digital Design” 4th edition Pearson, 2011.
2. Thomas L.Floyd, “Digital Fundamentals”, Prentice Hall, 11th Edition, 2015.
3. Floyd and Jain, “Digital Fundamentals”, Pearsons Publication, 10th Edition, 2015.

REFERENCE BOOKS:

1. Anand Kumar, “Fundamentals of Digital Circuits”, 4th Edition PHI Learning Private Limited, 2016.
2. Donald P Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications”, 6thedition,Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008.
3. Tocci R J, “Digital systems: Principles and Applications”, PHI learning, New Delhi, 10th Edition, 2006.
4. Charles H. Roth, Larry L. Kinney “Fundamentals of Logic Design”, Cengage Learning, 2015.
5. R.P.Jain, “Modern Digital Electronics”, 4thEdition, Tata McGraw-Hill Education, 2009.

OPEN ELECTIVES -II

U23ECT51	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To study and understand the concepts and design of a Cellular System.
2. To Study and Understand Mobile Radio Propagation and Various Digital Modulation Techniques.
3. To Understand the Concepts Of Multiple Access Techniques And Wireless Networks.

UNIT I THE CELLULAR CONCEPT-SYSTEM DESIGN FUNDAMENTALS 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 MODULATION TECHNIQUES AND EQUALIZATION 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 Performance In Fading And Multipath Channels - **Equalization, Diversity And Channel Coding:** Introduction-Fundamentals Of Equalization

UNIT IV 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 V WIRELESS NETWORKING 9

Introduction: Difference Between Wireless And Fixed Telephone Networks, The Public Switched Telephone Network(PSTN), Development Of Wireless Networks: First Generation Wireless Networks, Second Generation Wireless Networks, Third Generation Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing In Wireless Networks: Circuit Switching, Packet Switching- Personal Communication Services/ Networks(PCS/PCNs):Packet Vs Circuit Switching For PCN, Cellular Packet.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand The Concept And Design of A Cellular System.

CO2: Understand Mobile Radio Propagation and Various Digital Modulation Techniques.

CO3: Understand The Concepts of Multiple Access Techniques And Wireless Network.

CO4: Characterize a wireless channel and evolve the system design specifications.

CO5: Design a cellular system based on resource availability and traffic demands.

CO6: Summarize the principles and applications of wireless systems and standards

TEXT BOOKS:

1. Rappaport, T.S., “Wireless communications”, Pearson Education, Second Edition, 2010
2. A.F.Molisch, “Wireless Communications”, Wiley, 2005

REFERENCE BOOKS:

1. Andrea Goldsmith, “Wireless Communication”, 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, 2005.
4. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.
5. Andreas.F. Molisch, “Wireless Communications”, John Wiley, India, 2006.
6. William Stallings, “Wireless Communication and Networks”, Pearson Education, Second Edition 2002

U23ECO22	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the concept about Wireless networks, protocol stack and standards
2. To understand and analyse the network layer solutions for Wireless networks
3. To study about fundamentals of 3G Services, its protocols and applications
4. To have in depth knowledge on internetworking of WLAN and WWAN
5. To learn about evolution of 4G Networks, its architecture and applications

UNIT I WIRELESS LAN 9

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART.

UNIT II MOBILE NETWORK LAYER 9

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

UNIT III 3G OVERVIEW 9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS 9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT V 4G & BEYOND 9

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Conversant with the latest 3G/4G networks and its architecture.

CO2 : Design and implement wireless network environment for any application using latest wireless protocols and standards.

CO3: Analyse the latest wireless protocols

CO4: Ability to select the suitable network depending on the availability and

requirement.

CO5: Implement different type of applications for smart phones.

CO6: Understand the concept of mobile devices with latest network strategies

TEXT BOOKS:

1. Jochen Schiller, ‖Mobile Communications‖, Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, ―Wireless Communications and networking‖, First Edition, Elsevier 2007.(Unit IV,V)

REFERENCE BOOKS:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband‖, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, ―Wireless Networking‖, First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, ―Modern Wireless Communications‖, First Edition, Pearson Education 2013

U23ECT44	NETWORKS AND SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn the Network Model sand data link layer functions.
2. To understand routing in the Network Layer.
3. To explore methods of communication and congestion control by the Transport Layer.
4. To study the Network Security Mechanisms.
5. To learn various hardware security attacks and their countermeasures.

UNIT I NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks– Network Models – OSI, TCP/IP, Addressing – Introduction to Data link Layer – Error Detection and Correction – Ethernet(802.3)- Wireless LAN – IEEE 802.11,Bluetooth– Flow and Error Control Protocols–HDLC-PPP.

UNIT II NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols(IP,ICMP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 –Datagram Format -TransitionfromIPv4 toIPv6.

UNIT III TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram – Congestion Control and Avoidance(DEC bit, RED) -Application Layer Paradigms – Client – Server Programming–Domain Name System–World Wide Web, HTTP, Electronic mail.

UNIT IV NETWORK SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – AdvancedEncryptionStandard–PublicKeyCryptosystems–RSAAlgorithm–HashFunctions– Secure Hash Algorithm **–** Digital Signature Algorithm.

UNIT V HARDWARE SECURITY 9

Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Explain the Network Models, layers and functions.
CO2 : Categorize and classify the routing protocols.
CO3: List the functions of the transport and application layer.
CO4: Evaluate and choose the network security mechanisms.
CO5: Explain the various algorithms.
CO6: Discuss the hardware security attacks and counter measures.

TEXT BOOKS:

1. Behrouz. A.Forouzan, “Data Communication and Networking”, Fifth Edition,TMH,2017.

2. William Stallings, “Cryptography and Network Security”, Seventh Edition, Pearson Education,2017

REFERENCE BOOKS:

1. James. F.Kurosea Keith. W.Ross, “Computer Networking–Atop Down Approach”,Sixth Edition, Pearson,2017.
2. Bhunia Swarup, “Hardware Security– A Hands On Approach”, Morgan Kaufmann, First edition,2018.
3. Doughlas. E.Comer, “ Computer Networks and Internets with Internet Applications”, Fourth Edition, Pearson Education,2008.

U23ECV22	IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

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

UNIT II IMAGE ENHANCEMENT 9

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

UNIT III IMAGE RESTORATION 9

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

UNIT IV IMAGE SEGMENTATION 9

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

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1 : Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2 : Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3: Understand the restoration concepts and filtering techniques.

CO4: Learn the basics of segmentation, features extraction methods for colour models.

CO5: Comprehend image compression concepts.

CO6: Analyze the image recognition Technique.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23ECT54 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To study the architecture and addressing modes of 8085 and to write assembly language programs of 8085.
2. To study the architecture and addressing modes of 8086 and to write assembly language programs of 8086.
3. To know the importance of different peripheral devices and their interfacing to 8085/8086.
4. To study the architecture and addressing modes of 8051 and to write assembly language programs of 8051.
5. To study multiprocessor and high end processor configurations.

UNIT I 8086 MICROPROCESSOR 9

Introduction to 8086 Microprocessors – Architecture – Addressing modes – Memory organization – Instruction set – Assembler directives & Operations – Assembly language programming – Procedures – Macros – Interrupts & Interrupt Service Routines – Applications of 8086.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III PERIPHERAL INTERFACING WITH 8086 MICROPROCESSOR 9

Programmable devices – Parallel & Serial I/O and Data Communication – Timer - Keyboard /Display controller – Interrupt controller – DMA controller – Applications: Traffic Light control, LED display, LCD display.

UNIT IV 8051 MICROCONTROLLER 9

Introduction to 8051 Microcontroller – Architecture - Pin diagram - Special Function Registers - External Memory Interface with 8051 – Counter and Timers in 8051 - Interrupts - Addressing modes - Instruction set - Assembly language programming of 8051 – Applications of 8051.

UNIT V INTRODUCTION TO ARM PROCESSORS 9

Acron RISC Machine – Architectural Inheritance – Core & Architectures - The ARM Programmer's model -Registers – Pipeline- ARM processor family - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the architecture of microprocessor/ microcontroller and their operation.

CO2: To study the addressing modes for Processors and Controllers.

CO3: To study the Interrupts and Interrupt Service Routines for Processors and Controllers.

CO4: Demonstrate programming skills in assembly language for Processors and Controllers.

CO5: Analyze various interfacing techniques and apply them for the design of processor / Controller based systems.

CO6: To study multiprocessor and high end processor configurations.

TEXT BOOK:

1. Ramesh S. Gaonkar, "Microprocessor – Architecture, Programming and Applications with the 8085", Penram International Publisher, 6th Edition, 2013.
2. Ray.A.K. & Bhurchandi.K.M, "Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing", Tata Mc Graw Hill,3rd Edition, 2017
1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, "The 8051 microcontroller and embedded systems using Assembly and C", 2ndedition, Pearson education /Prentice hall of India, 2007.
2. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", 2nd Edition, Pearson 2011.

REFERENCE BOOK:

1. Douglas V.Hall, "Microprocessors and Interfacing: Programming and Hardware", 3rd edition, Tata Mc Graw Hill, 2017.
2. Mazidi M. A.McKinley R. D., Causey D. Smith, "PIC Microcontroller and Embedded Systems", Pearson Education International, 2008
3. Martin Bates, "PIC Microcontrollers", 3 rd Edition, Elsevier 2012
4. Yn-cheng Liu, Glenn A.Gibson, "Microcomputer systems: The 8086 / 8088 Family architecture, Programming and Design", 2ndedition, Pearson, 2015.