KCG

COLLEGE OF TECHNOLOGY

AFFILIATED TO ANNA UNIVERSITY | AUTONOMOUS

REGULATIONS - 2023

CURRICULUM AND SYLLABI

(2023-2024)

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

KCG College of Technology was founded in 1998 to fulfill the Founder-Chairman, Dr. KCG Verghese's vision of **"To Make Every Man a Success and No Man a Failure".** It is a Christian minority institution, affiliated to Anna University (Autonomous), Chennai and approved by AICTE, New Delhi.

VISION OF KCG

KCG College of Technology aspires to become a globally recognized centre of excellence for science, technology & engineering education, committed to quality teaching, learning and research while ensuring for every student a unique educational experience which will promote leadership, job creation, social commitment and service to nation building.

MISSION OF KCG

- Disseminate knowledge in a rigorous and intellectually stimulating environment.
- Facilitate socially responsive research, innovation and entrepreneurship.
- Foster holistic development and professional competency.
- Nurture the virtue of service and an ethical value system in the young minds.

VISION OF ELECTRONICS AND COMMUNICATION ENGINEERING

To become a center of excellence of global significance in Electronics and Communication engineering and producing competent professionals committed to nation building.

MISSION OF ELECTRONICS AND COMMUNICATION ENGINEERING

Provide quality education in the field of computer science and engineering & related domains

- Impart strong knowledge in the field of Electronics and communication engineering through innovative teaching and learning process
- Establish laboratories equipped with modern state of art technology resources to facilitate research and consultancy
- Enhance the knowledge and skills of the faculty to incorporate the latest advancements
- Facilitate Industrial collaboration in socially responsive research activities

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The graduates will:

PEO 1	Have a successful career as technically competent, highly skilled professionals in Electronics and communication engineering and its related fields
PEO 2	Demonstrate technical competence to provide solutions for real time Electronics and Communication engineering problems
PEO 3	Adopt technological challenges through skill upgradation in the relevant areas
PEO 4	Exhibit professionalism and ethical attitude in their work

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

PO 01	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 02	Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 03	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 04	Use research based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 05	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO 06	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 07	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 08	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 09	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 01	Apply the knowledge of Basic sciences, Electronics and Communication Engineering fundamentals and specialization for solving complex problems in Electronics and Communication systems.
PSO 02	Design suitable electronic circuits and communication systems using modern tools such as PSPICE, MATLAB / Simulink, Assemblers, Cadence and NS2.
PSO 03	Practice the ethics of their profession with a sense of social responsibility

INDEX

Sl.No	Description	Page No.
1	Curriculum	1
2	I Semester Syllabus	14
3	II Semester Syllabus	41
4	III Semester Syllabus	72
5	IV Semester Syllabus	95
6	V Semester Syllabus	116
7	VI Semester Syllabus	134
8	VII Semester Syllabus	154
9	VIII Semester Syllabus	167
10	Vertical 1 : Semiconductor Chip Design And Testing	170
11	Vertical 2 : Sensor Technologies And IoT	188
12	Vertical 3 : High Speed Communications	205
13	Vertical 4 : Networks And Cyber Security	223
14	Vertical 5 : Bio Medical Technologies	240
14	Vertical 6 : Signal And Image Processing	258

KCG COLLEGE OF TECHNOLOGY
AUTONOMOUS
REGULATIONS 2023
BE -ELECTRONICS AND COMMUNICATION ENGINEERING
CHOICE BASED CREDIT SYSTEM
CURRICULA FOR SEMESTERS I TO VIII

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	23IP101	Induction Programme		-	-	-	-	-
THEORY								
1	23HS101	Essential Communication	HSMC	3	0	0	3	3
2	23MA101	Matrices and Calculus	BSC	3	0	0	3	3
3	23CS101	Programming in C	ESC	3	0	0	3	3
4	23HS102	Heritage of Tamils	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
5	23PH111	Engineering Physics	BSC	3	0	2	5	4
6	23CY111	Engineering Chemistry	BSC	3	0	2	5	4
PRACTICALS								
7	23CS121	C Programming Laboratory	ESC	0	0	4	4	2
8	23HS121	Communication Skills Laboratory	HSMC	0	0	2	2	1
9	23HS122	General Clubs / Technical Clubs / NCC / NSS / Extension Activities	HSMC	0	0	2	2	1*
TOTAL				16	0	12	28	21

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER –II

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23HS201/ 23HS202	Professional English/ Foreign language	HSMC	3	0	0	3	3
2	23MA203	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	23PH203	Physics for Electronics Engineering	BSC	3	0	0	3	3
4	23EC201	Circuit Analysis	PCC	3	1	0	4	4
5	23HS203	Tamils and Technology	HSMC	1	0	0	1	1
THEORY AND PRACTICALS								
6	23EE284	Basic Electrical and Instrumentation Engineering	ESC	2	0	2	4	3
7	23ME211	Engineering Graphics	ESC	3	0	2	5	4
PRACTICALS								
8	23ME221	Engineering Practices Laboratory	ESC	0	0	4	4	2
9	23EC221	Circuits Analysis Laboratory	PCC	0	0	4	4	2
10	23HS221	Soft Skills	EEC	0	0	2	2	1*
TOTAL				18	2	14	34	26

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER- III

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA301	Linear Algebra	BSC	3	1	0	4	4
2	23EC301	Electronic Circuits	PCC	3	0	0	3	3
3	23EC302	Control Systems	PCC	3	0	0	3	3
4	23HS301	Universal Human Values and Ethics	HSMC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23EC311	Digital Systems Design	PCC	3	0	2	5	4
6	23EC312	Signals and Systems	PCC	3	0	2	5	4
PRACTICALS								
7	23EC321	Electronic Circuits Laboratory	PCC	0	0	4	4	2
8	23ES391	Presentation Skills	EEC	0	0	2	2	1*
TOTAL				18	1	10	29	23

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-IV

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23MA402	Probability and Random Processes	BSC	3	1	0	4	4
2	23EC401	Electromagnetic Fields	PCC	3	1	0	4	4
3	23EC402	Communication Systems	PCC	3	0	0	3	3
4	23EC403	Linear Integrated Circuits	PCC	3	0	0	3	3
5		Department Elective 1	DEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23EC411	Microprocessors and Microcontrollers	PCC	3	0	2	5	4
PRACTICALS								
7	23EC421	Communication Systems Laboratory	PCC	0	0	4	4	2
8	23EC422	Linear Integrated Circuits Lab	PCC	0	0	4	4	2
9	23ES491	Aptitude and Logical Reasoning – 1	EEC	0	0	2	2	1*
TOTAL				18	2	12	32	25

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER-V

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1	23RE501	Research Methodology and Intellectual Property Rights	ESC	2	0	0	2	2
2	23EC501	Transmission lines and RF Systems	PCC	3	1	0	4	4
3		Department Elective – 1	DEC	3	0	0	3	3
4		Open Elective – 1 (Emerging Technology)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
5	23EC511	Digital Signal Processing	PCC	3	0	2	5	4
6	23EC512	Networks and Security	PCC	3	0	2	5	4
PRACTICALS								
7	23EC521	Mini Project	EEC	0	0	4	4	2
8	23ES591	Aptitude and Logical Reasoning - 2	EEC	0	0	2	2	1*
TOTAL				17	1	10	28	22

*** The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA**

SEMESTER VI

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	credits
				L	T	P		
THEORY								
1	23EC601	Antenna and Wave Propagation	PCC	3	0	0	3	3
2	23EC602	VLSI and Chip Design	PCC	3	0	0	3	3
3		Department Elective – 2	DEC	3	0	0	3	3
4		Department Elective – 3	DEC	3	0	0	3	3
5		Open Elective – 2 (Management / Safety Courses)	OEC	3	0	0	3	3
THEORY AND PRACTICALS								
6	23CE611	Environmental Science and Engineering	ESC	3	0	2	5	4
PRACTICALS								
7	23EC621	VLSI Laboratory	PCC	0	0	4	4	2
8	23EC622	Project Work - Phase 1	EEC	0	0	4	4	2
9	23EC623	Technical Training	EEC	0	0	2	2	1
10	23ES624	Technical Seminar - 1	ESC	0	0	2	2	1
TOTAL				18	0	14	32	25

SEMESTER -VII

Sl. No.	Course Code	Course Title	Cate Gory	periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY								
1		Open Elective - 3 (Management Courses)	OEC	3	0	0	3	3
2		Department Elective – 4	DEC	3	0	0	3	3
3		Department Elective – 5	DEC	3	0	0	3	3
4	23EC701	Optical Communication and Networks	PCC	3	0	0	3	3
5	23EC702	Comprehension	EEC	2	0	0	2	2
PRACTICALS								
6	23EC721	Advanced Communication Laboratory	PCC	0	0	4	4	2
7	23EC722	Project Work – Phase 2	EEC	0	0	6	6	3
8	23EC723	Technical Seminar – 2	ESC	0	0	4	4	2
TOTAL				14	0	14	28	21

SEMESTER -VIII

Sl. No.	Course code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
PRACTICALS								
1	23EC821/ 23EC822	Capstone Project / Internship cum project	EEC	0	0	20	20	10
TOTAL				0	0	20	20	10

TOTALCREDITS: 173

DEPARTMENT ELECTIVE COURSES: VERTICALS

VERTICAL 1: SEMICONDUCTOR CHIP DESIGN AND TESTING

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC031	Advanced Digital System Design	DEC	3	0	0	3	3
2	23EC032	Analog IC Design	DEC	2	0	2	3	3
3	23EC033	Low Power IC Design	DEC	2	0	2	3	3
4	23EC034	VLSI Testing and Design For Testability	DEC	2	0	2	3	3
5	23EC035	Physical Design	DEC	3	0	0	3	3
6	23EC036	Mixed Signal IC Design and Testing	DEC	3	0	0	3	3

VERTICAL 2 : SENSOR TECHNOLOGIES AND IOT

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC037	Embedded Systems and IOT Design	DEC	2	0	2	3	3
2	23EC038	IoT Based System Design	DEC	3	0	0	3	3
3	23EC039	Wireless Sensor Network Design	DEC	3	0	0	3	3
4	23EC040	Industrial IoT and Industry 4.0	DEC	2	0	2	3	3
5	23EC041	MEMS Design	DEC	3	0	0	3	3
6	23EC042	Fundamentals of Nano electronics	DEC	3	0	0	3	3

VERTICAL 3 : HIGH SPEED COMMUNICATIONS

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC043	Wireless Communication	DEC	3	0	0	3	3
2	23EC044	Microwave Communication	DEC	3	0	0	3	3
3	23EC045	Satellite Communication	DEC	3	0	0	3	3
4	23EC046	Radar Technologies	DEC	3	0	0	3	3
5	23EC047	4G/5G Communication Networks	DEC	2	0	2	3	3
6	23EC048	Wireless Broadband Communication	DEC	3	0	0	3	3

VERTICAL 4 : NETWORKS AND CYBER SECURITY

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC049	Network Essentials	DEC	2	0	2	3	3
2	23EC050	Network Engineering	DEC	2	0	2	3	3
3	23EC051	Switching, Routing, And Wireless Essentials	DEC	2	0	2	3	3
4	23EC052	Enterprise Networking, Security, and Automation	DEC	2	0	2	3	3
5	23EC053	Network Design	DEC	3	0	0	3	3
6	23EC054	Cyber Security Essentials	DEC	3	0	0	3	3

VERTICAL 5 : BIO MEDICAL TECHNOLOGIES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC055	Wearable Devices	DEC	3	0	0	3	3
2	23EC056	Human Assist Devices	DEC	3	0	0	3	3
3	23EC057	Therapeutic Equipment	DEC	3	0	0	3	3
4	23EC058	Medical Imaging Systems	DEC	3	0	0	3	3
5	23EC059	Brain Computer Interface and Applications	DEC	3	0	0	3	3
6	23EC060	Body Area Networks	DEC	3	0	0	3	3

VERTICAL 6 : SIGNAL AND IMAGE PROCESSING

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23EC061	Advanced Digital Signal Processing	DEC	3	0	0	3	3
2	23EC062	Image Processing	DEC	3	0	0	3	3
3	23EC063	Speech Processing	DEC	3	0	0	3	3
4	23EC064	Software Defined Radio	DEC	2	0	2	3	3
5	23EC065	DSP Architecture and Programming	DEC	2	0	2	3	3
6	23EC066	Computer Vision	DEC	2	0	2	3	3

OPEN ELECTIVE – EMERGING TECHNOLOGIES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact periods	Credits
				L	T	P		
1	23OAD971	Artificial Intelligence and Machine Learning Fundamentals	OEC	3	0	0	3	3
2	23OAS971	Space Engineering	OEC	3	0	0	3	3
3	23OCS971	Augmented Reality and Virtual Reality	OEC	3	0	0	3	3
4	23OEE971	Renewable Energy Technologies	OEC	3	0	0	3	3
5	23OEE972	Integrated Energy Planning for Sustainable Development	OEC	3	0	0	3	3
6	23OMA971	Resource Management Techniques	OEC	3	0	0	3	3
7	23OMA972	Graph Theory	OEC	3	0	0	3	3
8	23OMT971	Foundation of Robotics	OEC	3	0	0	3	3

OPEN ELECTIVE – MANAGEMENT COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OMG971	Total Quality Management	OEC	3	0	0	3	3
2	23OMG972	Engineering Economics and Financial Accounting	OEC	3	0	0	3	3
3	23OMG973	Engineering Management and Law	OEC	3	0	0	3	3
4	23OMG974	Knowledge Management	OEC	3	0	0	3	3
5	23OMG975	Industrial Management	OEC	3	0	0	3	3
6	23OMG976	Entrepreneurship and Business Opportunities	OEC	3	0	0	3	3
7	23OMG977	Modern Business Administration and Financing	OEC	3	0	0	3	3
8	23OMG978	Essentials of Management	OEC	3	0	0	3	3

OPEN ELECTIVE – SAFETY RELATED COURSES

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	23OAU981	Automotive Safety	OEC	3	0	0	3	3
2	23OCE981	Disaster Management	OEC	3	0	0	3	3
3	23OME981	Industrial Safety	OEC	3	0	0	3	3

SEMESTER-WISE CREDIT DISTRIBUTION

SEMESTER	HSMC	BSC	ESC	PCC	DEC	OEC	EEC	Total
Semester I	5	11	5					21
Semester II	4	7	9	6				26
Semester III	3	4		16				23
Semester IV		4		18	3			25
Semester V			2	12	3	3	2	22
Semester VI			5	8	6	3	3	25
Semester VII			2	5	6	3	5	21
Semester VIII							10	10
Total	**12**	**26**	**23**	**65**	**18**	**9**	**20**	**173**

SEMESTER –I

23IP101	INDUCTION PROGRAMME	L	T	P	C
		-	-	-	0

COURSE OBJECTIVES:

- This is a mandatory 2 weeks 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 objectives
- Engineering colleges were established 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
- **Physical Activity**
  This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.,
- **Life skills**
  Every student would choose one skill related to daily needs such as stitching, accounting, finance management, etc.,

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 dos and don'ts, 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.

Club Activity

Students will be introduced to more than 20 Clubs available in the college-both technical and non-technical. The student can choose as to which club the student will enroll in.

Value Based Communication
This module will focus on improving the communication skills of students
Lectures by Alumni
Lectures by alumni are arranged to bring in a sense of belonging to the student towards the institution and also to inspire them to perform better
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
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
Address by different heads
Heads of Placement, Training, Student affairs, counsellor, etc would be interacting with the students to introduce them to various measures taken in the institution for the betterment of students.
Induction Programme is totally an activity-based Programme and therefore there shall be no tests / assessments during this Programme.
REFERENCES:
Guide to Induction program from AICTE

23HS101	ESSENTIAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from short and simple correspondence
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, short paragraphs and essays
- To enable learners to use language efficiently while expressing their opinions via various media.

UNIT I	FORMATION OF SENTENCES	9

Reading- Read pictures-notices- short comprehension passages and recognize main ideas and specific details. Writing- framing simple and compound sentences, completing sentences, developing hints, writing text messages. Language development- Parts of Speech, Wh- Questions, yes or no questions, direct and indirect questions. Vocabulary development– prefixes- suffixes- articles – countable and uncountable nouns

UNIT II	NARRATION AND DESCRIPTION	9

Reading – Read short narratives and descriptions from newspapers, dialogues and conversations. Reading strategies and practices. Language development – Tenses- simple present, present continuous, present perfect, simple past, past continuous, past perfect, simple future, future continuous, past participle, pronouns. Vocabulary development- guessing meanings of words in context. Writing – Write short narrative paragraphs, biographies of friends/relatives - writing- topic sentence- main ideas- free

writing, short narrative descriptions using some suggested vocabulary and structures.		
UNIT III	**COMPARING AND CONTRASTING**	**9**
Reading- short texts and long texts -understanding different types of text structures, -coherence-jumbled sentences. Language development- degrees of comparison, concord- Vocabulary development – single word substitutes- discourse markers- use of reference words Writing - comparative and contrast paragraphs writing- topic sentence- main idea, free writing, compare and contrast using some suggested vocabulary and structures.		
UNIT IV	**SOCIAL MEDIA COMMUNICATION**	**9**
Reading- Reading blogs, social media reviews, posts, comments, process description, Language development - relative clause, Vocabulary development- social media terms-words, abbreviations and acronyms Writing- -e-mail writing-conventions of personal email, descriptions for simple processes, critical online reviews, blog, website posts, commenting to posts.		
UNIT V	**ESSAY WRITING**	**9**
Reading- Close reading non-technical longer texts Language development - modal verbs, phrasal verbs- Vocabulary development - collocation. Writing- Writing short essays- brainstorming – developing an outline- identifying main and subordinate ideas.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize simple, level-appropriate texts of around 300 words recognizing main ideas and specific details.	

CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing.
CO3:	Use appropriate expressions to describe, compare and contrast people, things, situations etc., in writing.
CO4:	Establish the ability to communicate effectively through emails.
CO5:	Determine the language use appropriate for different social media platforms.
CO6:	Use appropriate expressions for narrative descriptions and process descriptions.

TEXT BOOKS:

1	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 2. Cambridge University Press and Assessment
2	Susan Proctor, Jack C. Richards, Jonathan Hull. Interchange Level 3. Cambridge University Press and Assessment

REFERENCES:

1	Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
2	Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning , USA: 2007

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23MA101	MATRICES AND CALCULUS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I	MATRICES	9

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	DIFFERENTIAL CALCULUS	9

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

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	9

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

UNIT IV	INTEGRAL CALCULUS	9

Definite and Indefinite integrals - Substitution rule - Techniques of

Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		
UNIT V	**MULTIPLE INTEGRALS**	**9**
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.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the matrix algebra techniques and applications in Engineering Problems.
CO2:	Make use of the concept of limits and rules of differentiation to differentiate functions
CO3:	Find the derivative of functions of several variables
CO4:	Examine the application of partial derivatives
CO5:	Compute integrals by different techniques of Integration.
CO6:	Apply the concept of integration to compute multiple integrals.
TEXT BOOKS:	
1	Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.
REFERENCES:	
1	Dr.P.Sivaramakrishnadas, Dr.C.Vijayakumari., — Matrices and Calculus‖ Pearson Publications Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.
2	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016

3	Bali. N., Goyal. M. and Watkins. C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4	Narayanan. S. and Manicavachagom Pillai.T. K., ―Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**02-08-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CS101	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic constructs of C Language.
- To develop C Programs using basic programming constructs.
- To develop C programs using arrays and strings.
- To develop modular applications in C using functions and pointers.
- To develop applications in C using structures and Unions.
- To understand file handling in C.

UNIT I	BASICS OF C PROGRAMMING	9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.

UNIT II	ARRAYS AND STRINGS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III	FUNCTIONS AND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV	STRUCTURES AND UNION	9
Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.		
UNIT V	**FILE PROCESSING**	**9**
Files- Types of file processing: Sequential access, Random Access- Sequential access file- Random access file- Command line arguments.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Describe the basic constructs of C Programming Language.
CO2:	Develop simple applications using C basic constructs.
CO3:	Construct and Implement applications using Arrays and Strings.
CO4:	Develop and Implement applications using Functions and pointers.
CO5:	Construct applications using structures and Unions.
CO6:	Demonstrate File handling concepts and Command line arguments.

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

REFERENCES:	
1	Paul Deitel and Harvey Deitel, "C How to program with an introduction to C++", Eighth Edition, Pearson Education,2018.
2	Yashwant Kanetkar, "Let us C", seventeenth Edition, BPB Publications, 2020.
3	Anita Goel and Ajay Mittal, "Computer Fundamentals and

	programming in C", First Edition, Pearson Education, 2013.
4	Byron S. Gotfried, "Schaum's outline of Theory and Problems of Programming with C", McGraw-Hill Education,1996.
5	PradipDey, ManasGhosh, "Computer Fundamentals and Programming in C" Second Edition, Oxford University Press, 2013.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	-	1	1	1	1	3	1	-
2	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
3	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
4	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
5	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-
6	2	1	-	-	1	-	-	-	1	1	1	1	3	1	-
Overall Correlation	3	2	1	1	1	-	-	-	1	1	1	1	3	1	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS102	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- Explain the classical literature of Tamil and highlight notable Tamil poets.
- Explain the creation of traditional Tamil musical instruments.
- Explain the sports and games associated with Tamil heritage.
- Explore the education and literacy practices during the Sangam period.
- Explain the contributions of Tamils to the Indian freedom struggle.
- Explain the development and history of printing in Tamil Nadu.

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, Leatherpuppetry, Silambattam, Valari, Tiger dance – Sports and Games of Tamils.		
UNIT IV	**THINAI CONCEPT OF TAMILS**	**3**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature – Aram Concept of Tamils – Education and Literacy during Sangam Age – Ancient Cities and Ports of Sangam Age – Export and Import during Sangam Age – Overseas Conquest of Cholas		
UNIT V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
TOTAL: 15 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the evolution of Tamil language and literature, focusing on its cultural, ethical, and secular themes.	
CO2:	Outline the making of musical instruments related to Tamil heritage.	
CO3:	Discuss the sports and games of Tamils	
CO4:	Explain the education and literacy during Sangam age.	
CO5:	Express the importance and contribution of Tamils to Indian Freedom Struggle	
CO6:	Outline the print history of books in Tamil Nadu	
TEXT BOOKS:		
1	தமிழக வரலாறு-மக்களும் பண்பாடும்-கே.கேபிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).	

2	கணினித்தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்).

REFERENCES:

1	**கீழடி- வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)**
2	பொருனை- ஆற்றங்கரை **நாகரிகம் (தொல்லியல் துறை வெளியீடு)**

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
2	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
3	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
4	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
6	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-
Overall Correlation		-	-	-	-	2	2	-	-	-	-	-	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23PH111	ENGINEERING PHYSICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To make the students effectively achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of optics and lasers.
- To equip the students successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I	MECHANICS	9

Types of stress, Stress-strain diagram and its uses- factors affecting elastic modulus- tensile strength- Bending of beams, bending moment – theory and experiment: Uniform and non-uniform bending, Center of mass (CM) – CM of continuous bodies –rod, motion of the CM. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of rod, disc, solid sphere – M.I of a diatomic molecule - torque -rotational energy state of a rigid diatomic molecule – M.I of disc by torsional pendulum

UNIT II	ELECTROMAGNETIC WAVES	9

Concept of field-introduction to gradient, divergence and curl of field – Stokes theorem (No proof)-Gauss divergence theorem (No proof) - The Maxwell's equations in integral form and differential form - wave equation; Plane electromagnetic waves in vacuum - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - Energy and momentum in EM waves-Poynting's vector - Cell-phone reception.

UNIT III	OPTICS AND LASERS	9

Reflection and refraction of light waves - total internal reflection –

types of optical fiber, Numerical Aperture and acceptance angle - interference –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients(Qualitative) - population inversion - CO2 laser, semiconductor laser (Homo junction) - Applications of lasers in industry.

UNIT IV	BASIC QUANTUM MECHANICS	9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V	ADVANCED QUANTUM MECHANICS	9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

PRACTICAL EXERCISES: (Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects
2. Simple harmonic oscillations of cantilever
3. Non-uniform bending- Determination of Young's modulus
4. Uniform bending–Determination of Young's modulus
5. Laser-Determination of the wavelength of the laser using grating
6. Airwedge- Determination of thickness of a thinsheet /wire

7. a) Optical fibre-Determination of Numerical Aperture and acceptance angle b) Compact disc-Determination of width of the groove using laser. 8. Acoustic grating-Determination of velocity of ultrasonic waves in liquids. 9. Ultrasonic interferometer–determination of the velocity of sound and compressibility of liquids 10. Post office box-Determination of Band gap of a semiconductor. 11. Photoelectric effect 12. Michelson Interferometer. 13. Melde's string experiment 14. Experiment with lattice dynamics kit.	
TOTAL: 30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Determine the mechanical properties of materials.
CO2:	Apply the principles of electromagnetic waves to real world system.
CO3:	Determine the thickness of thin wire and the characteristic parameter of an optical fiber.
CO4:	Apply the principles of lasers to real world application.
CO5:	Organize the quantum mechanical properties of particles and waves.
CO6:	Utilize the quantum mechanical principles towards the formation of energy bands.
TEXT BOOKS:	
1	D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", McGraw Hill Education (Indian Edition), 2017.
2	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw-Hill (Indian Edition), 2017.

REFERENCES:	
1	R.Wolfson," Essential University Physics", Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2	Paul A. Tipler, "Physic – Volume 1 & 2", CBS, (Indian Edition), 2004.
3	K.Thyagarajan and A.Ghatak,"Lasers: Fundamentals and Applications," Laxmi Publications, (Indian Edition), 2019.
4	D.Halliday, R.Resnick and J.Walker, "Principles of Physics", Wiley (Indian Edition), 2015.
5	N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students",Springer Verlag, 2016.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	26-07-2023		
Approved	1st ACM	Date	09-09-2023

23CY111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	1	4

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage batteries.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, flouride and arsenic. Sewage treatment primary treatment and disinfection (UV, Ozonation, break-point chlorination). Hardness-Estimation of Hardness of water by EDTA-numerical Problems-Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials (Metal oxide and Metal) Synthesis and Characterization of nanomaterials: sol-gel, solvothermal, laser ablation, chemical

vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, energy, sensor , electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system – water system; CO_2 system; Reduced phase rule; Two component system: lead-silver system – Pattinson process. Composites: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites – definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Fossil Fuels, Classification of fuels; 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 sequestration, Green Hydrogen.

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Nuclear fission and fusion- 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 and its advanced technology, supercapacitor.	
TOTAL: 45 PERIODS	
LIST OF EXPERIMENTS	**TOTAL: 30 PERIODS**
1. Determination of hardness causing salts in water sample by EDTA method. 2. Determination of alkalinity in water sample. 3. Determination of chloride content of water sample by argentometric method. 4. Determination of strength of given Barium chloride using conductivity meter. 5. Determination of strength of Acid using pH meter. 6. Determination of strength of FAS by potentiometer 7. Determination of strength of acids in a mixture using conductivity meter. 8. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method. **9.** Estimation of Nickel in steel	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	Illustrate the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	Estimate the knowledge of phase rule and composites for material selection requirements
CO4:	Choose a suitable fuel for engineering processes and applications
CO5:	Relate the different forms of energy resources and apply them for suitable applications in energy sectors.
CO6:	Explain the different types of batteries, fuel cells and working principles of Electric vehicles

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.Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
REFERENCES:	
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, 2014New Delhi, 2018.
4	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019
5	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
2	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
4	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
5	3	2	1	1	-	-	3	-	-	-	-	2	3	-	-
6	2	1	-	-	-	-	2	-	-	-	-	1	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23CS121	C PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

PRACTICALS :

1. I/O statements, operators, expressions.
2. Decision-making constructs: if-else, goto, switch-case, break-continue.
3. Loops: for, while, do-while.
4. Arrays: 1D and 2D, multi-dimensional arrays, traversal.
5. Strings: operations.
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion.
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers.
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

HARDWARE : Standalone desktops – 30 No's

SOFTWARE: : C / C++ / Equivalent Compiler

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Demonstrate knowledge on C programming constructs.

CO2:	Develop programs in C using basic constructs.
CO3:	Develop programs in C using arrays and strings
CO4:	Develop applications in C using functions and pointers.
CO5:	Develop applications in C using structures and union.
CO6:	Develop applications in C using file processing.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	-	1	-	2	-	1	2	1	1
2	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1
3	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1
4	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1
5	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1
6	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1
Overall Correlation	3	2	1	1	3	1	-	1	-	2	-	1	3	3	1

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

23HS121	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enable the students to comprehend the main idea and specific information of the listening passage
- To help students express themselves clearly, and communicate effectively with others.
- To introduce authentic language use and context-specific vocabulary that might not be encountered in textbooks.

Exercise : 1	Listening to conversations set in everyday social context and complete gap-filling exercise
Exercise : 2	Listening to a monologue in everyday social context. Diagram labelling and MCQ
Exercise : 3	Listening to a group conversation in academic setting and answer MCQ
Exercise : 4	Listening to a lecture and answer MCQ or gap filling
Exercise : 5	Listening to Ted Talks, podcasts, documentaries - discussion
Exercise : 6	Listening to a lecture and reading a text on the same subject- compare and contrast
Exercise : 7	Speaking Introducing oneself
Exercise : 8	Answering questions based on the introduction
Exercise : 9	Speaking on a given prompt for 2 mins.
Exercise : 10	Answering questions based on the topic spoken
Exercise : 11	Role play- Engaging in conversation
Exercise : 12	Engaging in Podcast Discussion

TOTAL: 25 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Demonstrate fluency in speaking in variety of situations
CO2:	Express their knowledge by talking continuously for more than two minutes on a topic

CO3:	Develop active listening for more meaningful interactions and conversations
CO4:	Use a full range of structures naturally and appropriately
CO5:	Identify the specific information in conversations, interviews, talks and lectures
CO6:	Develop the ability to compare and analyse different forms of information, identifying key similarities and differences.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
5	-	-	-	-	-	1	1	-	3	3	-	2	-	-	-
6	-	-	-	-	-	1	1	-	2	3	-	-	-	-	-
Overall Correlation	-	-	-	-	-	**1**	**1**	-	**3**	**3**	-	**2**	-	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved	**1st ACM**	**Date**	**09-09-2023**

SEMESTER - II

23HS201	PROFESSIONAL ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To help learners extract information from longer, technical and scientific texts
- To familiarize learners with different text structures by engaging them in reading, writing and grammar learning activities
- To help learners write coherent, extensive reports and essays.
- To enable learners to use language efficiently while expressing their opinions in professional and business situations

UNIT I	WORKPLACE COMMUNICATION	9

Reading – Reading brochures (technical context), advertisements, telephone messages, gadget reviews social media messages, digital communication relevant to technical contexts and business. Writing – Writing emails -emails on professional contexts including introducing oneself, writing checklist, writing single sentence definition, product description- advertising or marketing slogans, Language Development– Tenses, Concord, Question types: Wh/ Yes or No/ and Tags, imperative sentences, complex sentences. Vocabulary - One-word substitutes; Abbreviations & Acronyms as used in technical contexts and social media.

UNIT II	EXPRESSING CAUSE AND EFFECT	9

Reading - Reading longer technical texts– Cause and Effect Essays, and emails of complaint. Writing - writing complaint emails (raising tickets) and responses to complaints, writing Cause and effect paragraphs and essays. Language Development– Active, Passive and Impersonal Passive Voice transformations, Infinitive and Gerunds Vocabulary – Synonyms- contextual meaning of

words, Same word acting as different parts of speech, causal expressions.		
UNIT III	**PROVIDING SOLUTIONS TO PROBLEMS**	**9**
Reading - Case Studies, editorials, news reports etc. Writing – Letter to the Editor, Writing instructions and recommendations, Problem solution essay / Argumentative Essay, Language Development – Error correction; If conditional sentences Vocabulary - Compound Words, discourse markers.		
UNIT IV	**INTERPRETATION OF GRAPHICS**	**9**
Reading - Reading newspaper articles, nonverbal communication (charts and graphs) Writing –Transferring information from nonverbal (chart, graph etc, to verbal mode) Process– description. Language development–Possessive & Relative pronouns, numerical adjectives Vocabulary Homonyms and Homophones, sequence words.		
UNIT V	**REPORT WRITING AND RESUME WRITING**	**9**
Reading – Company profiles, journal reports. Language Development– Reported Speech Vocabulary-reporting words and phrases. Writing - Writing accident report, survey report and progress report, project proposal, minutes of the meeting, writing statement of purpose, internship application and resume		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize long technical and scientific text of not less than 500 words recognizing main ideas and specific details	
CO2:	Demonstrate the understanding of more complex grammatical structures and diction while reading and writing	
CO3:	Use appropriate expressions to describe process and product, compare and contrast data, analyze problems, provide solutions and prove an argument in writing	

CO4:	Establish the ability to communicate effectively in professional environment through emails and reports
CO5:	Determine the language use appropriate for different social media platforms used for digital marketing
CO6:	Convert skills to assets and position themselves in job market through their own professional narratives
TEXT BOOKS:	
1	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology I, Cambridge University Press and Assessment
2	V. Chellammal, Deepa Mary Francis, K N Shoba, P R Sujatha Priyadharshini, Veena Selvam, English for Science & Technology II, Cambridge University Press and Assessment
REFERENCES:	
1	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
2	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	1	1	-	2	3	-	2	-	-	-
2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
3	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
5	-	-	-	-	-	-	1	-	2	3	-	2	-	-	-
6	-	-	-	-	-	-	-	-	2	3	-	3	-	-	-
Overall Correlation	-	-	-	-	-	1	1	-	2	3	-	3	-	-	-

Recommended by Board of Studies	**28-07-2023**		
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23MA203	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I	TESTING OF HYPOTHESIS	9+3

Sampling distributions – Standard error-Large sample test for single mean, proportion, difference of means -Small sample Tests– T Test for single mean and difference of means-F test for equality of variance – Chi square test for single variance- Independence of attribute-Goodness of fit (Binomial Distribution, Poisson Distribution).

UNIT II	DESIGN OF EXPERIMENTS	9+3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	9+3

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

Seidel - Eigenvalues of a square matrix by Power method		
UNIT IV	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**9+3**
Interpolation - Newton's forward and backward difference interpolation -Lagrange's and Newton's divided difference interpolations –- Approximation of derivative using interpolation polynomials – Numerical single integration and double using Trapezoidal and Simpson's 1/3 rules.		
UNIT V	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3**
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 Adam's Bashforth method.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Examine the given data for large and small samples problems.	
CO2:	Examine the problems involving design of experiments.	
CO3:	Find the numerical solutions for nonlinear (algebraic or transcendental) equations, large system of linear equations and Eigen value problem of a matrix, when analytical methods fail to give solution.	
CO4:	Determine the intermediate values of the experimental data, using Newton's forward, backward, divided difference and Lagrange's methods.	
CO5:	Find the solutions for the problems involving numerical differentiation and integration.	
CO6:	Solve numerically, ordinary differential equations which is used to solve different kinds of problems occurring in engineering and technology.	

TEXT BOOKS:	
1	Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
REFERENCES:	
1	P. Sivarama Krishna Das "A Text Book of Statistics and Numerical Methods" Viji's Academy.
2	Burden, R.L. and Faires, J.D. "Numerical Analysis" 9th Edition, Cengage Learning, 2016.
3	Devore.J.L " Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014
4	Gerald.C.F. and Wheatley.P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**28-07-2023**		
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23PH203	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I	CRYSTALLOGRAPHY	9

Crystal structures: Crystal lattice – basis - unit cell and lattice parameters – crystal systems and Bravais lattices – Structure and packing fractions of SC, BCC, FCC, diamond cubic, NaCL, ZnS structures – crystal planes, directions and Miller indices – distance between successive planes – linear and planar densities – crystalline and noncrystalline materials –Example use of Miller indices: wafer surface orientation – wafer flats and notches – pattern alignment - imperfections in crystals.

UNIT II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory :Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Magnetic materials: Dia, para and ferromagnetic effects – paramagnetism in the conduction electrons in metals – exchange interaction and ferromagnetism – quantum interference devices – GMR devices.

UNIT III	SEMICONDUCTORS AND TRANSPORT PHYSICS	9
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode - optical processes in organic semiconductor devices –excitonic state.		
UNIT V	**NANO DEVICES**	**9**
Density of states for solids - Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor – Carbon nanotubes: Properties and applications - Spintronic devices and applications – Optics in quantum structures – quantum well laser.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply the basics of crystallography and its importance in studying materials properties.
CO2:	Build the electrical properties of materials including free electron theory.
CO3:	Apply the knowledge of magnetic properties of materials in data storage.
CO4:	Compute carrier concentration in intrinsic and extrinsic semiconductor.
CO5:	Establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.

CO6:	Develop an idea of significance of nano structures, quantum confinement and ensuring nano device applications.
TEXT BOOKS:	
1	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2	R.F.Pierret. Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3	G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill (Indian Edition), 2017.
REFERENCES:	
1	Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2	Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4	Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
5	N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**28-07-2023**		
Approved by Academic	**1st ACM**	**Date**	**09-09-2023**

23EC201	CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To make students capable of analyzing any given network
- To get knowledge about the various network Theorems.
- To familiarize themselves with network parameters and Transient Response.
- To know the about resonance circuits.
- To understand the various Network Topologies.

UNIT I	NETWORK THEOREMS FOR DC CIRCUITS	12

Review of Current Electricity and basic Kirchoff's Laws- Star-Delta Transformation - Mesh Analysis-Nodal Analysis - Superposition Theorem-Thevenin Theorem, Norton Theorem

UNIT II	NETWORK PARAMETERS	12

Open circuit impedance (Z) parameters - short circuit admittance (Y) parameters - transmission (ABCD)parameters and inverse transmission parameters -Hybrid (h) parameters and inverse hybrid parameters -Conversion between parameters - interconnection of two-port networks.

UNIT III	TRANSIENT RESPONSE	12

Transients: First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC excitation. Solutions using Laplace transform method.

UNIT IV	RESONANCE CIRCUITS	12

Sinusoidal Steady – State analysis, Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance-Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

UNIT V	NETWORK TOPOLOGY	12
Graph of a network -Concept of tree, co-tree link, chord , forest, co-forest; Planar and non-planar graph; Incidence matrix, tie set matrix, cut set matrix; Fundamental cut set and tie set schedule; Introduction to equation formulation graphically; Duality of network.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Apply KVL and KCL Theorems to simplify the DC Circuits.	
CO2:	Identify how to validate the network theorems in DC circuits	
CO3:	Illustrate the various parameters of two port networks.	
CO4:	Construct the transient response for the RLC Circuits.	
CO5:	Identify the nature of R, L, C circuits under Steady State Condition	
CO6:	Summarize the various network topologies	
TEXT BOOKS:		
1	Hayt W.H Kemmerly J.E. and Durbin S.M., "Engineering Circuit Analysis" 6th Edition Tatta McGraw-Hill Publishing Company Ltd.,2008.	
2	Alexander, Charles K. Fundamentals of electric circuits / Charles K. Alexander, Matthew N. O. Sadiku. — 4th ed. p. cm	
REFERENCES:		
1	Valkenberg V., "Network Analysis", 3rd Edition., Pretentice Hall International Edition 2007.	
2	Joseph Edminister and Mahmood Nahvi,Electric Circuits,Tata McGraw Hill Publishing Company ,Schaum's Ouline Series,Fourth Edition New Delhi 2003.	
3	Network Analysis and Synthesis ,Ravish R Singh ,MC Graw Hill Education (india) PVt Ltd	
4	William HartHayt,Jack EllsworthKemmerly, StevenM.Durbin(2007), Engineering Circuit Analysis, 7 th edition, McGraw-	

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
2	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
3	2	1	-	-	1	-	-	-	-	1	-	-	2	1	-
4	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
5	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
6	2	1	-	-	-	-	-	-	-	1	-	-	2	-	-
Overall Correlation	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
Recommended by Board of Studies							28-07-2023								
Approved by Academic							1st ACM			Date			09-09-2023		

23HS203	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To summarize the weaving industry and ceramic technology during Sangam Age
- To explain the design and construction of houses during Sangam Age and the sculptures and temples of Chola,Pallava and Pandya period
- To Explain about the water bodies of Sangam age and relate it to the agricultural usage
- To Outline to students the agriculture and irrigation technology during the Chola Period
- To help students Interpret and explain the digitalization of Tamil books and development of Tamil software

UNIT I	WEAVING AND CERAMIC TECHNOLOGY	3

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

UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY	3

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

UNIT III	MANUFACTURING TECHNOLOGY	3

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

UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY	3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
UNIT V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
TOTAL: 15 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize the weaving industry and ceramic technology during Sangam Age	
CO2:	Explain the design and construction of houses during Sangam Age	
CO3:	Explain the sculptures and temples of Chola,Pallava and Pandya period.	
CO4:	Explain about the water bodies of Sangam age and relate it to the agricultural usage	
CO5:	Outline the agriculture and irrigation technology during the Chola Period.	
CO6:	Interpret and explain the digitalization of tamil books and development of Tamil software	
TEXT BOOKS:		
1	Dr.K.K.Pillay ,"Social Life of Tamils", A joint publication of TNTB & ESC and RMRL	

REFERENCES:	
1	Dr.S.Singaravelu ,"Social Life of the Tamils - The Classical Period", Published by: International Institute of Tamil Studies.
2	Dr.S.V.Subatamanian , Dr.K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", Published by: International Institute of Tamil Studies

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
2	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
3	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
4	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
5	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
6	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-
Overall Correlation	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-

Recommended by Board of Studies	28-07-2023		
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23EE284	BASIC ELECTRICAL & INSTRUMENTATION ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To impart knowledge in types, construction and working of transformers
- To impart knowledge in types, construction and working of DC machines
- To impart knowledge in types, construction and working of AC rotating machines
- To introduce the functional elements and working of measuring instruments.
- To introduce the basics of power system and protection schemes

UNIT I	TRANSFORMER	6

Introduction - Ideal and Practical Transformer – Phasor diagram- – Per Unit System – Equivalent circuit- Testing- Efficiency and Voltage Regulation

UNIT II	DC MACHINES	6

Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation – Circuit Model – Methods of Excitation- Characteristics – Starting and Speed Control –Stepper Motors

UNIT III	AC ROTATING MACHINES	6

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Speed Control - Single phase Induction motors -Construction– Types–starting methods. Alternator: Working principle–Equation of induced EMF – Voltage regulation.

UNIT IV	MEASUREMENTS AND INSTRUMENTATION	6

Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters,

Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.		
UNIT V	**BASICS OF POWER SYSTEMS**	**6**
Power system structure -Generation, Transmission and distribution, Various voltage levels, Earthing – methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker - safety precautions and First Aid		
		Total : 30 PERIODS

LAB COMPONENT

1. Load test on single phase Transformer.
2. Load test on DC shunt Generator
3. Load test on DC Motor.
4. Load test on single phase induction Motor.
5. Measurement of Amplitude, Frequency, Time and Phase measurement using DSO
6. Study on Earthing Device.

Total : 30 + 30 = 60 Periods

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the efficiency and voltage regulation of a transformer and verify its characteristics
CO2:	Apply the principles of EMF, torque equations, and speed control methods explain the characteristics of DC machines.
CO3:	Apply the working principle of AC induction motors in real time applications.
CO4:	Develop the EMF equation of an alternator and explain its working principles.
CO5:	Explain the types and operating principle of measuring instruments.
CO6:	Summarize the basic power system structure and protection schemes

TEXT BOOKS:	
1	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2	S. K, Bhattacharya, "Basic Electrical and Electronics Engineering", Second Edition, Pearson Education, 2017.
3	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 2015.
4	C.L. Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International pvt.ltd.,2003
REFERENCES:	
1	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019
2	Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
3	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	-	1	-	-	-	-	-	-	3	-	-
3	3	2	1	1	-	1	-	-	-	-	-	-	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
6	2	1	-	-	-	1	-	-	-	-	-	-	2	-	-
Overall Correlation	3	2	1	1	-	1	-	-	-	-	-	-	3	-	-

Recommended by Board of Studies	**28-07-2023**		
Approved by Academic	**1st ACM**	**Date**	**09-09-2023**

23ME211	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Gain a solid foundation in the fundamental principles and concepts of engineering graphics, including conic sections, orthographic projection, isometric projection, section views and development of surfaces, perspective projection, and dimensioning.
- Develop graphic skills for communication of concepts, ideas and design of engineering products.
- Gain knowledge on drafting software to construct part models.
- Familiarize with existing national standard practices and conventions related to technical drawings.
- Enhance the ability to visualize objects in three dimensions and translate them into 2D representations.

UNIT I	PLANE CURVES	9+6

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.

LIST OF EXERCISES:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola

UNIT II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	9+6

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. Projection of planes (hexagonal and pentagonal planes

only) inclined to both the principal planes by rotating object method.

LIST OF EXERCISES:

1. Draw the projection of points when it is placed in different quadrants
2. Draw the projection of lines when it is placed in first quadrant
3. Draw the planes when it is placed in first quadrant.

UNIT III	PROJECTION OF SOLIDS AND FREE HAND SKETCHING	9+6

Projection of simple solids - hexagonal prism, pentagonal pyramid and cone inclined to the horizontal plane by rotating object method. Free Hand sketching: Visualization principles - Representation of Three Dimensional objects - Layout of views - Free hand sketching of multiple views from pictorial views of objects

LIST OF EXERCISES:

1. Practicing three dimensional modelling of simple objects.
2. Drawing of orthographic views from the given pictorial diagram

UNIT IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	9+6

Sectioning of hexagonal prism, pentagonal pyramid and cone when the cutting plane is inclined to the horizontal plane, Development of lateral surfaces of simple and sectioned solids – hexagonal prism and cone cut by a plane inclined to horizontal plane only.

LIST OF EXERCISES:

1. Draw the sectioned views of prisms and pyramids
2. Draw the development of hexagonal prism cut by a section plane inclined to the horizontal plane

UNIT V	ISOMETRIC PROJECTION	9+6

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

LIST OF EXERCISES:

1. Drawing Isometric view and projection of simple solids.
2. Drawing three dimensional modeling of isometric projection of combination of solids.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Construct the conic curves, involutes and cycloids.
CO2:	Develop and Sketch the orthographic projections of points, lines and plane surfaces.
CO3:	Develop and Sketch the orthographic projections of simple solids.
CO4:	Construct the projections of sectioned solids and development of the lateral surfaces of solids.
CO5:	Develop and Sketch the isometric sections of solids.
CO6:	Develop and Sketch the orthographic projection 2D and 3D objects using Auto CAD.

TEXT BOOKS:

1	Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2019.
2	Basant Agarwal and Agarwal C.M.,―Engineering Drawing‖, McGraw Hill, 2nd Edition, 2019

REFERENCES:

1	Natrajan K.V., ―A Text Book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai, 2018.
2	Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I and II combined), Subhas Publications, Bangalore, 27th Edition, 2017.

3	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.
4	Parthasarathy N. S. and Vela Murali, —Engineering Graphics‖, Oxford University, Press, New Delhi, 2015. 5. Shah M.B., and Rana B.C., —Engineering Drawing‖, Pearson Education India, 2nd Edition, 2009.
5	Venugopal K. and Prabhu Raja V., —Engineering Graphics", New Age International (P) Limited, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
2	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
3	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
4	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
5	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
6	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-
Overall Correlation	3	2	1	1	2	-	-	1	-	3	2	2	2	2	-

Recommended by Board of Studies	**28-07-2023**		
Approved by Academic	**1st ACM**	**Date**	**09-09-2023**

23ME221	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Familiarize students with basic engineering tools and equipment.
- Educate students on the importance of safety practices, including proper handling of equipment, adherence to safety protocols, and understanding potential hazards in the laboratory environment. Develop basic manufacturing and fabrication skills.
- Provide hands on training to the students in plumbing and woodworking.
- Provide hands on training to the students in welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipment; Making a tray out of metal sheet using sheet metal work.
- Demonstrate the wiring and measurement methods in common household electrical applications.
- Study the basic electronic components, gates and provide hands on training in soldering.

GROUP A (CIVIL and MECHANICAL)

PART I	CIVIL ENGINEERING PRACTICES	15

PLUMBING WORK

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in households.
b) Preparation of 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.

WOOD WORK

a) Sawing
b) Planning
c) Making of T-Joint, Mortise joint and Tenon joint and Dovetail joint.

WOOD WORK STUDY

a) Study of joints in door panels and wooden furniture
b) Study of common industrial trusses using models.

PART II	**MECHANICAL ENGINEERING PRACTICES**	**15**

WELDING WORK

a) Study of Welding and its tools.
b) Welding of Butt Joints, Lap Joints and Tee Joints by metal arc welding.
c) Study of Gas Welding.

BASIC MACHINING PRACTICE

a) Facing and Plain Turning
b) Taper Turning
c) Drilling and Tapping

SHEET METAL WORK

a) Forming and Bending
b) Making of a square Tray

MACHINE ASSEMBLY WORK

a) Study of Centrifugal Pump
b) Study of Air Conditioner

FOUNDRY PRACTICE

Demonstration on Foundry operations like mould preparation.

TOTAL: 30 PERIODS

GROUP B (ELECTRICAL & ELECTRONICS)

PART III	**ELECTRICAL ENGINEERING PRACTICES**	**15**

1. Residential House wiring using Switches, Fuse, Indicators, Lamp and Energy Meter.
2. Staircase Wiring.

3. Fluorescent Lamp Wiring with Introduction to CFL and LED Types. 4. Measurement of Energy using Single Phase Energy Meter. 5. Study of Iron Box Wiring and Assembly **6.** Study of Fan Regulator – Electronic Type		
PART IV	**ELECTRONICS ENGINEERING PRACTICES**	**15**
1. Study of Electronic components and equipment – Resistors, Colour coding measurement of AC signal parameter (peak-peak, RMS period, frequency) using CRO. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering simple electronic circuits and checking continuity. 5. Study the elements of smart phone 6. Study of LED TV (Block diagram		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Plan the pipeline layout for common household plumbing work.	
CO2:	Make use of welding equipment and carpentry tool for making joints.	
CO3:	Demonstrate on centrifugal pump, air conditioner and foundry operations.	
CO4:	Demonstrate the electrical wiring connections for household applications and study the working of iron box and fan regulator.	
CO5:	Identify the basic electronic components and explain the gates and soldering methods.	
CO6:	Examine the performance and operation of CRO, LED TV and Smart phone.	

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
2	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
3	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
4	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
5	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
6	3	2	1	1	1	1	1	-	-	2	2	2	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**2**	**2**	**2**	**2**	**1**	**-**
Recommended by Board of Studies	**26-07-2023**														
Approved							**1st ACM**			**Date**			**09-09-2023**		

23EC221	CIRCUIT ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To gain hands- on experience in Thevenin & Norton theorem, KVL & KCL, and Superposition Theorems.
- To understand the working of RL, RC and RLC circuits

PRACTICALS:

1. To Verify Kirchoff 's Voltage Law (KVL).
2. To Verify Kirchoff 's current Law (KCL).
3. To Verify Thevenin 's Theorem for Resistive Network.
4. To Verify Norton 's Theorem for Resistive Network.
5. To Verify Superposition theorem for Resistive Network.
6. Determination of Z-Parameters of given Two Port Network.
7. Determination of ABCD Parameters of given Two Port Network.
8. Determination of H- Parameters of given Two Port Network.
9. Transient Response of a RL Circuit.
10. Transient Response of a RC Circuit.

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Build a circuit to verify the Kirchoff 's Voltage Law (KVL)
CO2:	Apply Kirchoff 's current Law (KCL) to verify the given circuit.
CO3:	Construct a circuit to verify the theorems for the electrical circuits
CO4:	Build a circuit to verify the two port network parameters for the electrical circuit.
CO5:	Construct an Electric Circuit to test the RC Condition

CO6:	Construct an Electric Circuit to test the RL Condition
TEXT BOOK:	
1	Network Analysis and Synthesis by U.A.Patel 6th Edition, Mahajan Publishing House.
REFERENCE:	
1	Circuit Theory (Analysis and Synthesis) By A. Chakrabarti, Dhanpat Rai & Company. Network Analysis by M.E.Vanvalkenburg, PHI Publication

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-
2	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-
3	3	2	1	1	1	-	-	-	2	1	-	-	2	1	-
4	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-
5	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-
6	3	2	1	1	-	-	-	-	2	1	-	-	2	-	-
Overall Correlation	3	2	1	1	1	-	-	-	2	1	-	-	3	1	-

Recommended by Board of Studies	**28-07-2023**		
Approved by Academic	**1st ACM**	**Date**	**09-09-2023**

23HS221	SOFT SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To help learners improve their interpersonal skills and critical thinking
- To familiarize learners with the attributes of a leader to enhance team performance
- To prepare students to face job interviews
- To help learners to know the importance of ethics in work place

UNIT I	INTERPERSONAL COMMUNICATION	6

Basic communication- verbal and non-verbal communication; passive, assertive and aggressive communication; presentation skills; giving feedback and responding to feedback.

UNIT II	TEAM WORK AND LEADERSHIP	6

Vision- setting realistic goals and objectives, collaboration, cooperation, dependability, empathy, sympathy, motivation, delegation of responsibilities, open mindedness, creativity, flexibility, adaptability, cross cultural communication and group dynamics.

UNIT III	TIME MANAGEMENT AND STRESS MANAGEMENT	6

Effective Planning, Planning activities at macro and micro levels, setting practical deadlines and realistic limits/targets, punctuality, prioritizing activities, spending the right time on the right activity, positive attitude, emotional intelligence, self- awareness and regulation.

UNIT IV	CRITICAL THINKING AND WORK ETHICS	6

Questioning, analysing, inferencing, interpreting, evaluating, solving problems, explaining, self-regulation, open-mindedness, conflict management- ethical dilemmas, appearance, attendance, attitude, character, organizational skills, productivity, respect.

UNIT V	INTERVIEW SKILLS AND RESUME BUILDING TECHNIQUES	6
Telephonic interview, online interviews, f2f interviews, FAQ soft skills interview questions, drafting error-free CVs/ Resumes and Cover Letters, selecting the ideal format for resume, content drafting along with sequencing, art of representing one's qualifications and most relevant work history, video resume, website resume.		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Express their thoughts, opinions and ideas confidently to one or more people in spoken form
CO2:	Develop evolving competences required for professional success
CO3:	Demonstrate knowledge and skills in a group as team player and leader
CO4:	Compose a comprehensive resume reflecting qualifications, exposure and achievements
CO5:	Exhibit knowledge and skills confidently during job interviews
CO6:	Demonstrate ethical and professional behaviour at workplace in all situations

TEXT BOOKS:	
1	Soft Skills: Key to Success in Workplace and Life by Meenakshi Raman & Shalini Upadhyay. Cengage

REFERENCES:	
1	English for Job Seekers (Language and Soft Skills for the Aspiring) by Geetha Rajeevan, C.L.N. Prakash) Cambridge University Press pvt, Ltd.
2	Business Benchmark by Norman Whitby. Cambridge University Press pvt, Ltd

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-
2	-	-	-	-	-	2	2	2	3	3	2	2	-	-	2
3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
6	-	-	-	-	-	-	-	3	3	3	-	-	-	-	3
Overall Correlation	-	-	-	-	-	2	2	2	3	3	2	2	-	-	**2**

Recommended by Board of Studies	**28-07-2023**		
Approved by Academic	**1st ACM**	**Date**	**09-09-2023**

SEMESTER –III

23MA301	LINEAR ALGEBRA	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To test the consistency and solve system of linear equations
- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To find orthonormal basis of inner product space.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I	MATRICES AND SYSTEM OF LINEAR EQUATIONS	9+3

Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordon method – Gauss Seidel Method

UNIT II	VECTOR SPACES	9+3

Vector spaces - Subspace - Linear independence and dependence – Linear Span - Basis and dimension – Maximal Linearly Independent Subsets.

UNIT III	LINEAR TRANSFORMATION	9+3

Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Invertibility and Isomorphisms – Dual Spaces.

UNIT IV	INNER PRODUCT SPACES	9+3

Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process – Adjoint of Linear operator – Normal and self adjoint operators – Unitary and orthogonal operators and their Matrices

UNIT V	EIGENVALUE PROBLEMS AND MATRIX DECOMPOSITION	9+3

Eigen value Problems - Power method, Jacobi rotation method - Singular value decomposition - QR decomposition – Generalized Inverse - Least square solution

TOTAL: 60 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Solve the system of linear equations.
CO2:	Find the basis and dimension of vector space.
CO3:	Find the matrix of linear transformation and its eigenvalues and eigenvectors.
CO4:	Find orthonormal basis of inner product space.
CO5:	Find eigenvalues of a matrix using numerical techniques
CO6:	Find Matrix Decomposition using different techniques
TEXT BOOKS:	
1	Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
2	Faires J.D. and Burden R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 2002.
REFERENCES:	
1	Kumaresan S, "Linear Algebra - A geometric approach", Prentice Hall of India, New Delhi, Reprint, 2010.
2	P.S.Das – "Numerical Analysis", Pearson Educations, New Delhi, 2002
3	Richard Branson, "Matrix Operations", Schaum's outline series, 1989.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**08-04-2024**		
Approved	**2nd ACM**	**Date**	**25-05-2024**

23EC301	ELECTRONIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers & oscillators principles

UNIT I	CHARACTERISTICS OF SEMICONDUCTORS DEVICES	9

PN junction diode, Zener diode, BJT - Construction, working and characteristics of CE, CB and CC configurations- diffusion and transition capacitance, FinFET, MOSFET, UJT –structure, operation and V-I characteristics, - Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator.

UNIT II	BJT AND FINFET AMPLIFIERS	9

Load line, operating point, biasing methods for BJT - fixed bias, voltage divider bias, collector to base bias, collector to emitter feedback bias, emitter feedback bias - Biasing methods for FinFET - BJT small signal model – Analysis of CE, CB, CC amplifiers – FINFET small signal model.

UNIT III	FREQUENCY RESPONSE OF AMPLIFIERS	9

Gain and frequency response – BJT, FINFET - High frequency analysis. Bias compensation circuits: Diode compensation, thermistor compensation and sensistor compensation

UNIT IV	MULTISTAGE AMPLIFIERS & TUNED AMPLIFIERS	9

Cascade Amplifier, Cascode amplifier, Differential amplifier –

Common mode and Difference mode analysis – FinFET input stages – Tuned amplifiers : Single tuned amplifier, Double tuned Amplifier, Stagger – Gain and frequency response – Neutralization methods.		
UNIT V	**POWER AMPLIFIERS AND DC/DC CONVERTERS**	**9**
Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using FET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyse the behaviour of semiconductor devices.
CO2:	Examine various transistor biasing and analyse the small signal model of amplifiers
CO3:	Analyse the gain and high frequency response of amplifiers
CO4:	Interpret the design and analysis of multistage amplifier and tuned amplifier circuits.
CO5:	Summarise the various power amplifiers
CO6:	Explain the various DC/DC converters

TEXT BOOKS:	
1	Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3rd Edition, 2010.
2	Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008.

REFERENCES:	
1	David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
2	D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3rd Edition, 1989
3	Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.
4	Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	1	1	-	1	-	1	1	1	2	1	1
2	3	3	2	2	1	1	-	1	-	1	1	1	2	1	1
3	3	3	2	2	1	1	-	1	-	1	1	1	2	1	1
4	2	1	-	-	1	1	-	1	-	1	1	1	2	1	1
5	2	1	-	-	1	1	-	1	-	1	1	1	2	1	1
6	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	-	2	2	2	3	1	1
Recommended by Board of Studies							01-04-2024								
Approved by Academic							2nd ACM			Date			25-05-2024		

23EC302	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the components and representation of control systems
- To learn methods of analyzing time response of systems
- To understand various techniques to analyze frequency response of systems.
- To learn the concept of stability analysis in control systems
- To study different approaches for state variable analysis

UNIT I	SYSTEM COMPONENTS AND THEIR REPRESENTATION	9

Introduction to Control System, Terminology and Basic Structure, Feed forward and Feedback control theory, Electrical and Mechanical transfer Function Models, Block diagram Models, Signal flow graphs, Multivariable control system.

UNIT II	TIME RESPONSE ANALYSIS	9

Transient response, Steady state response, Performance of standard first order and second order systems, Zeroes, Poles and Type of system, Analytical design - PD, PI and 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, Cascade lead compensation, Cascade lag compensation, Cascade lead-lag compensation.

UNIT IV	CONCEPTS OF STABILITY ANALYSIS	9

Concept of stability – Bounded Input and Bounded Output, 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.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basic elements of control systems and their modelling using block diagram reduction and signal flow graph.
CO2:	Apply time domain analysis for first and second order systems.
CO3:	Develop compensation techniques in frequency domain.
CO4:	Utilize Bode plot and Polar plot in control system analysis.
CO5:	Apply Routh criteria, Root locus method and Nyquist stability criterion for stability analysis.
CO6:	Explain state variable analysis method using state space representation.
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.
REFERENCES:	
1	K. Ogata, ‗Modern Control Engineering ', 5th edition, PHI, 2012.
2	S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

3	Benjamin.C. Kuo, —Automatic control systems, Prentice Hall of India, 7th Edition,1995.
4	A.Nagoor Kani - Control Systems Engineering, CBS Publishers & Distributors, 2021

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	-	-	-	2	3	3	3	-
2	3	2	1	1	2	3	-	-	-	-	2	2	3	3	-
3	3	2	1	1	2	2	-	-	-	-	2	3	3	2	-
4	3	2	1	1	2	2	-	-	-	-	2	3	3	2	-
5	3	2	1	1	2	2	-	-	-	-	2	2	3	3	-
6	2	1	-	-	2	3	-	-	-	-	2	3	2	2	-
Overall Correlation	**3**	**2**	**1**	**1**	**2**	**3**	-	-	-	-	**2**	**3**	**3**	**3**	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23HS301	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

UNIT I	COURSE INTRODUCTION	9

Need, Basic Guidelines, Content and Process for Value Education - Understanding the need, basic guidelines, content and process for Value Education -Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations -Right understanding, Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority -Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT II	UNDERSTANDING HARMONY IN THE HUMAN BEING	9

Harmony in Myself- Understanding human being as a co-existence of the sentient 'I' and the material 'Body' -Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) -Understanding the characteristics and activities of 'I' and harmony in 'I' -Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity.

UNIT III	UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY	9
Harmony in Human-Human Relationship -Understanding Harmony in the family – the basic unit of human interaction - Understanding values in human-human relationship; meaning of Nyaya and program for its fulfilment to ensure satisfaction; Trust(Vishwas) and Respect as the foundational values of relationship -Understanding the meaning of Vishwas; Difference between intention and competence -Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship -Understanding the harmony in the society (society being an extension of family)-Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order- from family to world family.		
UNIT IV	**ENGINEERING ETHICS**	**9**
Senses of ‗Engineering Ethics‟ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.		
UNIT V	**SAFETY, RESPONSIBILITY AND RIGHTS**	**9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination-Moral Leadership –Code of Conduct – Corporate Social Responsibility.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Understand the need of value education.	
CO2:	Comprehend the difference between self and body.	

CO3:	Understand the need to exist as an unit of Family and society.
CO4:	Understand Harmony at all levels.
CO5:	Apply the values acquired in the professional front.
CO6:	Identify appropriate technologies for ecofriendly production systems.
TEXT BOOKS:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010 3.
2	Mike W. Martin and Roland Schinzinger, —Ethics in Engineering‖, Tata McGraw Hill, New Delhi, 2003.
3	Govindarajan M, Natarajan S, Senthil Kumar V. S, —Engineering Ethics‖, Prentice Hall of India, New Delhi, 2004
REFERENCES:	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book).
4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi AICTE Model Curriculum in Humanities, Social Science and Management Courses (UG Engineering & Technology) 169 | Page .
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews.
7	Economy of Permanence - J C Kumarappa 8. Bharat Mein Angreji Raj – Pandit Sunderlal.
8	Rediscovering India - by Dharampal.
9	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10	India Wins Freedom - Maulana Abdul Kalam Azad.
11	Vivekananda - Romain Rolland (English) 13. Gandhi - Romain Rolland (English).

12	Charles B. Fleddermann, ―Engineering Ethics‖, Pearson Prentice Hall, New Jersey, 2004.
13	Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, ―Engineering Ethics – Concepts and Cases‖, Cengage Learning, 2009.
WEB SOURCES:	
1	www.onlineethics.org
2	www.nspe.org
3	www.globalethics.org

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
2	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
3	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
4	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
5	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
6	-	-	-	-	-	3	3	3	3	3	-	-	-	-	3
Overall Correlation	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**3**

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC311	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

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

UNIT I	BASIC CONCEPTS	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, Completely and Incompletely specified functions, Implementation of Boolean expressions using Universal gates, Tabulation methods.

UNIT II	COMBINATIONAL LOGIC CIRCUITS	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/De-mux, 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 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	**LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES**	**9**
Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL, TTL, ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/ sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM.		
TOTAL: 45 PERIODS		
PRACTICAL EXERCISES : 30 PERIODS		
1. Design of adders and subtractors & code converters using K Map 2. Design of Multiplexers & Demultiplexers using K Map 3. Design of Encoders and Decoders. 4. Design of Magnitude Comparators using IC 7483 and gates 5. Design and implementation of counters using flip-flops 6. Design and implementation of shift registers.		
TOTAL: 45 +30 =75 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Interpret number system conversions and fundamentals of digitals systems.	
CO2:	Make use of Karnaugh map and Quine Mc-cluskey method for minimizing Boolean equations	
CO3:	Utilize logic gates and karnaugh map to design and implement combinational circuits	
CO4:	Construct synchronous sequential circuits using the concepts of flipflops	
CO5:	Illustrate the design of asynchronous sequential circuits and hazards	

CO6:	Explain various memory devices and digital integrated circuits.
TEXT BOOKS:	
1	M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 5th Edition, 2013.(Unit - I - V).
2	John M Yarbrough,-Digital Logic Applications and Design, Thomson Learning,2001.
REFERENCES:	
1	Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.
2	William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
3	Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
4	John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4th Edition, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	-	-	1	-	-	2	1	-
2	3	2	1	1	1	-	-	-	-	1	-	-	3	1	-
3	3	2	1	1	2	-	-	-	2	1	-	-	3	2	-
4	3	2	1	1	2	-	-	-	2	1	-	-	3	2	-
5	2	1	-	-	1	-	-	-	2	1	-	-	2	1	-
6	2	1	-	-	1	-	-	-	-	1	-	-	2	1	-
Overall Correlation	**3**	**2**	**1**	**1**	**2**	-	-	-	**1**	**1**	-	-	**3**	**2**	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**2nd ACM**

23EC312	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9

Standard signals- Step, Ramp, 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-Static and Dynamic System.

UNIT II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9

Fourier Transform – Properties-Linearity-Time Shifting-Time reversal -Time Scaling-Differentiation-Convolution- Parseval's Theorem- Inverse Fourier Transform-Laplace Transform -Basic Properties- Linearity-Time Shifting-Time reversal -Time Scaling-Differentiation-Convolution -Initial value theorem-Final Value Theorem-Inverse Laplace Transform.

UNIT III	LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS	9

Fourier and Laplace transforms in analysis of CT systems- Impulse response and step response (without initial conditions) - Convolution integrals- Differential Equation- Realization of CT systems-Direct Form-I , Direct Form-II Cascade and Parallel forms.

UNIT IV	ANALYSIS OF DISCRETE TIME SIGNALS	9
Fourier Transform of discrete time signals (DTFT)– Properties of DTFT- Z Transform – Unilateral & Bilateral Z transforms – Properties-Inverse Z transform: Power series expansion – Long Division method-Partial fraction method-Convolution method		
UNIT V	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS**	**9**
Discrete Fourier Transform and Z Transform in analysis of DT systems -Impulse response and step response (without initial conditions)–Difference Equations-Convolution sum-Graphical and Matrix method- Realization of DT systems-Direct Form-I and Direct Form-II Cascade and Parallel forms.		
TOTAL : 45 PERIODS		

PRACTICAL EXPERIMENTS: 30 PERIODS
MATLAB / EQUIVALENT SOFTWARE PACKAGE BASED IMPLEMENTATION

1. Introduction to MATLAB
2. Generation of basic continuous time signal
3. Generation of basic Discrete time signal
4. Linear Convolution on Discrete Time Signals
5. Operation on Signals
6. Linearity, Causality and Stability of the system
7. Convolution on Continuous Time Signals using Laplace Transform
8. Sampling Theorem
9. Convolution on Discrete Time Signals using Z Transform

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyze the given signals and perform various operations on it.
CO2:	Identify the types of signals and systems based on various factors.
CO3:	Apply Laplace transform and Fourier transform to Continuous time signals.

CO4:	Apply Laplace transform and Fourier transform to Continuous time systems.
CO5:	Utilise DTFT and Z- transform for Discrete time signals
CO6:	Solve the Discrete time systems using DTFT and Z Transform
TEXT BOOKS:	
1	Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2	Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002
REFERENCES:	
1	B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2	M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3	John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	3	-	-	-	-	-	-	2	3	3	-
2	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-
3	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-
4	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-
5	3	2	1	1	3	-	-	-	-	-	-	2	3	3	-
6	3	2	1	1	3	-	-	-	-	1	-	3	3	3	-
Overall Correlation	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC321	ELECTRONIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Design & Implement characteristics of PN Junction diode and Zener diode.
- To design rectifiers using filters.
- To Design & Implement characteristics of amplifier.

LIST OF EXPERIMENTS:

1. Characteristics of PN Junction Diode and Zener diode.
2. Design Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
4. Design of Common Emitter Transistor and plot input-output Characteristics.
5. MOSFET Drain current and Transfer Characteristics.
6. Design and determine Frequency response of CE and CS amplifiers.
7. Design and determine Frequency response of CB and CC amplifiers.
8. Design and determine Frequency response of Cascode Amplifier
9. CMRR measurement of Differential Amplifier
10. Mini Project

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Experiment with the characteristics of PN Junction Diode and Zener diode.
CO2:	Develop and Design the BJT and MOSFET amplifiers.
CO3:	Analyze the operations of Rectifiers and Filters.
CO4:	Construct the frequency response of BJT and MOSFET amplifiers.
CO5:	Develop the operation of Multistage Amplifiers & Power amplifiers.
CO6:	Analyze the operations of Oscillators

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	1	-	-	2	1	-	1	2	1	-
2	3	2	1	1	2	1	-	-	2	1	-	1	2	1	-
3	3	3	2	2	1	1	-	-	2	1	-	1	2	1	-
4	3	2	1	1	3	1	-	-	2	1	-	1	2	1	-
5	3	2	1	1	2	1	-	-	2	1	-	1	2	1	-
6	3	3	2	2	2	1	-	-	2	1	-	1	2	1	-
Overall Correlation	3	3	2	2	2	1	-	-	2	1	-	1	2	1	-
Recommended by Board of Studies							01-04-2024								
Approved by Academic							2nd ACM			Date			25-05-2024		

23ES391	PRESENTATION SKILLS	L	T	P	C
		0	0	2	1*

COURSE OBJECTIVES:

- To help learners use brainstorming techniques for generating, organizing and outlining ideas.
- To familiarize learners with different speech structures by engaging them in watching speeches with great opening and closing
- To give practice on voice modulation and use of body language and eye contact for making captivating presentations
- To give hands on training on preparing presentation slides and using remote presentation tools
- To train students on responding to question and feedback with confidence.

UNIT I	BRAINSTORMING AND OUTLINING	6

Mind Mapping based on prior knowledge, collecting additional information from external resources, giving prompts to Generative AI tools seeking information, organizing ideas generated, knowing your audience.

UNIT II	STRUCTURING THE PRESENTATION	6

3 Ts of a presentation, writing effective introduction- Beginning the introduction with a hook (question, data, storytelling) and closing the introduction with the objective of the presentation. Structuring the body paragraphs -Choosing key ideas from the list of ideas generated during brainstorming. Substantiating ideas with examples, data, reasons and anecdotes. Summarizing the ideas for conclusion.

UNIT III	DELIVERY TECHNIQUES	6

Vocal variety, intonation, reducing filler words and improving articulation, inflection, engaging the audience. Body language- eye contact, gestures, movement on stage.

UNIT IV	USE OF TECHNOLOGICAL AIDS	6
Use of presentation software like MS Power Point, Google Slides etc, incorporating images, graphs, charts and videos, using interactive tools like quizzes and polls, using remote presentation tools like zoom, MS Teams, WebEx for screen sharing, virtual whiteboards and chat functionalities, incorporating AR/VR for more immersive presentations.		
UNIT V	**HANDLING QUESTIONS AND FEEDBACK**	**6**
Audience engagement through questions, PAR (Point, Answer, Redirect) strategy for structuring responses to questions. Understanding feedback process - Receiving, interpreting and evaluating constructively, active listening techniques for processing feedback, responding to feedback- acknowledging, clarifying and appreciating, Dealing with challenging feedback.		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Construct ideas for presentation through mind mapping techniques
CO2:	Organize ideas and structure the presentation with captivating introduction, body paragraphs illustrated with examples and reasons and compelling conclusion
CO3:	Apply vocal variety and body language techniques to enhance delivery
CO4:	Prepare engaging presentations by integrating multimedia elements
CO5:	Demonstrate proficiency in delivering presentations in remote platforms utilizing various technological tools and strategies to engage audience in Virtual environments
CO6:	Exhibit active listening skills by responding to questions with clarity and confidence and incorporating constructive feedback for professional development

TEXT BOOKS:	
1	Nancy Duarte "Slide:ology: The Art and Science of Creating Great Presentations" O' Reilly Media.
2	Garr Reynolds "The Naked Presenter: Delivering Powerful Presentations with or Without Slides" New Riders.
REFERENCES:	
1	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds" by Carmine Gallo.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
2	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
3	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
4	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
5	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
6	2	2	1	1	-	-	-	1	1	1	-	1	2	2	1
Overall Correlation	**2**	**2**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**2**	**1**

Recommended by Board of Studies	**01-04-2024**		
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SEMESTER –IV

23MA402	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

UNIT I	PROBABILITY AND RANDOM VARIABLES	9+3

Probability – 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.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	9+3

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	9+3

Classification – Stationary process – Markov process – Markov chain – Poisson process – Random telegraph process.

UNIT IV	CORRELATION AND SPECTRAL DENSITIES	9+3

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties

UNIT V	LINEAR SYSTEMS WITH RANDOM INPUTS	9+3
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Apply the fundamental knowledge of the concepts of probability and one dimensional random variables	
CO2:	Apply standard probability distributions which can describe real life phenomenon.	
CO3:	Apply the basic concepts of two dimensional random variables in engineering applications.	
CO4:	Apply the concepts of random processes in real life situations	
CO5:	Solve problems in correlation and spectral densities	
CO6:	Examine the linear systems with random inputs	
TEXT BOOKS:		
1	Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Indian Reprint, Elsevier, 2007.	
2	Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.	
3	Probability and Random Processes by P.Sivaramakrishna Das and C.Vijayakumari	
REFERENCES:		
1	Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.	
2	Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.	

3	Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3rd Edition, 2002.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC401	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To study the basic laws, concepts and proofs related to Electromagnetic Fields
- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To study the significance of time varying EM waves propagating in different media

UNIT I	INTRODUCTION	12

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

UNIT II	ELECTROSTATICS	12

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Electric flux density and dielectric constant, Boundary conditions, Capacitance – Parallel and cylindrical, Electrostatic energy.

UNIT III	MAGNETOSTATICS	12

Lorentz force equation, Ampere's law, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions, Boundary conditions, Inductance and inductors.

UNIT IV	MAXWELL's EQUATIONS AND WAVE EQUATIONS	12
Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Wave equations and solutions, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations.		
UNIT V	**EM WAVE CHARACTERISTICS**	**12**
Uniform Plane Waves – Definitions, Relation between E & H, Wave Propagation in Lossless Media, Wave Propagation in Good Conductors and Good Dielectrics, Reflection and Refraction of Plane Waves – Normal Incidences for both Perfect Conductor and Perfect Dielectrics, Poynting Theorem.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:	
	After completion of the course, the students will be able to:
CO1:	Explain the fundamentals of vector, coordinate system to electromagnetic concepts
CO2:	Make use of the significance of electrostatics in solving electric components of a field
CO3:	Analyze the concept of Magneto Static field in material space and to understand the applications of solenoid and toroid
CO4:	Examine the characteristics of electric and magnetic fields at the boundary of two dissimilar media
CO5:	Demonstrate Faraday's laws and Ampere's laws to understand the significance of Maxwell's equations and time varying fields
CO6:	Make use of the phenomena of wave propagation in different media to estimate power flow at interfaces

TEXT BOOKS:	
1	D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002
2	M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

REFERENCES:	
1	Edward C. Jordan & Keith G. Balmain, Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
2	W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006
3	B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	-	-	-	1	-	1	2	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	1	1	-	-	-	-	-	1	-	1	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
5	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
6	2	1	-	-	-	2	-	-	-	-	-	1	2	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**-**	**1**	**3**	**-**	**-**

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC402	COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce analog Modulation Schemes
- To impart knowledge in random process
- To study various Digital techniques
- To introduce the importance of sampling & quantization
- To impart knowledge in demodulation techniques
- To enhance the class room teaching using smart connectivity instruments

UNIT I	AMPLITUDE & ANGLE MODULATION	9

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

UNIT II	RANDOM PROCESS & SAMPLING	9

Review of random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation sys tems. 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, 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:	
	After completion of the course, the students will be able to:
CO1:	Apply concepts of Amplitude modulation system and calculate the power.
CO2:	Apply Fundamental principles of frequency and phase modulation to calculate the modulation index for different signals.
CO3:	Summarize the properties of random process, noise characterization and to introduce Analog to Digital Modulation.
CO4:	Explain pulse modulation and examine channel coding considering the trade-offs between error correction capabilities and bandwidth utilization
CO5:	Explain various digital modulation schemes
CO6:	Summarize the demodulation of digital signals

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.

REFERENCES:	
1	Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2	D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006
3	A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.
4	B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007
5	H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
6	Couch.L., "Modern Communication Systems", Pearson, 2001

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	2	-	-	-	3	-	3	3	-	-
2	3	2	1	1	-	2	1	-	-	3	-	3	3	-	-
3	2	1	-	-	-	2	-	-	-	2	-	2	2	-	-
4	3	3	2	2	-	-	-	-	-	3	-	--	3	-	-
5	2	1	-	-	-	-	1	-	-	2	-	2	2	-	-
6	2	1	-	-	-	-	1	-	-	2	-	-	2	-	-
Overall Correlation	3	3	1	1	-	1	1	-	-	3	-	2	3	-	-

Recommended by Board of Studies	01-04-2024		
Approved by Academic	2nd ACM	Date	25-05-2024

23EC403	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- 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, Current sources as active loads Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations - Advantages of negative feedback – Voltage / Current, Series, Shunt feedback Amplifiers.

UNIT II	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9

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

UNIT III	ANALOG MULTIPLIER AND PLL	9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage

controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.		
UNIT IV	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**	**9**
Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type – Sample and hold circuit - A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - Over- sampling A/D Converters- Sigma –Delta Converters.		
UNIT V	**WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS**	**9**
Sine-wave generators – RC and LC oscillators, Multivibrators – Astable and Monostable, ICL8038 function generator, Timer IC 555 – Astable and Monostable operation, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator – Optocouplers and IC optocouplers.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain various circuits to form basic blocks of operational amplifier.
CO2:	Build linear and non-linear applications of operational amplifier.
CO3:	Utilise multipliers and PLL for various applications.
CO4:	Experiment with ADC and DAC using operational amplifier.
CO5:	Illustrate various waveforms using operational amplifier circuits.
CO6:	Identify the applications of various special function ICs.

TEXT BOOKS:	
1	D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,2018, Fifth Edition. (Unit I – V.

2	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)
REFERENCES:	
1	Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2	Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3	S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	-	-	-	-	-	-	2	2	3	-
2	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-
3	3	2	1	1	-	-	-	-	-	2	-	3	3	-	-
4	3	2	1	1	-	-	-	-	-	2	-	3	3	-	-
5	2	1	-	-	3	-	-	-	-	-	-	2	2	3	-
6	3	2	1	1	-	-	-	-	-	1	-	3	3	-	-
Overall Correlation	3	2	1	1	2	-	-	-	-	2	-	3	3	2	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC411	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- Learn the architecture and features of 8086 microprocessor.
- Explain the Bus structure and multiprocessor configuration of 8086
- Describe the architecture of ARM and CORTEX M3 processors
- Learn the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller

UNIT I	THE 8086 MICROPROCESSOR	9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming- Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II	8086 SYSTEM BUS STRUCTURE	9

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming –System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations

UNIT III	MICROCONTROLLER	9

Architecture of 8051 – Special Function Registers (SFRs) – Timers, Serial port, Interrupts - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming- External Memory and Stepper Motor Interface

UNIT IV	OVERVIEW OF ARM AND CORTEX-M3	9

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Link Register, Program Counter, Special Registers, Operation Mode, Stack Memory Operations, CORTEX M3

Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions, CORTEX M3 – Implementation Overview: Pipeline, Block Diagram- Exceptions and Interrupts		
UNIT V	**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, Debugging Tools: Software and Hardware tools like Cross Assembler Compiler, Debugger, Simulator, In – Circuit Emulator(ICE), Logic Analyser.		
TOTAL: 45 PERIODS		

PRACTICAL EXERCISES:

1. Arithmetic and logical operations using 8086
2. String manipulations / sorting
3. Stepper motor interface using 8086
4. 8255 parallel peripheral interface using 8086
5. Arithmetic operations using 8051
6. USART interface using 8051
7. Program to turn on LEDs on Port B on STM32L- Discovery by configuring GPIO
8. Transmit a string "Programming with ARM Cortex" to PC by configuring the registers of USART2. Use polling method

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply the features, architecture, addressing modes and instruction sets of 8086 Microprocessor for programming.
CO2:	Analyse 8086 system bus structure and multiprocessor configurations for Interfacing.
CO3:	Interpret the features, architecture, addressing modes, instruction sets and interfacing of 8051 microcontroller
CO4:	Explain the architecture and operation mode of ARM/CORTEX M3 Processor

CO5:	Make use of instruction sets and pipelining of CORTEX M3 Processor in programming
CO6:	Apply the architecture and debugging tools of STM32 CORTEX M4 microcontroller in simulator
TEXT BOOKS:	
1	Nagoorkani," Microprocessors and Microcontroller Interfacing, McGraw Hill, 2016
2	Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010.
REFERENCES:	
1	DoughlasV.Hall, "Microprocessors and Interfacing, Programming and Hardware:,TMH, 2012
2	Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and
3	Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, "The 8051 Microcontroller and Embedded Systems: Using
4	Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software,
5	Krishnakant, "Microprocessors and Microcontrollers", PHI, 2011

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	1	-	-	1	1	-	1	3	1	-
2	3	3	2	2	1	1	-	-	1	1	-	2	3	1	-
3	2	1	-	-	1	1	-	-	1	1	1	2	2	1	1
4	2	1	-	-	1	1	1	-	1	1	1	1	2	1	1
5	3	2	1	1	1	-	-	-	1	1	-	3	3	1	-
6	3	2	1	1	1	1	1	-	1	1	-	3	3	1	-
Overall Correlation	3	2	1	1	1	1	1	-	1	1	1	2	3	1	1

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23EC421	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM & Digital Modulation.
- To Simulate Digital Modulation Schemes.
- To Implement Equalization Algorithms and Error Control Coding Schemes.

LIST OF EXPERIMENTS:

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Pre-Emphasis and De-Emphasis.
4. Signal sampling and TDM.
5. Pulse Code Modulation and Demodulation.
6. Pulse Amplitude Modulation and Demodulation.
7. Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation.
8. Digital Modulation – ASK, PSK, FSK.
9. Delta Modulation and Demodulation.
10. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
11. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse Amplitude and Frequency modulation techniques.
CO2:	Apply sampling to implement Time Division Multiplexing.
CO3:	Make use of pulse modulation techniques to perform PCM and PAM.
CO4:	Analyse digital modulation schemes.
CO5:	Design and simulate Digital Modulation schemes.
CO6:	Apply linear block codes to improve noise performance.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	3	-	-	-	1	1	1	3	-	-
2	3	2	1	1	-	2	-	-	-	1	1	1	3	-	-
3	3	2	1	1	-	2	-	-	-	1	1	1	3	-	-
4	3	3	2	2	-	3	-	-	-	1	1	1	3	-	-
5	3	3	2	2	3	2	-	-	-	1	1	1	3	3	-
6	3	2	1	1	3	2	-	-	-	1	1	1	3	3	-
Overall Correlation	3	3	2	2	1	3	-	-	-	1	1	1	3	1	-
Recommended by Board of Studies							01-04-2024								
Approved by Academic							2nd ACM			Date			25-05-2024		

23EC422	LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Inverting /Non -Inverting Amplifier
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Schmitt Trigger
4. RC Integrator and Differentiator circuits using Op-Amp
5. Design Comparator using LM348
6. Active low-pass, High pass & Band pass filters
7. PLL Characteristics and its use as frequency multiplier, clock synchronization
8. R-2R ladder type D-A converter using Op-Amp

SIMULATION USING SPICE (Using Transistor):

1.Inverting /Non -Inverting Amplifier
2. Differentiator/ Integrator
3. Low Pass Filter
4. Schmitt Trigger circuit with Predictable hysteresis
5. Wien Bridge Oscillator

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.

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

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, LM 348, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse various types of feedback amplifiers.
CO2:	Develop oscillators and wave-shaping circuits.
CO3:	Analyse Multivibrator circuits using op-amps.
CO4:	Construct various D-A converters using op-amps.
CO5:	Examine various filters using op-amps.
CO6:	Make use of PSPICE to design and simulate various integrated circuits.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
3	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
5	3	3	2	2	-	-	-	-	-	-	-	-	2	-	-
6	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-
Overall Correlation	3	3	2	2	1	-	-	-	-	-	-	-	3	1	-

Recommended by Board of Studies	**01-04-2024**		
Approved by Academic	**2nd ACM**	**Date**	**25-05-2024**

23ES491	APTITUDE AND LOGICAL REASONING –1	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint student with frequently asked questions and patterns in quantitative aptitude and logical reasoning.

UNIT I	**4**
Numbers, LCM, HCF, Averages, Ratio & Proportion, Mixtures & Allegation.	
UNIT II	**4**
Percentages, Time and work, Pipes and Cistern, coding and decoding.	
UNIT III	**4**
Time Speed Distance, Train, Boats and Streams, Analogy.	
UNIT IV	**4**
Data Interpretation (BAR,PIE,LINE), Seating arrangement.	
UNIT V	**4**
Simple Interest and Compound Interest, Profit loss and Discount, Partnership.	
TOTAL: 20 PERIODS	

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse and solve complex problems, and foster critical thinking and logical reasoning skills.
CO2:	Solve fundamental mathematical problems, and enhance their computational skills and numerical ability.
CO3:	Develop strategies for tackling a variety of problem types, and encourage the use of multiple approaches to solve problems efficiently.
CO4:	Analyse and solve different data analysis problems for time and distance, and interpret data analysis for a case study.
CO5:	Derive information from graphs, and solve questions based on mathematical operations such as ratios, proportions, basic algebra, and statistical estimation.
CO6:	Solve questions in a fraction of a minute using shortcut methods

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	-	2	1	1	2	1	2	3	1	-	3
2	2	3	3	-	-	2	-	1	3	2	2	3	2	1	3
3	3	3	3	-	-	2	-	1	2	2	2	3	2	-	3
4	2	3	2	3	-	2	1	2	3	3	2	3	1	2	3
5	3	2	2	-	1	3	-	2	2	3	3	3	3	1	3
6	3	3	3	3	2	3	1	3	3	2	3	3	3	1	3
Overall Correlation	3	3	3	1	1	3	1	2	3	3	3	3	2	1	3

Recommended by Board of Studies	08-04-2024		
Approved	2nd ACM	Date	25-05-2024

SEMESTER -V

23RE501	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To provide an overview on selection of research problem based on the Literature review
- To enhance knowledge on the Data collection and Analysis
- To outline the importance of ethical principles to be followed in Research work and IPR

UNIT I	INTRODUCTION TO RESEARCH FORMULATION	6

Meaning of research problem, Sources of research problem, Criteria- good research problem, and selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Necessity of defining the problem - Importance of literature review in defining a problem

UNIT II	LITERATURE REVIEW	6

Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis

UNIT III	DATA ANALYSIS	6

Execution of the research - Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Generalization and Interpretation

UNIT IV	REPORT, THESIS PAPER, AND RESEARCH PROPASAL WRITING	6

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports –

Illustrations and tables - Bibliography, types of referencing, citations- index and footnotes, how to write report- Paper Developing,- Plagiarism- Research Proposal- Format of research proposal- a presentation - assessment by a review committee		
UNIT V	**INTELLECTUAL PROPERTY AND PATENT RIGHTS**	**6**
Ethical principles- Plagiarism, Nature of Intellectual Property - Patents, Designs, Trade and Copyright- patent search, Process of Patenting and Development: technological research, innovation, patenting, and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of Patent Rights – Scope of Patent Rights, Geographical Indications		
TOTAL: 30 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze the literature to identify the research gap in the given area of research.
CO2:	Identify and formulate the research Problem
CO3:	Analyze and synthesize the data using research methods and knowledge to provide scientific interpretation and conclusion.
CO4:	Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report
CO5:	Conduct patent database search in various countries for the research problem identified.
CO6:	Apply ethical principles in research and reporting to promote healthy scientific practice

TEXT BOOKS:	
1	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An Introduction to Research Methodology, RBSA Publishers.

2	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4	Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5	Wadehra, B.L. 2000. Law relating to patents, Trade Marks, Copy right designs and Geographical indications. Universal Law Publishing
REFERENCES:	
1	Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2	Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3	Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4	Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5	Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6	Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7	Satarkar, S.V., 2000. Intellectual property rights and copy right. ESS Publications.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
2	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
3	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
4	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
5	3	2	1	1	1	-	-	1	1	2	-	1	3	2	1
6	2	2	1	1	1	-	-	1	1	2	-	1	3	2	1
Overall Correlation	3	2	**1**	**1**	**1**	**-**	**-**	**1**	**1**	2	**-**	**1**	**3**	**2**	**1**

Recommended by Board of Studies	**04-11-2024**		
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23EC501	TRANSMISSION LINES AND RF SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics
- To give a thorough understanding about high-frequency line, power and impedance measurements.
- To impart technical knowledge in impedance matching using Smith chart
- To introduce passive filters and basic knowledge of active RF components
- To get acquainted with RF system transceiver design

UNIT I	TRANSMISSION LINE THEORY	12

The general theory of Transmission lines - the transmission line - general solution - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z0 - 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	12

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 - Measurement of VSWR and wavelength

UNIT III	IMPEDANCE MATCHING IN HIGH FREQUENCY LINES	12

Impedance matching: Quarter wave, Half wave and Eighth wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single stub matching using Smith chart

UNIT IV	WAVE GUIDES	12
General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides		
UNIT V	**RF SYSTEM DESIGN CONCEPTS**	**12**
Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, Basic concepts of RF design, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations		
TOTAL: 60 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the general characteristics of transmission lines and their losses
CO2:	Explain the standing wave ratio and input impedance in high-frequency transmission lines
CO3:	Explain various impedance-matching methods
CO4:	Make use of the Smith chart to design stub-matching transformers.
CO5:	Apply Maxwell's equation to explain the characteristics of TE and TM waves in various waveguides
CO6:	Build an RF transceiver system for wireless communication

TEXT BOOKS:	
1	John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015.
2	Mathew M. Radmanesh, ―Radio Frequency &Microwave Electronics‖, Pearson Education Asia, Second Edition,2002.

REFERENCES:	
1	Reinhold Ludwig and Powel Bretchko, "RF Circuit Design" – Theory and Applications",Pearson Education Asia, First Edition, 2001.
2	D. K. Misra, "Radio Frequency and Microwave Communication Circuits"- Analysis and Design, John Wiley & Sons, 2004.
3	Richard Chi-Hsi Li – , "RF Circuit Design" – A John Wiley & Sons, Inc, Publications
4	W.Alan Davis, Krishna Agarwal, "Radio Frequency Circuit Design", John willy & Sons,2001

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	-	2	-	-	2	-	-	2	-	-
2	2	1	-	-	-	-	2	-	-	2	-	-	2	-	-
3	2	1	-	-	2	-	2	-	-	2	-	-	2	2	-
4	3	2	1	1	2	-	2	-	-	2	-	-	3	2	-
5	3	2	1	1	-	-	2	-	-	2	-	-	3	-	-
6	3	3	2	2	2	-	2	-	-	2	-	-	3	2	-
Overall Correlation	3	2	1	1	2	-	2	-	-	2	-	-	3	2	-

Recommended by Board of Studies	04-11-2024		
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23EC511	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To learn discrete Fourier transform, properties of DFT and its application to linear filtering.
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands.
- To understand the effects of finite precision representation on digital filters.
- To understand the fundamental concepts of multi rate signal processing and its applications.
- To introduce the concepts of adaptive filters and its application to communication engineering

UNIT I	DISCRETE FOURIER TRANSFORM	9

Discrete Fourier transform (DFT) - Properties of DFT - Periodicity, symmetry, circular convolution.-Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT), Decimation-in-frequency (DIF) algorithm.

UNIT II	FINITE IMPULSE RESPONSE FILTERS	9

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

UNIT III	INFINITE IMPULSE RESPONSE FILTERS	9

Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) using Impulse invariance method, Bilinear transformation Frequency transformation in the analog domain (simple problems only).

UNIT IV	FINITE WORD LENGTH EFFECTS	9
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	**DSP APPLICATIONS**	**9**
Multi-rate signal processing: Decimation, Interpolation, Sampling rate conversion by rational factor–– Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture- Fixed- and Floating-point architecture principles		
TOTAL: 45 PERIODS		
PRACTICAL EXERCISES:		
MATLAB / EQUIVALENT SOFTWARE PACKAGE/ PROCESSOR BASED IMPLEMENTATION		
1. Linear and Circular convolutions 2. Auto correlation and Cross Correlation 3. Frequency Analysis using DFT 4. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation 5. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations 6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations 7. Implement an Up-sampling and Down-sampling 8. Perform MAC operation using various addressing modes.		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Examine discrete-time signal using Discrete Fourier Transform (DFT).	

CO2:	Examine discrete-time signal using Fast Fourier Transform (FFT).
CO3:	Interpret the design of IIR digital filter.
CO4:	Construct FIR digital filter using Fourier series, windowing and frequency sampling method.
CO5:	Illustrate the effects of finite precision representation on digital filters
CO6:	Explain Multi-rate signal Processing, Adaptive filters and DSP architecture.
TEXT BOOKS:	
1	John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2	A. V. Oppenheim, R.W. Schafer and J.R. Buck, —Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
REFERENCES:	
1	Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2	Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3	Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	1	-	1	-	1	1	1	3	3	1
2	3	3	2	2	1	1	-	1	-	1	1	1	3	3	1
3	2	1	-	-	1	1	-	1	-	1	1	1	3	2	1
4	3	2	1	1	1	1	-	1	-	1	1	1	3	2	1
5	2	1	-	-	1	1	-	1	-	1	1	1	3	2	1
6	2	1	-	-	1	1	-	1	-	1	1	1	3	2	1
Overall Correlation	3	2	1	1	2	2	-	2	-	2	2	2	3	3	2

Recommended by Board of Studies	**04-11-2024**		
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23EC512	NETWORKS AND SECURITY	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

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

UNIT I	NETWORK MODELS AND DATALINK LAYER	9

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

UNIT II	NETWORK LAYER PROTOCOLS	9

Network Layer – IPv4 Addressing – Network Layer Protocols (IP,ICMP and Mobile IP) Unicast and Multicast Routing – Intra domain and Inter domain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format.

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)- QoS - Application Layer Paradigms –Domain Name System – World Wide Web, HTTP, Electronic Mail.

UNIT IV	NETWORK SECURITY	9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption –Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – 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 Block chain Technology.		
		TOTAL: 45 PERIODS

PRACTICAL EXERCISES:

1. Implement the Data Link Layer framing methods,
2. Implementation of Error Detection / Correction Techniques
3. Implementation of Stop and Wait, and Sliding Window Protocols
4. Implementation of Go back-N and Selective Repeat Protocols.
5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).
6. Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).
7. Data encryption and decryption using Data Encryption Standard algorithm.
8. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
9. Implement Client Server model using FTP protocol.

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the network models, layers and functions
CO2:	Make use of IP protocol and routing techniques to explain network layer
CO3:	Apply TCP, UDP and Congestion control techniques in Transport Layer
CO4:	Explain the various functions of Application layer
CO5:	Examine and choose the various network security mechanism

CO6:	Make use of various hardware security attacks and countermeasures for Hardware security
TEXT BOOKS:	
1	Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2017.(Unit – I,II,III)
2	William Stallings, Cryptography and Network Security, Seventh Edition, Pearson Education, 2017(Unit- IV)
3	Bhunia Swarup, Hardware Security –A Hands On Approach,Morgan Kaufmann, First edition, 2018.(Unit – V).
REFERENCES:	
1	James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, Sixth Edition, Pearson, 2017.
2	Doughlas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.
3	Andrew S Tanenbaum. Computer Networks Pearson Prentice Hall, 2011
4	Behrouz.A.Forouzan, Cryptography and Network security , Sixth Edition, TMH, 2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
2	3	2	1	1	1	-	-	-	-	-	-	-	3	1	-
3	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
5	3	3	2	2	-	-	-	2	-	-	-	-	3	-	2
6	3	2	1	1	-	-	-	2	-	-	-	-	3	-	2
Overall Correlation	3	2	1	1	1	-	-	1	-	-	-	-	3	1	1

Recommended by Board of Studies	**04-11-2024**		
Approved by Academic	**3rd ACM**	**Date**	**30-11-2024**

23EC521	MINI PROJECT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- Encourage students to apply foundational theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork and effective communication.
- Train students in basic research methodology, technical documentation, and presentation techniques to articulate project outcomes clearly.
- Enhance students' ability to systematically design, analyze, and evaluate simple prototypes or models.
- Prepare students for real-world engineering challenges and lay the foundation for multidisciplinary teamwork and problem-solving in advanced projects.

COURSE DESCRIPTION:

This course serves as an introductory platform for students to apply the foundational knowledge acquired from their core and interdisciplinary subjects in a practical setting. This course enables students to work on small-scale, department-relevant projects that focus on problem identification, basic design, and preliminary prototype development. With limited prior expertise, students will explore the process of translating theoretical concepts into tangible solutions, fostering creativity, teamwork, and critical thinking. The course emphasizes hands-on learning, communication, and project documentation, laying a strong foundation for advanced projects and professional challenges in later semesters.

PROJECT OUTLINE:

Week 1	Course Orientation and Topic Selection
Week 2	Problem Definition and Objective Setting

Week 3	Literature Review and Research
Week 4	First Review and Feedback
Week 5	Problem Refinement and Research Gap Identification
Week 6	Conceptual Design and Initial Approach
Week 7	Methodology and Project Planning
Week 8	Second Review and Project Evaluation
Week 9	Design Refinement and Testing
Week 10	Resource Identification and Budget Estimation
Week 11	Report Writing and Presentation Preparation
Week 12	Third Review Presentation and Submission of Thesis

EVALUATION:

- The progress of the mini project will be evaluated through three reviews, conducted by a committee appointed by the Head of the Department. A final project report must be submitted at the end of the semester. Evaluation will be based on oral presentation and the written report, assessed by internal examiners designated by the Head of the Department.
- The project should focus on topics from first three or four semester (whichever is applicable) subjects / industry demand topics, or futuristic technologies. It is recommended for Faculty of Aeronautical Engineering, Civil Engineering, and Mechanical Engineering students, the project should demonstrate an understanding of first principles of engineering.
- Similarly for students of Faculty of Computer Science Engineering, the project may involve programming using Python or C language. For Faculty of Electronics and Communication Engineering, the student project shall

incorporate appropriate techniques and systems relevant to the field. For the students of Faculty of Fashion Technology, the project based on material innovations, or technology in fashion is recommended. • The evaluation will focus on how well the project is structured, including clarity and logical flow in both oral presentations and written texts. • The relevance and innovation of the project will be assessed, particularly its potential to contribute to sustainability, innovation, and SDG-aligned goals. • The accuracy of English usage, including grammar, clarity, and coherence, will be reviewed in both oral and written communication to ensure effective delivery of technical content.	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Apply basic engineering principles to solve simple problems.
CO2:	Choose relevant sources to understand the current knowledge and identify areas to improve.
CO3:	Utilise basic tools and techniques to test simple solutions.
CO4:	Interpret the impact of engineering solutions on society and the environment.
CO5:	Combine in teams to plan and complete projects within given constraints.
CO6:	Develop comprehensive technical reports and deliver structured presentations to effectively convey project outcomes.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
2	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
3	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
4	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
5	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
6	3	2	1	1	1	1	1	3	2	2	2	1	3	1	3
Overall Correlation	3	2	**1**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**1**	**3**
Recommended by Board of Studies							**04-11-2024**								
Approved by Academic							**3rd ACM**			**Date**			**30-11-2024**		

23ES591	APTITUDE AND LOGICAL REASONING –2	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To improve the problem solving and logical thinking ability of the students.
- To acquaint the student with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews

UNIT I		**4**
Probability, Permutation & Combination, Algebra, Problems on ages		
UNIT II		**4**
Mensuration, Logarithms, inequalities and modulus, Syllogism		
UNIT III		**4**
Directions, logical sequence words, number series, Analytical Reasoning		
UNIT IV		**4**
Blood relation, Clock and Calendar, Picture puzzles		
UNIT V		**4**
Data sufficiency, cube and cuboids, odd man out		
	TOTAL: 20 PERIODS	

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply concepts of probability, permutation, and combination to solve real-world problems.
CO2:	Solve algebraic problems and age-related problems using logical approaches and techniques.
CO3:	Analyze and solve problems in mensuration, logarithms, and inequalities.
CO4:	Interpret and solve problems related to directions, logical sequence, and number series.
CO5:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.
CO6:	Identify and solve problems in logical reasoning such as syllogism, blood relations, clock and calendar.

TEXT BOOK:	
1	Smith, John. "APTIPEDIA." 2nd ed., Wiley Publishers, 2020.
2	Agarwal, R.S. "Quantitative Aptitude." 2nd ed., S. Chand Publishing.
REFERENCES:	
1	Agarwal, R.S. "A Modern Approach to Verbal & Non-Verbal Reasoning." 2nd ed., S. Chand Publishing.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	3	2	2	2	1	3	1	2	3	2	2
2	3	2	2	2	3	2	3	2	1	2	1	2	3	2	3
3	3	3	2	2	2	2	2	2	1	3	1	2	3	3	2
4	2	3	2	1	2	3	1	2	3	3	2	3	2	2	3
5	2	3	3	2	2	2	2	3	2	2	2	3	3	3	3
6	3	3	2	2	3	2	3	3	2	2	1	2	3	3	2
Overall Correlation	3	3	3	2	3	3	3	3	2	3	2	3	3	3	3

Recommended by Board of Studies	13-11-2024		
Approved	3rd ACM	Date	30-11-2024

SEMESTER –VI

23EC601	ANTENNA AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various antenna parameters
- To derive the radiation pattern of basic antenna
- To study about the aperture and slot antennas and special antennas
- To introduce the pattern multiplication and to design antenna arrays
- To familiarize the measurement of various antenna parameters
- To introduce the concepts of radio wave propagation

UNIT I	FUNDAMENTALS OF RADIATION	9

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance. Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, half wave dipole.

UNIT II	APERTURE AND SLOT ANTENNAS	9

Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Microstrip antennas.

UNIT III	ANTENNA ARRAYS	9

N-element linear array, Pattern multiplication, Broadside and End fire array – Yagi array antenna, Basic principle of antenna Synthesis- Binomial array.

UNIT IV	SPECIAL ANTENNAS AND MEASUREMENTS	9

Principle of frequency independent antennas –Spiral antenna, helical antenna, Log periodic. Modern antennas- Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR.

UNIT V	PROPAGATION OF RADIO WAVES	9
Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept Sky wave propagation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Make use of different antenna parameters to derive the radiation pattern of oscillating and half-wave dipole antenna.
CO2:	Explain various aperture and slot antennas.
CO3:	Apply pattern multiplication to design various antenna arrays.
CO4:	Explain the various types of special antennas such as frequency-independent antennas.
CO5:	Interpret the procedure to measure antenna parameters.
CO6:	Explain the Radio Wave propagation for the desired application and its various parameters.

TEXT BOOKS:	
1	John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2005.
2	Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
3	Raju, G. S. N. Antennas and wave propagation. Pearson Education India, 2006.

REFERENCES:	
1	R.E.Collin,"Antennas and Radiowave Propagation", Mc Graw Hill 1985.
2	Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.

3	Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
4	S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
5	Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
6	H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	1	-	2	3	-	-
2	2	1	-		-	-	-	-	-	-	-	2	2	-	-
3	3	2	1	1	-	-	-	-	-	1	-	2	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
5	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
6	2	1	-	-	-	-	-	1	-	-	-	2	2	-	1
Overall Correlation	3	2	1	1	-	-	-	1	-	1	-	3	3	-	1

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23EC602	VLSI AND CHIP DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I	MOS TRANSISTOR PRINCIPLES	9

MOS logic families (NMOS and PMOS), Ideal and Non Ideal IV 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- bi stable Sequential Circuits, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

UNIT IV	INTERCONNECT AND ARITHMETIC CIRCUITS	9

Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Sequential digital circuits: adders, multipliers, comparators, shift registers. Logic Implementation using Programmable Devices (ROM, PLA,

FPGA), FPGA Building Block Architectures (XC4000 Series), FPGA Interconnect Routing Procedures.		
UNIT V	**ASIC DESIGN AND TESTING**	**9**
ASIC Design Flow, Full custom and Semi-custom design, Standard cell design and cell libraries, Introduction to test benches, writing test benches in Verilog HDL, Automatic test pattern generation, Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the MOS Transistor Principle
CO2:	Develop Combinational Logic Circuits and Design Principles in VLSI
CO3:	Develop Combinational Logic Circuits and Design Principles in VLSI
CO4:	Analyze various interconnect models and arithmetic circuits in VLSI
CO5:	Explain the FPGA building blocks and Memory Architecture building blocks
CO6:	Summarize ASIC Design and Chip Design Testing

TEXT BOOKS:	
1	Jan D 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)
REFERENCES:	
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	SamihaMourad and YervantZorian, "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

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
3	3	2	1	1	1	-	-	-	-	-	1	2	3	1	-
4	3	3	2	2	-	-	-	-	-	-	1	1	3	-	-
5	2	1	-	-	-	-	-	-	-	-	-	3	3	-	-
6	2	1	-	-	-	-	-	-	-	-	-	3	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	1	2	3	1	-

Recommended by Board of Studies	**04-11-2024**		
Approved by Academic	**3rd ACM**	**Date**	**30-11-2024**

23CE611	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To provide basic knowledge on environment impact assessment
- To create an awareness on the pollutants in the environment
- To familiarize the student with the technology for restoring the environment.
- Applying the technology for producing ECO safe products
- To develop simple climate models and evaluate climate changes using models

UNIT I	INTRODUCTION TO ENVIRONMENT IMPACT ASSESSMENT	9

Impacts of Development on Environment – Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework

UNIT II	MOVEMENT OF POLLUTANTS IN ENVIRONMENT	9

Concepts of diffusion and dispersion, point and area source pollutants, pollutant dispersal; Gaussian plume model, hydraulic potential, Darcy's equation, types of flow, turbulence. Concept of heat transfer, conduction, convection; concept of temperature, lapse rate (dry and moist adiabatic); mixing heights, laws of thermodynamics; concept of heat and work, Carnot engine, transmission of electrical power, efficiency of turbines, wind mills and hydroelectric power plants.

UNIT III	ECOLOGICAL RESTORATION	9

Wastewater treatment: anaerobic, aerobic process, methanogenesis, treatment schemes for waste water: dairy, distillery, tannery, sugar, antibiotic industries; solid waste treatment: sources and management (composting, vermiculture

and methane production, landfill. hazardous waste treatment).		
UNIT IV	**ECOLOGICALLY SAFE PRODUCTS AND PROCESSES**	**9**
Biofertilizers, microbial insecticides and pesticides, bio-control of plant pathogen, Integrated pest management; development of stress tolerant plants, biofuel; mining and metal biotechnology: microbial transformation		
UNIT V	**CLIMATE CHANGE MODELS**	**9**
Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming –climate change observed to date		
TOTAL: 60 PERIODS		

LIST OF EXPERIMENTS

1. Determination of Bio fuel parameters such as flash point and fire point.
2. Determination of density of biofuels.
3. Determination of BOD/COD in water.
4. Simulating the RCM and GCM model for different geographic conditions.
5. Measurement of Pollutant in environment by Gaussian Plume model.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the importance of the process of Environmental impact assessment and its types.
CO2:	Illustrate the chemical processes and pollutant chemistry
CO3:	Identify the methods to solve environmental problems
CO4:	Apply the knowledge to develop ecofriendly products.
CO5:	Construct the various simple climate models for simulation
CO6:	Apply the climate model simulation to monitor climate change

TEXT BOOKS:	
1	David .E Neelin "Climate Change and Modelling", Cambridge University Press, California 2012.
2	Evans, G.G. & Furlong, J. 2010. Environmental Biotechnology: Theory and Application (2nd edition). Wiley-Blackwell Publications.
3	Pani, B. 2007. Textbook of Environmental Chemistry. IK international Publishing House
4	N.S. Raman , A.R. Gajbhiye & S.R. Khandeshwar, Environmental Impact Assessment, 2014,IK International Pvt Ltd.
REFERENCES:	
1	Carson (1907-1964). Environment Conservation-book
2	Encyclopaedia of Environmental Issues by Craig W. Allin &Probe.
3	Encyclopaedia of Environmental studies by William Ashworth.
4	Climate Change and Climate Modeling- Kindle Edition.
5	Environmentally- Friendly Product development - Eberhand Abile ,Reiner Anderl,2005

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	1	-	-	-	-	-	2	-	-
2	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
3	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
4	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
5	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
6	3	2	1	1	-	3	2	-	-	-	-	1	3	-	-
Overall Correlation	**3**	**2**	**1**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**

Recommended by Board of Studies	**07-11-2024**		
Approved	**3rd ACM**	**Date**	**30-11-2024**

23EC621	VLSI LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of Digital System Design using HDL and FPGA.
- To learn the fundamental principles of VLSI circuit design in digital domain
- To learn the fundamental principles of VLSI circuit design in analog domain
- 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-Flops. 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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Apply HDL code for basic as well as advanced digital integrated circuit.
CO2:	Apply the logic modules into FPGA Boards.
CO3:	Make use of Synthesize process in Place and Route to digital circuits.
CO4:	Develop Simulate and Extract the layouts of Digital IC Blocks using EDA Tools.
CO5:	Build Simulate and Extract the layouts of Analog IC Blocks using EDA Tools.
CO6:	Apply Test and Verification of IC design.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	-	1	1	-	1	3	2	-
2	3	2	1	1	2	-	-	-	1	1	-	2	3	2	-
3	3	2	1	1	2	-	-	-	1	1	1	2	3	2	-
4	3	2	1	1	2	-	-	-	1	1	1	1	3	2	-
5	3	2	1	1	2	-	-	-	1	1	-	3	3	2	-
6	3	2	1	1	2	-	-	-	1	1	-	3	3	2	-
Overall Correlation	3	2	1	1	2	-	-	-	1	1	1	2	3	2	-

Recommended by Board of Studies	**04-11-2024**		
Approved by Academic	**3rd ACM**	**Date**	**30-11-2024**

23EC622	PROJECT WORK PHASE-1	L	T	P	C
		0	0	4	2

COURSE DESCRIPTION:

This course provides an opportunity for students to apply their engineering knowledge to solve real-world problems through project-based learning. Students, working in groups with maximum of 4 under faculty supervision, undertake a comprehensive project addressing an approved topic. The course focuses on fostering collaboration, research, and practical skills, culminating in a detailed Phase 1 project report and oral presentations. Regular reviews ensure consistent progress and adherence to academic standards.

COURSE OBJECTIVES:

- Encourage students to apply theoretical knowledge to practical engineering problems.
- Develop collaborative and project management skills through teamwork.
- Train students in research methodology, technical documentation, and presentation skills.
- Enhance students' ability to design, analyze, and evaluate solutions systematically.
- Prepare students for real-world engineering challenges and multidisciplinary teamwork

PROJECT OUTLINE:

Week 1	Orientation and course overview. Formation of project teams and approval of topics by HoD.
Week 2	Initial meeting with supervisors. Define problem statement and objectives
Week 3	Literature review: Research methodologies and topic-specific studies.
Week 4	Zeroth Review.

Week 5	Refinement of literature review and identification of research gaps.
Week 6	Identification of Base Paper.
Week 7	First Review.
Week 8	Conceptual design discussions and brainstorming solutions.
Week 9	Narrowing done on the exact work.
Week 10	Completion of first stage of the Project.
Week 11	Development of detailed conceptual design and methodology.
Week 12	Incorporation of feedback and refinement of design and methodology.
Week 13	Second Review.
Week 14	Compilation of Phase 1 results, report writing, and presentation preparation.
Week 15	Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A phase 1 project report is required to be submitted at the end of the semester. Evaluation is based on oral presentation and the phase 1 project report jointly by internal examiners constituted by the Head of the Department.
- Evaluate how effectively the project is structured and communicated in both oral presentations and written texts, emphasizing logical flow and coherence.
- Evaluate the relevance and innovation of practical resources or prototypes developed, focusing on their potential to support sustainability, innovation, and SDG-aligned goals.

- Review the accuracy of English usage, including grammar, clarity, and coherence in oral and written communication, ensuring effective delivery of technical content.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Develop feasible solutions by analyzing complex engineering problems using foundational knowledge, mathematics, and science.
CO2:	Survey literatures to identify gaps, define research questions, and propose designs and methods for solving engineering problems.
CO3:	Make use of modern tools to check the feasibility of the solutions effectively.
CO4:	Evaluate societal and environmental impacts of solutions while incorporating sustainability and ethical practices.
CO5:	Combine in teams to plan, manage, and lead projects within professional and economic constraints.
CO6:	Formulate technical reports, deliver presentations, and engage in lifelong learning to adapt to new technologies.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

Recommended by Board of Studies	**04-11-2024**		
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23EC623	TECHNICAL TRAINING	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Training' is intended to enable a B.E./B.Tech. graduate to practice, learn, apply and prepare report about the training undergone. The learner shall be trained in the latest technology in relevant Industry preferably in computer-oriented platform. This course can help the learner to experience training and learn practical skills for the relevant domain. Learner should also be able to present his learning through PPT and report articulating his level of learning about the specific training.

COURSE OBJECTIVES:

- To equip students with practical skills and real-world experience in technical domains, enabling them to effectively apply theoretical knowledge to hands-on applications.
- To develop competencies in working with industry-relevant tools and software technologies.
- To foster teamwork, problem-solving, and technical skills through innovative technologies

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Identify specific domain from the enrolled branch and to get training preferable in computer-oriented platform.
CO2:	Survey and apprehend the learning modules in the training program and to become expert in the specific domain.

CO3:	Apply theoretical learning in the practical environment and enhance the skillset of learner.
CO4:	Estimate the learning using available data.
CO5:	Defend a presentation about the learning done in the specified skillset.
CO6:	Construct a technical report about the training.

GUIDELINES:

- More than one training program may be given depending on availability and interest of the students. One training coordinator may be appointed for the same.
- Training coordinator shall provide required input to their students regarding the selection of training topic.
- Choosing a Training topic: The topic for a Technical Training should be current and broad based rather than very specific area of interest. It should also be outside the present syllabus. It's advisable to choose a training topic to be computer oriented as the resources for the same may be readily available. Every student of the program should be involved and assessed.
- Head of Department shall approve the selected training topic by the second week of the semester. Training may be assessed based on the ability to apply the skillset in a practical domain.

EVALUATION PATTERN:

Training Coordinator:

50 marks (Training Manual – 40 (Each student shall maintain a Training Manual and the Coordinator shall monitor the progress of the training work on a weekly basis and shall

approve the entries in the Training Manual during the weekly meeting with the student), Attendance – 10,).

Presentation of Application:

Candidate should apply the skillset attained in training. 20 marks to be awarded by the Examiners (Clarity of presentation – 5, Interactions – 10, Quality of the slides – 5).

Report about Application:

30 marks to be awarded by the Examiners (check for technical content, overall quality, templates followed, adequacy of application of the skillset etc.).

Training duration – 30 Hours

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	2	1	-	-	-	-	3	3	-	-
2	3	3	2	1	-	2	1	-	-	-	-	3	3	-	-
3	3	3	3	3	3	-	-	1	-	2	-	3	3	3	1
4	3	3	3	2	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	3	2	2	-	2	-	3	-	3	3	2	2
Overall Correlation	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**2**	**2**

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23EC624	TECHNICAL SEMINAR – 1	L	T	P	C
		0	0	2	1

PREAMBLE:

The course 'Technical Seminar' is intended to enable a B.E./B. Tech graduate to read, understand,present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned

Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).
(Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical content, overall quality, templates followed, adequacy of references etc.).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

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SEMESTER – VII

23EC701	OPTICAL COMMUNICATION AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study various optical fiber modes and configurations of optical fibers
- To study transmission characteristics of optical fibers
- To learn about the various optical sources and detectors employed for communication
- To explore about various optical networking concepts
- To enrich knowledge about optical switching networks and protocols

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 - 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	TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS	9

Attenuation - Bending Loss - 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 - Dispersion: Chromatic dispersion, Material dispersion, Waveguide dispersion, Intermodal dispersion.

UNIT III	OPTICAL SOURCES AND OPTICAL DETECTORS	9

LED : Planar LED, Dome LED, Surface emitter LED, Edge emitter

LED, Power and Efficiency, LED Characteristics – LASER: Structure and radiation pattern of laser diode, modes and threshold conditions, quantum efficiency and resonant frequency - Optical Detectors: Introduction, Optical Detection Principles, Quantum Efficiency, Responsivity, P-N Photodiode ,P-I-N Photo Diode and Avalanche Photodiode		
UNIT IV	**OPTICAL NETWORKING CONCEPTS**	**9**
Optical Networking: Terminology, Optical Network Node and Switching Elements, Wavelength Division Multiplexed Networks, Overview of Public Telecommunications Network - Optical Network Transmission Modes, Layers and Protocols: Synchronous Networks, Asynchronous Transfer Mode, Open System Interconnection Reference Model, Optical Transport Network, and Internet Protocol		
UNIT V	**OPTICAL SWITCHING NETWORKS**	**9**
Wavelength Routing Networks: Routing And Wavelength Assignment- 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		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Apply basic terminologies of optical fibers, different modes and configurations	
CO2:	transmission characteristics of fibers for deployment in optical communication systems	
CO3:	Make use of optical sources for their use in transmitter section of optical communication system	
CO4:	Develop optical detectors for their use in receiver section of optical communication system	

CO5:	Analyze characteristics of optical networking layers and protocols associated with different types of networks
CO6:	Explain optical switching networks, their classification and deployment
TEXT BOOKS:	
1	Gred Keiser,"Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint
2	John M.Senior, "Optical Fiber Communication", Pearson Education, Fouth Edition.2010.
REFERENCES:	
1	Govind P. Agrawal, "Fiber-Optic Communication Systems", Third Edition, John Wiley & Sons, 2004.
2	J.Gower, "Optical Communication System", Prentice Hall Of India, 2001
3	Rajiv Ramaswami, "Optical Networks " , Second Edition, Elsevier , 2004.
4	P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India)Private Limited, 2016

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	1	-	-	-	2	-	2	2	-	-
2	3	3	2	2	-	2	-	-	-	2	-	2	2	-	-
3	3	2	1	1	-	1	-	-	-	2	-	2	2	-	-
4	3	2	1	1	-	1	-	-	-	2	-	2	2	-	-
5	3	3	2	2	-	1	-	-	-	2	-	2	2	-	-
6	3	2	1	1	-	1	-	-	-	2	-	2	2	-	-
Overall Correlation	3	3	2	2	-	2	-	-	-	2	-	3	3	-	-

Recommended by Board of Studies	**04-11-2024**		
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23EC702	COMPREHENSION	L	T	P	C
		2	0	0	2

PURPOSE:

To provide a complete review of the topics covered in the previous semesters, to ensure that a comprehensive understanding of the subjects is achieved. The student will be tested as per the guidelines given by national level examinations like GATE, TANCET etc. It will also help students to face job interviews and competitive examinations.

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Analyse the phenomena involved in the concerned problem and solve them.
CO2:	Apply principles to new and unique circumstances.
CO3:	Estimate concepts and principles of concerned branch of engineering.
CO4:	Distinguish between facts and opinion in the engineering field.
CO5:	Deduct cause-and-effect relationships of any relationship.
CO6:	Interpret data from charts and graphs and judge the relevance of information.

GUIDELINES:

- The Department shall form an Internal Assessment Committee for the Comprehension with Academic coordinator for that class as the Comprehension Instructor and Class coordinator as member.
- Instructor shall provide required input to their students regarding the overview of all topics covered in the previous semesters.
- Periodic tests can be conducted to assess students.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	-	2	1	-	-	-	-	1	3	-	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	-
3	3	3	3	3	3	-	-	3	-	3	-	3	3	3	3
4	3	2	1	1	2	-	-	1	-	3	-	3	3	2	1
5	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
6	3	3	3	2	1	2	-	2	-	2	-	2	3	1	2
Overall Correlation	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**-**	**3**	**-**	**3**	**3**	**3**	**2**
Recommended by Board of Studies							**04-11-2024**								
Approved by Academic							**3rd ACM**			**Date**			**30-11-2024**		

23EC721	ADVANCED COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- Understand the working principle of optical sources, detectors, fibers
- Develop an understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand and capture an experimental approach to digital wireless communication
- Understand actual communication waveforms that will be sent and received across the wireless channel

LIST OF OPTICAL EXPERIMENTS

1. Measurement of connector, bending, and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. DC Characteristics of LED and PIN Photodiode.
4. Fiber optic Analog and Digital Link Characterization - frequency response (analog),eye diagram and BER (digital)

LIST OF WIRELESS COMMUNICATION EXPERIMENTS

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques
3. Analyze Impact of Pulse Shaping and Matched Filtering using Software Defined Radios
4. OFDM Signal Transmission and Reception using Software Defined Radios

LIST OF MICROWAVE AND ANTENNA EXPERIMENTS

1. Characterization of Directional Couplers, Isolators, Circulators
2. Gunn Diode Characteristics

3. Radiation Pattern measurement of Horn Antenna **4.** Simulation of Patch Antenna	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Test for the performance of simple optical links by measurement of losses
CO2:	Analyse the mode characteristics of fiber
CO3:	Analyse the Eye Pattern, Pulse broadening of optical fiber, and the impact on BER
CO4:	Analyse the Wireless Channel Characteristics
CO5:	Analyze the performance of Wireless Communication System
CO6:	Develop the intricacies of Microwave System design

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	-	2	-	2	3	-	-
2	3	3	2	2	-	-	-	-	-	2	-	2	3	-	-
3	3	3	2	2	-	-	-	-	-	2	-	2	3	-	-
4	3	3	2	2	3	-	-	-	-	2	-	-	2	3	-
5	3	3	2	2	3	-	-	-	-	2	-	-	2	3	-
6	3	2	1	1	-	-	-	-	-	2	-	2	3	-	-
Overall Correlation	3	3	2	2	1	-	-	-	-	2	-	2	3	1	-

Recommended by Board of Studies	**04-11-2024**		
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23EC722	PROJECT WORK PHASE-2	L	T	P	C
		0	0	6	3

COURSE DESCRIPTION:

Project Phase 2 is a continuation of Project Phase 1, focusing on implementing the proposed methodology through fabrication, simulation, or experimental validation. Students will refine their designs, validate test problems, and commission setups for final testing. This phase emphasizes hands-on application, calibration, and demonstration of results, culminating in a final presentation and report submission.

COURSE OBJECTIVES:

- Implement the proposed methodology to address engineering problems identified in Phase 1.
- Develop and fabricate prototypes or simulate solutions for the selected project integrating theoretical knowledge with practical application across hardware and software systems.
- Validate solutions through testing ensuring reliability and performance in both physical and virtual environments.
- Enhance problem-solving and critical thinking skills by troubleshooting and optimizing either experiment setups or software code to improve results.
- Prepare a research manuscript or applying for patent grant either for design or research.

PROJECT OUTLINE:

Week 1	Review of Phase 1 outcomes and refinement of proposed methodology.
Week 2	Material procurement/ software setup for simulation, and initiation of fabrication/simulation work.
Week 3	Intermediate fabrication/simulation work and initial testing or calibration, troubleshooting challenges.

Week 4	Second Review.
Week 5	Validation of test problem or refinement of prototype/simulation
Week 6	Optimisation of the test setup or solution trials, Data curation / uncertainty analysis
Week 7	Final testing of setup or simulation outcomes, Validation of Data .
Week 8	Third Review
Week 9	Demonstration of the solution with high level of data accuracy and precision.
Week 10	Compilation of Phase 2 results, report writing, and presentation preparation.
Week 11	Preparing or publishing of research article/ Filing or Grant of Patent
Week 12	Final Viva Voce Presentations.

Individual meetings will be set up on a need's basis in conjunction with developing work

EVALUATION:

- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.
- Assess the depth of understanding demonstrated in the project's conceptualization and the ability to answer questions during public presentations.

• Publication of Research article in indexed journal or Patent award is necessary at the end of completion of the project.
COURSE OUTCOMES:
After completion of the course, the students will be able to:

CO1:	Apply appropriate methodologies to implement solutions for complex engineering problems identified in phase -1 using hardware / software or both systems.
CO2:	Develop existing functional prototypes or simulations models by integrating theoretical and practical knowledge.
CO3:	Evaluate solutions ensuring compliance with design specifications.
CO4:	Appraise the performance of solutions by refining designs or improving algorithms for enhanced outcomes.
CO5:	Collaborate effectively with team members to plan, manage, and execute engineering projects adhering to ethical principles and professional standards.
CO6:	Prepare technical reports, impactful presentations that communicate solutions effectively.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
2	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
3	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
4	3	2	2	2	1	1	2	3	3	3	3	3	3	1	3
5	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
6	3	2	2	2	1	2	2	3	3	3	3	3	3	1	3
Overall Correlation	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**3**

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23EC723	TECHNICAL SEMINAR – 2	L	T	P	C
		0	0	4	2

PREAMBLE:

The course 'Technical Seminar 2' is intended to be continuation of Technical Seminar 1. It enables a B.E./B. Tech graduate to read, understand, present and prepare report about higher level academic document. The selected topic should be outside the given syllabus. The learner shall search in the literature / current affairs including mass media, print media, peer reviewed journals, conference, books, project reports etc., and identify an appropriate topic/paper/thesis/report in her/his area of interest, in consultation with her/his seminar coordinator. This course can help the learner to experience how a higher-level presentation can be made about a selected academic document and empower her/him to prepare a technical report.

COURSE OBJECTIVES:

- To do Literature surveys in a selected area of study
- To understand an academic document from the literature and to give a presentation about it
- To prepare a technical report.

GUIDELINES:

- The Department shall form an Internal Assessment Committee (IAC) for the seminar with academic coordinator for that program as the Chairperson and seminar coordinator as member. During the seminar presentation of a student, all members of IAC shall be present.
- Formation of IAC shall be completed within a week after the End Semester Examination (or last working day) of the previous semester.
- Seminar Coordinator shall provide required input to their students regarding the selection of topic/ paper.

- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than very specific research work, beyond the syllabus. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IAC. The IAC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

EVALUATION PATTERN

Seminar Coordinator:

40 marks (Background Knowledge – 10 (The coordinator shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).
(Seminar Diary – 10 (Each student shall maintain a seminar diary and the coordinator shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation:

40 marks to be awarded by the IAC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report:

20 marks to be awarded by the IAC (check for technical

content, overall quality, templates followed, adequacy of references etc.).	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Identify academic documents from the literature which are related to her/his areas of interest.
CO2:	Survey and apprehend an academic document from the literature which is related to her/ his areas of interest.
CO3:	Compile a presentation about an academic document.
CO4:	Estimate the Contents using available literature.
CO5:	Defend a presentation about an academic document.
CO6:	Construct a technical report.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	1	1	2	3	3	2	2	3	2	2
2	3	3	3	1	2	1	1	2	3	3	2	2	3	2	2
3	3	3	2	2	2	1	1	1	3	3	1	1	3	2	2
4	3	3	2	1	1	1	2	2	3	3	2	1	3	2	2
5	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
6	3	3	2	1	1	1	1	2	2	2	2	2	3	1	2
Overall Correlation	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**2**

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SEMESTER -VIII

23EC821	CAPSTONE PROJECT	L	T	P	C
		0	0	20	10

COURSE DESCRIPTION:

Prerequisites:

i) Team segregation.
ii) Identification of Project Guide.
iii) Identification of Area of Interest.
iv) Literature Review on the chosen area of interest.

Zeroth Review needs to be completed in the previous semester by the project coordinator

The *Capstone Project* ***(CP)*** provides an opportunity for students to engage in high-level inquiry focusing on an area of specialization within the engineering field. Capstone projects will be investigative, practice-centered. All capstones aim to bridge theory and practice and are aimed to have an impact on the professional life of students

The aim of the course is to facilitate the development of your *Capstone Projects.* Students are encouraged to apply and expend knowledge gained on teaching and learning throughout the Bachelor of Engineering Education program as part of this process

COURSE OBJECTIVES:

The Capstone Project should demonstrate the depth and extent of knowledge of students

During this course, students will

- Investigate and evaluate prominent literature connected to your CP.
- Present a clearly articulated investigative framework, while situating projects within established academic

practices and/ or ideas.

- Develop and create practical resources (either computational or experimental) for the concerned area of interest in engineering field.
- Offer inquiry-based argumentation for development in the concerned area within engineering field.
- Summarize the findings in the form of report, documentation and presentation

PROJECT OUTLINE:

Week 1	Identification problem.
Week 2	Literature review.
Week 3	Preliminary work.
Week 4	First review.
Week 5	Completion of first stage of the Project methodology.
Week 6	Development.
Week 7	Testing & Validation.
Week 8	Second review.
Week 9	Repeatability.
Week 10	Report correction and Documentation
Week 11	Third review-Submission of paper for conference/journal
Week 12	Thesis Correction and Submission

Individual meetings will be set up on a need's basis in conjunction with developing work

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Take part in challenging practical problems and find solutions by formulating proper methodology.
CO2:	Plan research methodology to tackle a specific problem.
CO3:	Construct extensive study on particular research projects.
CO4:	Develop experimental and computational studies on innovative research projects.
CO5:	Estimate incremental study on existing research projects.
CO6:	Take part in real life engineering challenges and propose appropriate solutions.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
2	3	2	3	3	2	3	2	3	2	3	2	3	3	2	3
3	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
5	2	3	3	3	3	3	3	3	3	3	3	3	2	3	3
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overall Correlation	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

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VERTICAL 1 - SEMICONDUCTOR CHIP DESIGN AND TESTING

23EC031	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To design asynchronous sequential circuits.
- To learn about hazards in asynchronous sequential circuits.
- To study the fault testing procedure for digital circuits.
- To understand the architecture of programmable devices.
- To design and implement digital circuits using programming tools.

UNIT I	SEQUENTIAL CIRCUIT DESIGN	9

Analysis of Clocked Synchronous Sequential Circuits and Modelling- State Diagram, State Table, State Table Assignment and Reduction-Design of Synchronous Sequential Circuits Design of Iterative Circuits-ASM Chart and Realization using ASM.

UNIT II	ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN	9

Analysis of Asynchronous Sequential Circuit – Flow Table Reduction-Races-State Assignment-Transition Table and Problems in Transition Table- Design of Asynchronous Sequential Circuit - Static, Dynamic and Essential hazards – Mixed Operating Mode Asynchronous Circuits – Designing Vending Machine Controller.

UNIT III	FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS	9

Fault Table Method-Path Sensitization Method – Boolean Difference Method - D Algorithm –– Tolerance Techniques – The Compact Algorithm – Fault in PLA – Test Generation - DFT Schemes – Built in Self Test.

UNIT IV	SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES	9
Programming Logic Device Families – Designing a Synchronous Sequential Circuit using PLA/PAL – Designing ROM with PLA – Realization of Finite State Machine using PLD – FPGA – Xilinx FPGA - Xilinx 4000.		
UNIT V	**SYSTEM DESIGN USING VERILOG**	**9**
Hardware Modelling with Verilog HDL – Logic System, Data Types And Operators For Modelling In Verilog HDL - Behavioral Descriptions In Verilog HDL – HDL Based Synthesis – Synthesis Of Finite State Machines– Structural Modelling – Compilation And Simulation Of Verilog Code – Test Bench - Realization Of Combinational And Sequential Circuits Using Verilog – Registers – Counters – Sequential Machine – Serial Adder – Multiplier- Divider – Design Of Simple Microprocessor, Introduction To System Verilog.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Analyze and design synchronous sequential circuits.
CO2:	Analyze hazards and design asynchronous sequential circuits.
CO3:	Explain the testing procedure for combinational circuit and PLA.
CO4:	Construct synchronous design using programmable device.
CO5:	Interpret Hardware Modelling using Verilog HDL
CO6:	Construct digital circuits using HDL language.

TEXT BOOKS:	
1	Charles H.Roth jr., "Fundamentals of Logic Design" Thomson Learning,2013.
2	M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999

3	M.G.Arnold, Verilog Digital – Computer Design, Prentice Hall (PTR), 1999.
REFERENCES:	
1	Nripendra N Biswas "Logic Design Theory" Prentice Hall of India,2001.
2	Paragk.Lala "Fault Tolerant and Fault Testable Hardware Design" B S Publications,2002
3	Paragk.Lala "Digital System Design Using PLD" B S Publications,2003.
4	Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson , 2003.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
2	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
3	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
4	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
5	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
6	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
Overall Correlation	3	3	2	2	1	1	-	1	-	1	1	2	3	1	1

23EC032	ANALOG IC DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To design and analyse basic MOS amplifier configurations for key performance parameters.
- To evaluate frequency response and noise in amplifier stages.
- To study feedback and design single-stage operational amplifiers.
- To understand stability and apply frequency compensation techniques.
- To learn fault detection and testability methods in logic circuits.

UNIT I	SINGLE STAGE AMPLIFIERS	6

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

UNIT II	HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS	6

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

UNIT III	FEEDBACK AND SINGLE STAGE OPERATIONAL AMPLIFIER	6

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, single stage Op Amps, two-stage Op Amps, input

range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.		
UNIT IV	**STABILITY, FREQUENCY COMPENSATION**	**6**
Multipole Systems, Phase Margin, Frequency Compensation, Compensation of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.		
UNIT V	**LOGIC CIRCUIT TESTING**	**6**
Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- AdHoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Design a CMOS inverter and analyze its characteristics. 2. Design a Common source amplifier and analyze its performance. 3. Design a Common drain amplifier and analyze its performance. 4. Design a Common gate amplifier and analyze its performance. **5.** Design a differential amplifier with resistive load using transistors.		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the specification of designing an amplifier.	
CO2:	Design of differential and cascode amplifiers.	
CO3:	Design and analyse feedback amplifiers.	
CO4:	Design and analyse of single stage op-amps.	
CO5:	Analyse the stability of op amp.	
CO6:	Explain the 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)
REFERENCES:	
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	Jacob Baker "CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
2	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
3	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
4	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
5	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
6	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
Overall Correlation	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1

23EC033	LOW POWER IC DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the fundamentals of low power low voltage VLSI design.
- To understand the impact of power on system performance.
- To understand the different design approaches.
- To develop the low power low voltage memories.
- To develop the low power low voltage memories.

UNIT I	FUNDAMENTALS OF LOW POWER CIRCUITS	6

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

UNIT II	LOW-POWER DESIGN APPROACHES	6

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

UNIT III	LOW-VOLTAGE LOW-POWER ADDERS	6

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

UNIT IV	LOW-VOLTAGE LOW-POWER MULTIPLIERS	6
Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh-Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier		
UNIT V	**LOW-VOLTAGE LOW-POWER MEMORIES**	**6**
Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

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

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Outline the fundamentals of low power circuits.
CO2:	Explain various low-power design approaches.
CO3:	Construct various low-voltage low-power adders.
CO4:	Examine various low-voltage low-power multipliers.
CO5:	Summarize low-voltage low-power read-only memories.
CO6:	Illustrate low-voltage low-power random-access memories.

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.

REFERENCES:	
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, 2005.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
2	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
3	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
4	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
5	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
6	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1

23EC034	VLSI TESTING AND DESIGN FOR TESTABILITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the basics of semiconductor testing
- To study various fault modelling and simulation
- To know about various basic methods of fault modelling and functional testing
- To introduce purpose of design for testability
- To study about the built in self-test and PLA testing

UNIT I	INTRODUCTION TO SEMICONDUCTOR TESTING	6

Introduction to semiconductor testing – Need for Testing, Modelling of faults – Functional and Structural, Level of Fault Modelling, Logic Simulation – types of simulation – Delay Models, Various types of faults - Controllability and Observability

UNIT II	FAULT MODELLING AND SIMULATION	6

Fault Modelling – Logic fault modelling – Fault detection and redundancy – Fault equivalence and Fault location – Fault Dominance –Single Stuck Fault Model – Multiple Stuck Fault Model – Fault Variables, Fault Simulation Techniques – Combinational Circuits – Fault Sampling – Statistical fault analysis

UNIT III	TESTING FOR SINGLE STUCK AND BRIDGING FAULT AND FUNCTIONAL TESTING	6

ATG for single stuck fault - Combinational circuits – Sequential Circuits, Bridge fault model – Feedback and Non-feedback bridge model – Functional testing - without fault model – with specific fault model – Exhaustive and Pseudo-exhaustive testing

UNIT IV	DESIGN FOR TESTABILITY	6

Testability – Ad hoc design for testability techniques – Controllability and Observability by means of scan registers –

Generic scan based design – Classical scan designs - Broad level and system level DFT approaches – Boundary scan standards		
UNIT V	**BUILT IN SELF-TEST AND PLA TESTING**	**6**
Introduction to BIST concepts - Test pattern generation for BIST – BIST architecture – Specific BIST architecture, PLA testing – Test generation algorithms for PLAs – Testable PLA Design		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

DESIGN AND TESTING OF THE FOLLOWING CIRCUITS

1. Verification of single stuck fault model for a combinational circuit.
2. Verification of bridge fault model for a combinational circuit.
3. Implementation and Testing of RS Latch and Flip-flops
4. Design and testing of asynchronous counter
5. Design and testing of synchronous counter

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Illustrate the purpose of semiconductor testing and its modelling.
CO2:	Examine combinational and sequential circuit using fault modeling.
CO3:	Apply single stuck and bridge fault to test a circuit.
CO4:	Illustrate about the design for testability techniques.
CO5:	Interpret built in self-test and its architecture.
CO6:	Explain PLA testing and the test generation algorithms

TEXT BOOKS:

1	M. Abramovici M.A, Breuer and Ad Friedman, "Digital Systems Testing and Testable Design", Computer Sciences Press, 2002 (Unit I – IV)
2	P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 2002

REFERENCES:	
1	Robert J.Feuguate, Jr. Steven M.Mcintyre, "Introduction to VLSI testing', Prentice Hall, Englewood Cliffs, 1998.
2	Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,Vishwani Agrawal and Michael Bushnell, Springer, 2002.
3	Jan D Rabaey, Anantha Chandrakasan, " Digital Integrated Circuits: A Design Perspective", PHI, 2016.
4	SamihaMourad and YervantZorian, "Principles of Testing Electronic Systems", Wiley 2000

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
2	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
3	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
4	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
5	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
6	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1

23EC035	PHYSICAL DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about VLSI Technology back end design flow and about implementations.
- To understand about the input and output of Physical design
- To understand about the procedure of Floor plan and Power plan
- To understand Placement, CTS, hold fixing, Routing

UNIT I	INTRODUCTION TO PHYSICAL DESIGN	9

Introduction to PD flow, Inputs of PD – Library files, Net list, SDC(Synopsis Design Constraints), LEF(Library Exchange File),Output of PD – GDSII, Area, Power, Timing reports.

UNIT II	PARTITIONING AND FLOOR PLANNING	9

Partitioning, Floor planning, Floor plan Algorithms, Pin Assignment, Floor plan-Die size estimation, Aspect Ratio, Core Utilization, Macros and Types –Soft macros, Hard macros, Firm macros

UNIT III	POWER PLAN	9

Power plan – Rings, Stripes, Rails, Core power management, I/O cell power management, IR drop – types of IR drop

UNIT IV	PLACEMENT	9

Type of Placement – Standard cell placement, Building block placement Cell types – Well tap cells, End cap cells, Decap cells, Filler cells, Spare cells, Timing driven placement, Congestion driven placement, Placement Congestion – Global route congestion, Congestion map, Easing congestion

UNIT V	CLOCK TREE SYNTHESIS AND ROUTING	9

Skew, Latency, Jitter, Early clock tree, Useful skew, Hold fixing function mode and shift mode, Generated clocks, clock groups vs. false paths, clock routing, NDR, Routing - Global Routing,

Detailed Routing, Design Rule check, clock route vs. signal route, shorts, drc, opens, routing signals in higher layers, Getting attributes like route length, number of vias for a given net	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Illustrate various stages of back-end VLSI design
CO2:	Analyse and implement partitioning, floor-planning, and pin assignment strategies to optimize the physical layout of IC's
CO3:	Outline the various ideas of Power plan
CO4:	Explain the various types of placement and understand the challenges of placement.
CO5:	Summarize clock tree synthesis and its techniques.
CO6:	Construct various routing algorithm and understand the common issues in routing.
TEXT BOOKS:	
1	S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
2	N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
REFERENCES:	
1	Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World scientific 1999.
2	Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.
3	Michael J Smith ," Application Specific Integrated Circuits, Addison Wesley,
4	D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
2	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
3	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
4	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
5	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
6	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1

23EC036	MIXED SIGNAL IC DESIGN AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about mixed-signal devices and the need for testing these devices.
- To study the various techniques for testing.
- To learn about ADC and DAC based testing.
- To understand the Clock and Serial Data Communications Channels.
- 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 Equipment – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam equipment – 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 Reproducibility 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 Centre 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 MEASUREMENT**	**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:	
After completion of the course, the students will be able to:	
CO1:	Outline the fundamentals of mixed signal circuits.
CO2:	Explain the various optimizing measurements and yield in testing
CO3:	Illustrate various DAC testing methods
CO4:	Illustrate various ADC testing methods
CO5:	Examine ADC code edge measurements and transfer curves
CO6:	Construct serial data communication systems and performance metrics

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
REFERENCES:	
1	BapirajuVinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.(Unit - II)
2	Digital and Analogue Instrumentation: Testing and Measurement by NihalKularatna
3	Mixed Signal and DSP design Techniques, Analog Device, Newness, 2003.
4	SamihaMourad and YervantZorian, "Principles of Testing Electronic Systems", Wiley 2000

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
2	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
3	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
4	2	1	-	-	1	1	-	1	-	1	1	1	3	1	1
5	3	3	2	2	1	1	-	1	-	1	1	1	3	1	1
6	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1
Overall Correlation	3	2	1	1	1	1	-	1	-	1	2	2	3	1	1

VERTICAL 2- SENSOR TECHNOLOGIES AND IOT

23EC037	EMBEDDED SYSTEMS AND IoT DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

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

UNIT I	EMBEDDED SYSTEMS	6

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 II	REAL TIME OPERATING SYSTEMS	6

Structure of a Real Time System –– Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronization.

UNIT III	REAL TIME PROCESSES	6

Multiple Tasks and Multiple Processes –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	6

Internet – of – Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

UNIT V	IOT SYSTEM DESIGN	6
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: 30 PERIODS
PRACTICAL EXERCISES:		
1. Experiments using ARM 2. Interfacing ADC and DAC 3. Blinking of LEDs and LCD 4. Interfacing keyboard and Stepper Motor. 5. Mini projects for IoT		
		TOTAL:30 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Develop a model of an embedded system	
CO2:	Summarize the concepts of real time operating systems.	
CO3:	Make use of various real time processes to design an embedded systems	
CO4:	Explain the architecture of IoT.	
CO5:	Develop protocols of IoT.	
CO6:	Construct an IoT based system for any application.	
TEXT BOOKS:		
1	Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012.	
2	Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.	
REFERENCES:		
1	Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.	

2	Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.
3	Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands on Approach, Universities Press, 2015.
4	Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	-	-	-	-	-	3	2	-
2	2	1	-	-	2	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	2	-	-	-	-	-	-	-	2	1	-
4	2	1	-	-	2	-	-	-	-	-	-	-	3	3	-
5	3	2	1	1	2	-	-	-	-	-	-	-	3	3	-
6	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-
Overall Correlation	3	2	1	1	3	-	-	-	-	-	-	-	3	3	-

23EC038	IoT BASED SYSTEM 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 panoramic 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 (Compass 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 Lora WAN – 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 IoT tools, 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:	
After completion of the course, the students will be able to:	
CO1:	Explain the main concepts, key technologies, strength and limitations of IoT.
CO2:	Summarize the architecture, infrastructure models of IoT.
CO3:	Examine the IOT access technology
CO4:	Analyze the networking and how the sensors are communicated in IoT.
CO5:	Analyze and design different models for IoT implementation.
CO6:	Develop 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-on Approach)", VPT, 1st Edition, 2014.

REFERENCES:	
1	Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.
2	Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
3	Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, "Internet of Things (IoT) in 5G Mobile Technologies" Springer International Publishing Switzerland 2016.
4	Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things" Springer-Verlag Berlin Heidelberg, 2011.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	1	3	-	-	-	-	2	3	3	3	-
2	2	1	-	-	1	-	-	-	-	-	1	2	3	3	-
3	3	3	2	2	1	2	-	-	-	-	3	2	3	2	-
4	3	3	2	2	1	2	-	-	-	-	3	2	3	2	-
5	3	3	2	2	3	-	-	-	-	-	1	3	3	3	-
6	3	2	1	1	2	1	-	-	-	-	2	1	3	2	-
Overall Correlation	3	3	2	2	2	2	-	-	-	-	2	2	3	3	-

23EC039	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic WSN technology and different applications in WSN.
- To understand MAC and Routing protocols used in WSN.
- To understand Design principles and architecture of a WSN.
- Understand various operating systems used in WSN

UNIT I	INTRODUCTION	9

Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet. Hardware Platform, Motes, Sensor Devices, Types of Sensors, Sensor's Specification, Commercial available smart sensors with microcontrollers

UNIT II	MAC AND ROUTING PROTOCOLS	9

MAC Protocols : Fundamentals of MAC protocols - Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols, MAC protocols for wireless sensor networks, Contention-based protocols â€“ CSMA, PAMAS, The IEEE 802.15.4 MAC protocol. Routing Strategies in Wireless Sensor Networks - WSN Routing Techniques, Geographical Routing.

UNIT III	DATA AGGERATION IN WIRELESS SENSOR NETWORKS	9

Challenges & techniques; Node Clustering and its Algorithms in Wireless Sensor Networks. Node Localization: Concepts, Challenges, & Algorithms; Ranging Techniques. Time Synchronization: Need and Requirements of Synchronization in Wireless Sensor Networks; Synchronization Protocols for Wireless Sensor Networks. Security Issues in Wireless Sensor networks: Challenges of Security in Wireless Sensor Networks, Security

Attacks in Sensor Networks, Protocols and Mechanisms for Security. Future Trends in Wireless Sensor Networks.		
UNIT IV	**OPERATING SYSTEMS FOR WIRELESS SENSOR NETWORKS**	**9**
Operating Systems for Wireless Sensor Networks : Introduction, Operating System Design Issues, Examples of Operating Systems â€“ TinyOS, Mate, MagnetOS, MANTIS, OSPM, EYES OS, SenOS, EMERALDS, PicOS, Performance Modeling of WSNs		
UNIT V	**QoS AND MANAGEMENT**	**9**
QoS and Energy Management : Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the WSN Node Architecture with issues and challenges
CO2:	Develop the various Routing and MAC Protocols
CO3:	Evaluate the various aggregation used in sensor networks
CO4:	Evaluate the various tools and Operating system used in WSN
CO5:	Apply the various QoS and Management Systems to study the performance of WSN
CO6:	Infer the various Energy Management System to study the performance in WSN
TEXT BOOKS:	
1	William Stallings, "Wireless Communications and Networks ", Pearson Education 2004
2	Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.

REFERENCES:	
1	Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks John Wiley & Sons, Ltd, 2005.
2	Kazem Sohrby, Daniel Minoli, Wireless Sensor Network Technology, Protocols and Applications, Wiley-Inter science.
3	Philip Levis, "TinyOS Programming", 2006 – www.tinyos.net.
4	The Contiki Operating System.http://www.sics.se/contiki.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	2	1	-	-	-	-	2	2	3	1	-
2	3	2	1	1	2	1	-	-	-	-	-	2	3	2	-
3	3	3	2	2	2	1	-	-	-	-	-	3	3	2	-
4	3	3	2	2	2	2	-	-	-	-	-	2	2	2	-
5	3	2	1	1	3	2	-	-	-	-	-	2	2	2	-
6	2	1	-	-	3	2	-	-	-	-	-	2	2	2	-
Overall Correlation	3	2	1	1	3	2	-	-	-	-	1	3	3	2	-

23EC040	INDUSTRIAL IoT AND INDUSTRY 4.0	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basic concepts of IoT Nodes & Sensors
- To study and understand about IoT Gateways
- To familiarize themselves in IoT Cloud Systems
- To learn about IoT Cloud Dashboards
- To know about the Challenges in Iot system Design – Hardware & Software

UNIT I	UNDERSTANDING IoT CONCEPT AND DEVELOPMENT PLATFORM	6

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	6

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 CONTROLLIN HARDWARE AND SENSORS	6

IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI, Controlling Hardware, Sensors- Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT IV	CLOUD SERVICES USED IN IoT DEVELOPMENT PLATFORM	6
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, Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect.		
UNIT V	**CHALLENGES IN IOT SYSTEM DESIGN - HARDWARE & SOFTWARE**	**6**
Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability Battery simulation.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Write a program using IR sensor for working morning alarm and night lamp 2. Write a program using Temperature sensor for detecting heat / fire 3. Write a program using Gas sensor for detecting LPG gas leak 4. Write a program using Ultrasound sensor for range detection 5. Write a program using sensors for car parking assist 6. Write a program using sensors for water level indicator and overflow detection		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the building blocks of IoT technology and explore the vast spectrum of IoT applications	
CO2:	Analyse various communication protocols used in IoT Design	

CO3:	Interpret IoT physical devices and endpoint
CO4:	Develop various controlling Hardware and Sensors used in IoT
CO5:	Make use of cloud services used in IoT Development platform
CO6:	Explain the various challenges in IoT design
TEXT BOOKS:	
1	Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2	Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759
REFERENCES:	
1	Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2	N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3	Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan
4	Dr. OvidiuVermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	-	-	-	-	-	-	2	3	2	-
2	3	3	2	2	2	-	-	-	-	-	-	2	3	3	-
3	2	1	-	-	2	-	-	-	-	-	-	2	3	3	-
4	3	2	1	1	2	-	-	-	-	-	-	2	3	3	-
5	3	2	1	1	2	-	-	-	-	-	-	2	3	3	-
6	2	1	-	-	3	-	-	-	-	-	-	1	3	2	-
Overall Correlation	3	2	1	1	3	-	-	-	-	-	-	2	3	3	-

23EC041	MEMS DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Learn the basic electrical and mechanical concepts of MEMS design
- To Interpret the design aspects of electrostatic and its actuators
- To Interpret the design aspects of thermal sensors and its actuators
- To Study the design aspects of piezoelectric sensors
- To Study the design aspects of magnetic sensors and its 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 SENSING 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, Thermal 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:	
After completion of the course, the students will be able to:	
CO1:	Apply electrical concepts in MEMS design
CO2:	Make use of the mechanical concepts in MEMS design
CO3:	Analyze the design of electro static sensors and actuators.
CO4:	Examine the design of thermal sensors and actuators.
CO5:	Examine the design of magnetic sensors and actuators.
CO6:	Analyze the design of piezoelectric sensors and actuators.
TEXT BOOKS:	
1	Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006
2	Mohamed Gad-el-Hak, Mems Design and Fabrication , First Edition, CRC Press, 2019.
REFERENCES:	
1	Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002
2	Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcgraw Hill, 2002
3	Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press,2012.
4	Siva Yellampalli, MEMS Sensors: Design and Application, Intech open, 2018

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
3	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1
4	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1
5	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1
6	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1
Overall Correlation	3	3	2	2	-	1	1	1	-	-	-	-	3	-	1

23EC042	FUNDAMENTALS OF NANO ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concepts of nano electronics
- To understand the concepts of quantum electronics
- To interpret the nano electronic devices and transistors,
- To familiarize tunneling devices and super conducting devices
- To summarize the basics of nanotube devices

UNIT I	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:	
After completion of the course, the students will be able to:	
CO1:	Explain the basics of Nano electronics
CO2:	Interpret the quantum electronic devices and the mechanism
CO3:	Develop the various Nano electronics transistor
CO4:	Analyze the key performance aspects of tunneling Nano electronic devices
CO5:	Analyze the key performance aspects of super conducting Nano electronic devices
CO6:	Make use of Nano electronics in the development of Nano tubes and structures.

TEXT BOOKS:	
1	Hanson, Fundamentals of Nano electronics, Pearson education, 2009.
2	Kumar Sanjay Sinha, Fundamentals of Nano electronics, Anmol Publishers, 2012

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

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	-	-	-	-	2	2	-	-
2	2	1	-	-	-	2	-	-	-	-	-	2	3	-	-
3	3	2	1	1	-	2	-	-	-	-	-	2	3	-	-
4	3	3	2	2	-	2	-	-	-	-	-	2	3	-	-
5	3	3	2	2	-	2	-	-	-	-	-	2	3	-	-
6	3	2	1	1	-	3	-	-	-	-	-	2	3	-	-
Overall Correlation	3	2	1	1	-	2	-	-	-	-	-	2	3	-	-

VERTICAL 3 - HIGH SPEED COMMUNICATIONS

23EC043	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study and understand the concepts and design of a Cellular System.
- To Study And Understand Mobile Radio Propagation
- To Study And Understand Various Digital Modulation Techniques.
- 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

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

UNIT III	MODULATION TECHNIQUES AND EQUALIZATION AND DIVERSITY	9

Digital Modulation – An Overview: Factors That Influence The Choice Of Digital Modulation, Linear Modulation Techniques:

Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying(GMSK), Spread Spectrum Modulation Techniques: Pseudo- Noise (PN) Sequences, Direct Sequence Spread Spectrum (DS-SS) Equalization, Diversity And Channel Coding: Introduction-Fundamentals Of Equalization- Diversity Techniques: Practical Space Diversity Considerations, Polarization Diversity, Frequency Diversity, Time Diversity.		
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)		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Explain the cellular concept and capacity improvement Techniques.	
CO2:	Analyse mathematically mobile radio propagation mechanisms & its fading Effects.	
CO3:	Summarize the Various Digital Modulation Techniques.	
CO4:	Summarize the various Equalization Algorithms and Diversity combining techniques	

CO5:	Illustrate a cellular system based on resource availability and traffic demands.
CO6:	Interpret a wireless channel and evolve the system design specifications.
TEXT BOOKS:	
1	Rappaport,T.S.,-Wireless communications", Pearson Education, Second Edition, 2010.
2	Andreas.F. Molisch,-Wireless Communications, John Wiley-India,2006(INIT III,V)
REFERENCES:	
1	Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2	Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech, House, 2000
3	David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge, University Press, 2005.
4	Upena Dalal, —Wireless Communication", Oxford University Press, 2009.
5	Andreas.F. Molisch, —Wireless Communications", John Wiley – India, 2006.
6	Wireless Communication and Networks –William Stallings, Pearson Education, Second Edition, 2002.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	1	-	-	-	-	-	1	3	3	-
2	3	3	2	2	3	2	-	-	-	-	-	-	3	3	-
3	2	1	-	-	3	2	-	-	-	-	-	-	3	3	-
4	2	1	-	-	2	2	-	-	-	-	-	1	3	2	-
5	2	1	-	-	2	1	-	-	-	-	-	1	2	2	-
6	2	1	-	-	2	2	-	-	-	-	-	1	2	2	-
Overall Correlation	3	2	1	1	2	2	-	-	-	-	-	1	3	2	-

23EC044	MICROWAVE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate an understanding of the basics required for circuit representation of RF networks.
- To deal with the issues in the design of microwave amplifiers.
- To instill knowledge of the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques

UNIT I	PASSIVE AND ACTIVE MICROWAVE DEVICES	9

Formulation of S-parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behaviour of Resistors, Capacitors and Inductors. Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, PIN diode switch, Gunn diode oscillator, IMPATT diode, Varactor diode.

UNIT II	MICROWAVE GENERATION	9

Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Travelling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT III	MICROWAVE MEASUREMENTS	9

Measuring Instruments: Principle of operation and application of VSWR meter, Power meter, Spectrum analyser, Network analyser, Measurement of Impedance, Frequency, Power, VSWR, Q-factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters

UNIT IV	ADVANCEMENTS IN MICROWAVE ENGINEERING	9
Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC), Monolithic Microwave IC fabrication, RF MEMS for microwave components, Microwave Imaging		
UNIT V	**MICROWAVE COMMUNICATION SYSTEMS**	**9**
Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation, Microwave Antennas.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the active & passive microwave devices & components used in Microwave communication systems
CO2:	Develop and design microwave amplifiers.
CO3:	Analyze the Microwave signals and parameters
CO4:	Explain the effects of microwaves on human body.
CO5:	Explain the fundamentals that are essential for electronics industry in the field of EMI / EMC.
CO6:	Explain various microwave systems and its applications

TEXT BOOKS:	
1	Samuel Liao - Microwave devices and circuits, PHI. (Unit I - III)
2	Basu 'Introduction to Microwave Measurements,' CRC Press 2014. (Unit IV)
3	D. Kraus, Antennas, McGraw Hill, 1988. (Unit V)

REFERENCES:	
1	D. M. Pozar, Microwave Engineering, John Wiley, USA.
2	Sanjeev Gupta, Microwave Engineering, Khanna Pub.

3	Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009.
4	Hector J. De Los Santos, "RF MEMS Circuit Design for Wireless Applications", Artech House, 2002
5	B. Edde, Radar: Principles, Technology, Applications, Prentice Hall, 1993.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	2	-	2	3	-	-
2	3	2	1	1	-	-	-	-	-	1	-	2	2	-	-
3	3	3	2	2	-	-	-	-	-	2	-	-	1	-	-
4	2	1	-	-	-	-	-	-	-	2	-	-	2	-	-
5	2	1	-	-	-	-	-	-	-	2	-	2	2	-	-
6	2	1	-	-	-	-	-	-	-	2	-	2	2	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	2	-	2	3	-	-

23EC045	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of satellite orbits.
- To understand the satellite segment and earth segment.
- To analyse the various methods of satellite access.
- To understand the applications of satellites.
- To understand the basics of satellite Networks.

UNIT I	SATELLITE ORBITS	9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, 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-The Antenna Subsystem.

UNIT III	SATELLITE LINK DESIGN	9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV	EARTH SEGMENT AND SATELLITE ACCESS METHODS	9

Earth Station- Transmitter and Receiver Earth Station, TVRO, MATV and CATV. Multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods

UNIT V	SATELLITE APPLICATIONS	9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS

Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).	
TOTAL: 45 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Utilise the Kepler's and Newton's Laws to explain various parameters of the satellite orbits and the launching procedures.
CO2:	Explain the different subsystems of the satellite space segment.
CO3:	Analyse uplink and downlink equations for the satellite using noise effects.
CO4:	Explain various types of transmitters and receivers in earth segment.
CO5:	Compare and interpret various multiple access techniques.
CO6:	Summarize different satellite access performance metrics apply it in satellite applications.
TEXT BOOKS:	
1	Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.
2	Timothy Pratt, Charles, W. Bostain, Jeremy E. Allnutt, "Satellite Communication", 2nd Edition, Wiley Publications,2002.
REFERENCES:	
1	Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2	Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.
3	M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
3	3	3	2	2	-	-	-	-	-	-	-	-	3	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
6	2	1	-	-	-	-	-	-	-	-	-	-	3		
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-

23EC046	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Radar and Radar equation
- To understand the types of Radar
- To understand tracking Radar
- To understand the various signal processing in Radar
- To understand the Subsystems in Radar

UNIT I	INTRODUCTION TO RADARS	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:	
After completion of the course, the students will be able to:	
CO1:	Analyze the various Radar parameters
CO2:	Summarize various radar types
CO3:	Explain different tracking and filtering schemes
CO4:	Apply signal processing in target detection
CO5:	Develop and design Construct Radar transmitter blocks
CO6:	Develop and design Radar receiver functional 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

REFERENCES:	
1	Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition,2007.
2	M.I.Skolnik , "Introduction to Radar Systems", Tata McGraw Hill 2006.
3	Mark A. Richards, "Fundamentals of Radar Signal Processing", McGraw-Hill, 2005.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	-	-	-	-	-	-	3	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
3	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-
6	3	2	1	1	-	-	-	-	-	-	-	-	3		
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	-	3	-	-

23EC047	4G/5G COMMUNICATION NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks

UNIT I	EVOLUTION OF WIRELESS NETWORKS	6

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	6

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	6

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	6

Mobility management, Command and control, spectrum sharing and spectrum trading, cognitive radio based on 5G, millimeter waves.

UNIT V	SECURITY IN 5G	6

Security features in 5G networks, network domain security, user domain security, flow based QoS framework, mitigating the threats in 5G.

	TOTAL: 30 PERIODS
PRACTICAL EXERCISES:	
1. 4G / 5G-Compliant waveform generation and testing 2. Modeling of 5G Synchronization signal blocks and bursts 3. Channel modeling in 5G networks 4. Multiband OFDM demodulation 5. Perfect Channel estimation 6. Development of 5G New Radio Polar Coding	
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Make use of the evolution of wireless networks and explain its components.
CO2:	Make use of the 5G architecture and its components.
CO3:	Utilize the Radio access technologies, cloud technologies and EPC for 5G.
CO4:	Apply the network slicing, MEC and 5G protocols.
CO5:	Make use of the different spectrum sharing mechanisms.
CO6:	Analyze the various security attacks in 5G and QoS mechanisms in 4G and 5G.
TEXT BOOKS:	
1	5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press,2019.
2	An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020.
REFERENCES:	
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.
3	Fundamentals of 5G Mobile Networks, Johnathan Rodriguez, Wiley June 2015

4	5G Communication, Aaron Kevin Cameron, Karthika, SIPH Publications, 2024

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	-	-	2	2	1	-
2	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
3	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
6	3	3	2	2	3	-	-	-	-	-	-	3	3	3	-
Overall Correlation	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**

23EC048	WIRELESS BROAD BAND COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the various network layer and transport layer protocols for wireless networks
- To study the architecture and interference mitigation techniques in 3G standards
- To learn about 4G technologies and LTE-A in mobile cellular network.
- To learn about the layer level functionalities in interconnecting networks.
- 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:

After completion of the course, the students will be able to:

CO1:	Summarise the various protocols in wireless networks.
CO2:	Utilise the architecture of 3G network standards for wireless communication (WCDMA and 3GPP).
CO3:	Examine the authentication techniques for the data transfer in WCDMA and 3GPP systems.
CO4:	Explain the various MAC elements.
CO5:	Make use of the interconnecting network functionalities for layer level functions.
CO6:	Summarise the communication concepts in current generation (5G) network architecture.

TEXT BOOKS:

1	Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.(Unit-1)

2	Clint Smith,P.E, Dannel Collins, "3G Wireless Networks" Tata McGraw- Hill, 2nd Edition, 2011.(Unit 2)
REFERENCES:	
1	Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.(Unit3&4)
2	Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.(Unit 5)
3	Vijay K.Garg, "Wireless Network Evolution - 2G & 3G". Prentice Hall, 2008.
4	Kaveh Pahlavan, "Principles of wireless networks", Prentice-Hall of India, 2008.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	-	-	-	-	-	-	2	2	3	-
2	3	2	1	1	3	-	-	-	-	2	-	3	3	3	-
3	3	2	1	1	-	-	-	-	-	2	-	3	3	-	-
4	3	2	1	1	-	-	-	-	-	2	-	3	3	-	-
5	2	1	-	-	3	-	-	-	-	-	-	2	2	3	-
6	2	1	-	-	1	1	-	1	-	-	-	3	2	1	1
Overall Correlation	3	2	1	1	2	-	-	-	-	2	-	3	3	2	-

VERTICAL 4 - NETWORKS AND CYBER SECURITY

23EC049	NETWORK ESSENTIALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Concept of network communication
- Importance of standards and protocols in network communications
- Configuration of an integrated wireless router and wireless client to connect securely to the internet.
- Connecting wireless PC clients to a wireless router
- Concept to build a simple computer network using Cisco devices and troubleshoot basic network connectivity issues.

UNIT I	BASICS OF NETWORKING	6

The Fundamentals of Internet Connectivity - PC Basics - Overview of High-Speed and Dialup Connectivity - Web Browsers and Plug-Ins - Networking Terminology - Analogies That Describe Digital Bandwidth.

UNIT II	INTRODUCTION TO NETWORK SIMULATION AND COMMUNICATION	6

Network Simulation using Packet Tracer: Packet Tracer Network Simulator - Networking Models - Network Topologies - Wireless Communications.

UNIT III	INTRODUCTION TO NETWORK ADDRESSING	6

Introduction to TCP/IP: Comparing the OSI Reference Model Layers and the TCP/IP Reference Model Layers, Internet Architecture - IP Addresses: IPv4 Addressing, IP Address Classes, Reserved IP Addresses, Public and Private Addresses, Introduction to Subnetting, IPv4 Versus IPv6 - IP Address Assignment, Acquisition, and Hierarchy: Obtaining an Internet Address, Static Assignment of an IP Address, Address Resolution Protocol, RARP IP Address Assignment.

UNIT IV	INTRODUCTION TO TRANSPORT LAYER	6
Transport Layer Services - Understanding the TCP/IP Transport Layer: Flow Control, Session Establishment, Maintenance, and Termination Overview, Three-Way Handshake. Windowing: Acknowledgment, TCP, UDP, TCP and UDP Port Numbers		
UNIT V	**INTRODUCTION ROUTER TROUBLESHOOTING**	**6**
Introduction to Network Testing - Troubleshooting Router Issues Using the show interface and show interfaces Commands - Troubleshooting Routing Issues Using the show CDP neighbors Command - Troubleshooting Routing Issues Using show IP route and show IP protocol - Troubleshooting Router Connections Using the show controllers serial Command.		
TOTAL: 30 PERIODS		

PRACTICAL EXERCISES:

1. Making of cross cable and straight cable.
2. Configuration of switches and routers
3. Creation of different Topologies using switches and Routers for Connecting Computers
4. Transferring data in an established Computer Network using addressing schemes.
5. Creation of a simple Local Area Network.
6. Routing Protocols.
7. Simulation of unicast and multicast routing protocols

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the Basic concepts of Networking
CO2:	Illustrate about the various types of cabling used in the networking
CO3:	Interpret the various addressing scheme used in networking
CO4:	Explain the basic of Transport Layer
CO5:	Summarize the basic of Network Security

CO6:	Make use of the configuration to troubleshoot the devices
TEXT BOOKS:	
1	Cisco Networking Academy Program CCNA 1 and 2 Companion Guide, third Edition by CISCO Press
2	Cisco Certified Network Associate Study Guide Seventh Edition, Todd Lammle, SYBEX
REFERENCES:	
1	Beasley, J.S. and Nilkaew, P., 2018. Networking Essentials: A CompTIA Network+ N10-007 Textbook. Pearson IT Certification
2	McMillan, T., 2015. Cisco networking essentials. John Wiley & Sons, 2nd Edition

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
2	2	1	-	1	3	2	1	2	2	2	-	2	3	3	3
3	2	1	-	1	3	2	1	2	2	2	-	2	3	3	3
4	2	1	-	1	3	2	1	2	2	2	-	2	3	3	3
5	2	1	-	1	3	2	1	2	2	2	-	2	3	3	3
6	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3
Overall Correlation	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3

23EC050	NETWORK ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

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

UNIT I	NETWORKING TODAY	6

Networking – Components, types, Internet Connections, Requirements of a reliable network, Network Components, Network Representations and Topologies, Common Types of Networks, Internet Connections, Reliable Networks, Network Trends, Network Security

UNIT II	BASIC SWITCH AND END DEVICE CONFIGURATION	6

Cisco IOS Access, IOS Navigation, The Command Structure, Basic Device Configuration, Save Configurations, Ports and Addresses, Configure IP Addressing, Verify Connectivity

UNIT III	PROTOCOLS AND MODELS	6

The Rules, Protocols, Protocol Suites, Standards Organizations, Reference Models, Data Encapsulation, Data access

UNIT IV	ETHERNET SWITCHING	6

Ethernet Frames, Ethernet MAC Address, The MAC Address Table, Switch Speeds and Forwarding Methods

UNIT V	ADDRESS RESOLUTION	6

Introduction, MAC and IP, Packet Tracer—Identify MAC and IP Addresses, ARP, Video—ARP Request, Video—ARP Role in Remote Communications, IPv6 Neighbor Discovery, IPv6 Neighbor Discovery—Address Resolution

	TOTAL: 30 PERIODS
PRACTICAL EXERCISES:	
1. Basic Switch and End Device Configuration and examine the ARP Table - ILM 2. Create network and assign Static IP address to the host using Supernetting and subnetting. 3. Design a network using VLANs, Wireless LANs and InterVLAN routing. 4. Design a simple firewall for host and network. 5. Configure and troubleshoot redundancy on a switched network using EtherChannel. 6. Simulation of Transport Layer Protocols and analysis of congestion control techniques in network	
	TOTAL:30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basic of IOS Commands to configure the devices using CLI
CO2:	Interpret the usage of various transmission medium used in the connectivity
CO3:	Make use of the IP Addressing scheme to implement the VLSM Scheme, Subnetting to interconnect various active ports of routers
CO4:	Summarize the various protocols used in transport layer
CO5:	Interpret the protocols used in the Application Layer.
CO6:	Make use of the security features to configure the devise to enhance the security as well to protect from the threats.
TEXT BOOKS:	
1	Introduction to Networks Companion Guide (CCNAv7), CISCO Press
2	Juniper, 'Distinguished Network Engineering Book SET', Wiley, 2011

REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Keshav, 'An Engineering Approach To Computer Networking: ATM Networks, The Internet, And The Telephone Network', Pearson Education, 1997
3	Jason Edelman, Scott S. Lowe, Matt Oswalt, 'Network Programmability and Automation Skills for the Next-Generation Network Engineer', O'Reilly Media, 2018
4	Stallings, 'Computer Networking With Internet Protocols And Technology', Pearson Education, 2003

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
2	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
3	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3
4	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
5	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
6	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3
Overall Correlation	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3

23EC051	SWITCHING, ROUTING AND WIRELESS ESSENTIALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Student will understand a switch functionality and able to configure VLANs.
- Students will gain knowledge of dynamic host configuration protocols, understand LAN security concepts.
- Students will study switch security issues and methods to address them. Understand Wireless LAN concepts and providing wireless security.
- Students will study routing concepts and perform static routing configurations.

UNIT I	BASIC DEVICE CONFIGURATION	6

Configure a Switch with Initial Settings, Configure Switch Ports, Secure Remote Access, Basic Router Configuration, Verify Directly Connected Networks

UNIT II	SWITCHING CONCEPTS	6

Frame Forwarding, Collision and Broadcast Domains, Overview of VLANs, VLANs in a Multi-Switched Environment, VLAN Configuration, VLAN Trunks

UNIT III	SWITCH SECURITY CONFIGURATION	6

Implement Port Security, Mitigate VLAN Attacks, Mitigate DHCP Attacks, Mitigate ARP Attacks, Mitigate STP Attacks

UNIT IV	ROUTING CONCEPTS	6

Path Determination, Packet Forwarding, IP Routing Table, Static and Dynamic Routing

UNIT V	WIRELESS LAN	6

Introduction to Wireless, WLAN Components, WLAN Operation, CAPWAP Operation, WLAN Threats, Secure WLANs

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:	
1. Basic Switch and Router Configuration using console mode 2. Configure VLANs and Trunking 3. Implementation of VLANs and Trunking 4. Configure Router-on-a-Stick Inter-VLAN Routing 5. Troubleshoot Inter-VLAN Routing 6. Implement the Inter VLAN Routing	
TOTAL:30 PERIODS	
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain how Layer 2 switches forward data
CO2:	Explain how STP enables redundancy in a Layer 2 network.
CO3:	Make use of DHCPv4 to operate across multiple LANs
CO4:	Explain how to configure DTP and native VLAN to mitigate VLAN attacks
CO5:	Summarize the operation of SLAAC.
CO6:	Interpret how a router processes packets when a static route is configured
TEXT BOOKS:	
1	Switching, Routing, and Wireless Essentials v7.0 (SRWE) Companion Guide, Cisco Press
2	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021
REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022
3	Wendell Odom, CCNA Routing and Switching 200-125 Official Cert Guide, CISCO press, 1st edition
4	Bruce Hartpence, 'Packet Guide to Routing and Switching', O'Reilly Media, Inc. 2011

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
2	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
3	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3
4	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
5	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
6	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
Overall Correlation	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3

23EC052	ENTERPRISE NETWORKING, SECURITY AND AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Work with routers and switches using OSPF in point-to-point and multi-access networks.
- Mitigate threats and enhance network security using access control lists and security
- Develop critical thinking and problem-solving skills using real equipment and Cisco Packet Tracer.
- Understand virtualization, SDN, and how APIs and configuration management tools enable network automation.

UNIT I	SINGLE-AREA OSPFV2	6

OSPF Features and Characteristics- OSPF Packet- OSPF Operations- OSPF Router ID- Point-to-Point OSPF Networks- Multi access OSPF Networks- Modify Single-Area OSPFv2- Default Route Propagation- Verify Single-Area OSPFv2

UNIT II	NETWORK SECURITY CONCEPTS	6

Current State of Cyber security- Threat Actors- Threat Actors Tool- Malware- Common Network Attacks- IP Vulnerabilities and Threats- TCP and UDP Vulnerabilities- IP Services- Network Security Best Practices- Cryptography

UNIT III	ACL CONCEPTS	6

Purpose of ACLs- Wildcard Masks in ACLs- Guidelines for ACL Creation- Types of IPv4 ACLs- ACLs for IPv4 Configuration- Configure Standard IPv4 ACLs-Modify IPv4 ACLs- Secure VTY Ports with a Standard IPv4 AC- Configure Extended IPv4 ACLs NAT for IPv4

UNIT IV	WAN, VPN, IPSEC AND QOS	6

Wan Concepts- Purpose of WANs- VPN Technology- Types of VPNs- IPsec- Network Transmission Quality- Traffic Characteristics- QoS Models

UNIT V	NETWORK TROUBLESHOOTING AND VIRTUALIZATION	6
Network Documentation- Troubleshooting Process- Troubleshooting Tools- Cloud Computing – Virtualization		
		TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

1. Configure Single-Area OSPFv2
2. Explore DNS Traffic
3. Configure and Verify Extended IPv4 ACLs
4. Configure NAT for IPv4
5. Investigate the Broadband distribution and analyse the access options for the Scenarios

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain how single-area OSPF operates in both point-to-point and broadcast multi access networks.
CO2:	Summarize network security concepts with respect to TCP and UDP vulnerabilities
CO3:	Illustrate the ACL and NAT and its types in IPv4
CO4:	Make use of NAT services on the edge router to provide IPv4 address scalability
CO5:	Interpret how VPNs and IPsec secure site-to-site and remote access connectivity
CO6:	Summarize how network automation is enabled through Restful APIs and configuration management tools.

TEXT BOOKS:

1	Enterprise Networking, Security, and Automation Course Booklet (CCNAv7), CISCO Press
2	Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012

REFERENCES:	
1	CCNA 200-301, Volume 1 Official Cert Guide, WENDELL ODOM, CCIE No. 1624 Emeritus, CISCO Press
2	Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010
3	Markus Schumacher, Security Patterns: Integrating Security and Systems Engineering, Wiley Software Pattern Series, 2010
4	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	**-**	**-**	3	2	1	2	2	2	-	2	3	3	3
2	2	1	**-**	**-**	3	2	1	2	2	2	-	2	3	3	3
3	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
4	**3**	2	1	1	3	2	1	2	2	2	-	2	3	3	3
5	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
6	2	1	-	-	3	2	1	2	2	2	-	2	3	3	3
Overall Correlation	3	2	1	1	3	2	1	2	2	2	-	2	3	3	3

23EC053	NETWORK DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inspire the students to learn the various switching technologies
- To design the networks for various categories
- To introduce the purpose of management of the network systems

UNIT I	SWITCHING TECHNOLOGIES	9

Switching technologies, multiplexing, circuit switching, packet switching X.25, frame relax, SMDs ATM, B-ISDN, traffic matrix, traffic pattern calculations, performance issues of packet networks, delay, availability and reliability

UNIT II	NETWORK DESIGN FOR ACCESS	9

Network Design for Access: Campus network design, leased line and radio modems, DDR & ISDN Access Network design, X.25 remote access network design, Frame-relay interfaces & traffic shaping VSAT & WLAN network design

UNIT III	NETWORK DESIGN FOR BACKBONE	9

Network Design for Backbone: Identification & selection of internetworking devices, CISCO routers & Nortel switches, EIGRP

UNIT IV	NETWORK DESIGN FOR CONVERGENCE	9

Network Design for convergence: UDP broadcasts, IP Networks for Voice, Data, Video, Fax, Soft & hard design examples for IP Technology networks, network design for digital video broadcast

UNIT V	DATA NETWORK MANAGEMENT SYSTEMS	9

Data Network Management Systems: Managing IP, ICMP, TCP, UDP, X.25 reporting Ethernet traffic, managing bridges & routers. Microsoft & HP, NMS Tools. Case Studies: selected from design, architecture & topology areas of internetworks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Explain the various switching techniques use in the network design
CO2:	Interpret the network design for the access
CO3:	Summarize the network design process employed for the backbone system
CO4:	Explain the process involved in the design process for the convergence networks
CO5:	Interpret the Various data processing tools used in Network Design
CO6:	Explain the various managing schemes used in the Network Design
TEXT BOOKS:	
1	Data Network Design; D L Spolin, Mc-Graw Hill, 1993
2	Network Design & Case Studies "CISCO Systems Inc." CISCO Press, 1993
REFERENCES:	
1	Feit , 'SNMP GDE Networking Management', Mc-Graw Hill Inc., 1995
2	Jeff Doyle, Jennifer Dehaven Carroll 'Routing TCP/IP', CISCO systems, 2001
3	Designing Cisco Network Service Architectures (ARCH) Foundation Learning Guide: (CCDP ARCH 642-874) 3rd Edition
4	Tim Szigeti, Christina Hattingh, Al Gore, 'End-to-End QoS Network Design: Quality of Service in LANs, WANs, and VPNs (Networking Technology)', 1st Edition, Cisco Press

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	1	1	1	3	2	1	2	3	2	2
2	2	1	-	-	2	1	1	2	2	1	3	3	3	2	2
3	2	1	-	-	2	1	1	2	2	3	1	2	3	3	2
4	2	1	-	-	1	3	1	2	3	2	1	1	3	3	2
5	2	1	-	-	2	1	1	3	2	2	1	2	3	2	2
6	2	1	-	-	3	3	1	3	2	3	1	2	3	3	2
Overall Correlation	2	1	-	-	2	2	1	3	3	3	2	2	3	3	2

23EC054	CYBER SECURITY ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Examine the concept of privacy and its legal protections.
- Perform basic computer forensics.
- Describe the social implications of cybersecurity.
- Understand the risks and benefits of social networks
- Describe the basic ethical considerations related to cyber security

UNIT I	INTRODUCTION TO CYBER SECURITY	9

Overview of Cyber Security– Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime, Cyber terrorism, Cyber Espionage, Cyber Operations, Cyber Weaponry, Cyber world, Advanced Persistent Threat- Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority

UNIT II	CYBER SECURITY VULNERABILITIES AND CYBER SECURITY SAFEGUARDS	9

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration and Open Access to Organizational Data, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards-Overview, Security Services and Mechanism, Audit

UNIT III	SECURING WEB APPLICATION, SERVICES AND SERVERS	9

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security- Intrusion, Physical Theft, Abuse of Privileges

UNIT IV	CYBERSPACE AND THE LAW	9

Introduction to Cyberspace environment and its characteristics, Cyberspace Operations –Network Operations (NETOPS), Defensive Cyberspace Operations (DCO), Offensive Cyberspace

Operations (OCO), Operational methodologies to conduct cyberspace operations, Cyber Security Regulations		
UNIT V	**CYBER FORENSICS**	**9**
Introduction to Cyber Forensics, Spyware and Adware, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the basics of cyber security.
CO2:	Summarize the steps involved in finding vulnerabilities in cyber security and to offer counter measures.
CO3:	Apply security mechanisms and develop audit processes to enhance cybersecurity.
CO4:	Summarize the security in servers and web applications.
CO5:	Apply methodologies to conduct cyberspace operations and utilize cybersecurity regulations for effective NETOPS, DCO, and OCO.
CO6:	Analyze cyber forensic techniques to investigate digital evidence and examine email and internet traces

TEXT BOOKS:	
1	Jeffery Carr et al, "Inside Cyber Warfare: Mapping the Cyber Underworld," O'Reilly Publication December 2012
2	George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013
REFERENCES:	
1	Martti Lehto, Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland, 2015

2	Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, "Security in Computing", 5th Edition, Pearson Education, 2015.
3	Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009
4	Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture", 6th Edition, PHI – 2014.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	1	3	-	-	2	2	-	1
2	2	1	-	-	-	1	-	2	2	-	-	3	2	-	2
3	3	2	1	1	-	1	-	2	2	-	-	2	3	-	2
4	2	1	-	-	-	3	-	2	3	-	-	1	2	-	2
5	3	2	1	1	-	1	-	3	2	-	-	2	3	-	3
6	3	3	2	2	-	3	-	3	2	-	-	2	3	-	3
Overall Correlation	3	2	1	1	-	2	-	3	3	-	-	2	3	-	3

VERTICAL 5 - BIO MEDICAL TECHNOLOGIES

23EC055	WEARABLE DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- 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 TEXTILES	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:	
After completion of the course, the students will be able to:	
CO1:	Illustrate the concepts of wearable system.
CO2:	Apply signal processing techniques to analyse the output of sensors
CO3:	Experiment with the energy harvestings in wearable device.
CO4:	Utilise the concepts of BAN in health care.
CO5:	Summarise the concepts of smart textile.
CO6:	Analyse the various wearable devices in healthcare system.

TEXT BOOKS:	
1	Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
2	Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.

REFERENCES:	
1	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.

3	Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014.
4	Mehmet R. Yuce and Jamil Y. Khan, Wireless Body Area Networks Technology, Implementation applications, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
2	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
3	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
4	3	2	1	1	2	-	-	-	-	-	-	2	3	2	-
5	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
6	3	3	2	2	2	-	-	-	-	-	-	3	2	2	-
Overall Correlation	3	2	1	1	1	-	-	-	-	-	-	3	3	1	-

23EC056	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 Hemodialysis, 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:	
After completion of the course, the students will be able to:	
CO1:	Explain the principles and construction of artificial heart
CO2:	Summarise various mechanical techniques that improve therapeutic technology
CO3:	Experiment with the functioning of the membrane or filter that cleanses the blood.
CO4:	Identify the tests to assess the hearing loss.
CO5:	Illustrate the development of wearable devices for the same.
CO6:	Analyse the 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

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.
4	Joseph D.Bronzino, The Biomedical Engineering Handbook, Third Edition: Three Volume Set, CRC Press, 2006
5	Andreas.F. Von racum, "Hand book of bio material evaluation", Mc-Millan publishers, 1980.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
2	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
3	3	2	1	1	-		-	-	-	-	-	3	3	-	-
4	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
5	2	1	-	-	1	-	-	-	-	-	-	2	2	1	-
6	3	3	2	2	2							3	3	2	-
Overall Correlation	3	2	1	1	1	-	-	-	-	-	-	3	3	1	-

23EC057	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

Electro diagnosis, 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 hand piece, High-speed hand piece, Hand piece maintenance. Vacuum and Pneumatic techniques: Vacuum techniques, Oral evacuation systems, Vacuum pump, Pneumatic techniques, Dental compressor. Decontamination Unit and constant fumigation unit. Dental Radiography: Dental X-ray Machine.		
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:	
After completion of the course, the students will be able to:	
CO1:	Summarise suitable therapeutic devices for ailments related to cardiology, pulmonology, neurology
CO2:	Utilize the different types of equipment in biomechanical therapy.
CO3:	Demonstrate the principles of body care equipment
CO4:	Analyze the basic operations of dental care equipment.
CO5:	Examine different technologies involved in heat and photon therapy equipment.
CO6:	Develop 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.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	1	-	1	-	-	-	2	2	-	1
2	3	2	1	1	-	1	-	-	-	-	-	2	3	-	-
3	2	1	-	-	-	1	-	-	-	-	-	2	2	-	-
4	3	3	2	2	-	1	-	1	-	-	-	2	3	-	1
5	3	3	2	2	-	1	-	1	-	-	-	2	2	-	1
6	3	2	1	1	-	1	-	1	-	-	-	2	3	-	1
Overall Correlation	3	3	1	1	-	1	-	1	-	-	-	3	3	-	1

23EC058	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	INTRODUCTION TO MEDICAL IMAGING AND X RAYS	9

Introduction to Medical imaging, 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, 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, generations of gradient magnetic fields, Radio Frequency coils shim coils, Electronic components.		
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:		
After completion of the course, the students will be able to:		
CO1:	Explain the working principle of the X-ray machine and its application.	
CO2:	Illustrate the principle computed tomography	
CO3:	Identify the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.	
CO4:	Demonstrate the applications of radionuclide imaging.	
CO5:	Analyse different imaging techniques and choose appropriate imaging equipment for better diagnosis	
CO6:	Apply 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, Vol 2. Medical Image Processing and Analysis, SPIE Press 2000
REFERENCES:	
1	Khin Wee Lai, Dyah Ekashant Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015.
2	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
3	Dougherty, Geoff (Ed.), "Medical Image Processing-Techniques and Applications ", Springer-Verlag New York, 2011

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	1	-	-	-	2	-	-	-	-	-	-	2	-	-
2	2	1	-	-	-	2	-	2	-	-	-	-	2	-	2
3	3	2	1	1	-	2	-	2	-	-	-	-	3	-	2
4	2	1	-	-	-	2	-	2	-	-	-	-	2	-	2
5	3	3	2	2	-	2	-	2	-	-	-	-	3	-	2
6	3	2	1	1	-	2	-	2	-	-	-	-	3	-	2
Overall Correlation	3	2	1	1	-	2	-	2	-	-	-	-	3	-	2

23EC059	BRAIN COMPUTER INTERFACE AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I	INTRODUCTION TO BCI	9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI - Partially Invasive BCI – Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI

UNIT II	BRAIN ACTIVATION	9

Brain activation patterns - Spikes, Oscillatory potential and ERD, slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT III	FEATURE EXTRACTION METHODS	9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering - Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence.

UNIT IV	MACHINE LEARNING METHODS FOR BCI	9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF's,

Perceptron's, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis		
UNIT V	**APPLICATIONS OF BCI**	**9**
Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant, Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs: P300 Mind Speller, Visual cognitive BCI, Emotion detection, Ethics of Brain Computer Interfacing		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Interpret the significance and role of this course in the present contemporary world
CO2:	Compare various concept of BCI.
CO3:	Identify functions appropriately to the brain activation.
CO4:	Select appropriate feature extraction methods for different applications.
CO5:	Examine a system using machine learning algorithms for translation.
CO6:	Apply BCI in various applications.

TEXT BOOKS:	
1	Rajesh.P.N.Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, First edition, 2013.
2	Jonathan Wolpaw, Elizabeth Winter Wolpaw, ―Brain Computer Interfaces: Principles and practice‖, Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:	
1	Ella Hassianien, A &Azar.A.T (Editors), "Brain-Computer Interfaces Current Trends and Applications", Springer, 2015.

2	Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010
3	Ali Bashashati, Mehrdad Fatourechi, Rabab K Ward, Gary E Birch," A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals" Journal of Neural Engineering, Vol.4, 2007, PP.32-57.
4	Arnon Kohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	2	-	-	-	-	-	-	2	-	-
2	2	1	-	-	-	2	-	-	-		-	-	2	-	-
3	3	2	1	1	-	2	-	-	-	-	-	-	3	-	-
4	3	2	1	1	2	2	-	-	-	-	-	-	3	2	-
5	3	3	2	2	2	2	-	-	-	-	-	-	3	2	-
6	3	2	1	1	2	2	-	-	-	-	-	-	3	2	-
Overall Correlation	3	2	1	1	1	2	-	-	-	-	-	-	3	1	-

23EC060	BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- 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	FEATURE EXTRACTION METHODS	9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering - Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artifacts reduction, Feature Extraction - Phase synchronization and coherence.

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:		
After completion of the course, the students will be able to:		
CO1:	Illustrate the significance and role of this course in the present contemporary world.	
CO2:	Construct a BAN for appropriate hardware components.	
CO3:	Develop the different feature extraction methods.	
CO4:	Explain the need for different frequency and time domain analysis.	
CO5:	Analyse the coexistence issues with BAN.	
CO6:	Outline 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.	

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	-	-	-	1	2	1	1
2	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1
3	3	2	1	1	-	-	-	1	-	-	-	1	3	-	1
4	2	1	-	-	-	2	-	1	-	-	-	1	2	-	1
5	3	3	2	2	-	2	-	1	-	-	-	1	3	-	1
6	2	1	-	-	-	2	-	2				-	2	-	2
Overall Correlation	3	2	1	1	1	1	-	2	-	-	-	1	3	1	2

VERTICAL 6 - SIGNAL AND IMAGE PROCESSING

23EC061	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I	MULTIRATE SIGNAL PROCESSING	9

Multi rate 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, Power Spectra, Filters for generating random Processes from white noise and inverse filter – AR, MA and ARMA processes – Yule walker equations.

UNIT III	LINEAR PREDICTION AND FILTERING	9

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

UNIT IV	ADAPTIVE FILTERING	9

FIR adaptive filters – adaptive filters based on steepest descent method – 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:	
After completion of the course, the students will be able to:	
CO1:	Demonstrate multirate signal processing and its applications
CO2:	Demonstrate an understanding of the power spectral density and apply to discrete random signals and systems
CO3:	Apply linear prediction techniques to discrete random signals for signal detection and estimation.
CO4:	Apply filtering techniques to discrete random signals for signal detection and estimation.
CO5:	Analyze adaptive filtering problems and demonstrate its application
CO6:	Apply power spectrum estimation techniques to random signals.
TEXT BOOKS:	
1	Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2	John G. Proakis & Dimitris G.Manolakis, —Digital Signal Processing – Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
3	P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.
REFERENCES:	
1	Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2006.
2	Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw Hill, 2000.
3	Openheim AV & Schafer RW, Discrete Time Signal Processing PHI. Taan S.Elali, "Discrete Systems and Digital Signal Processing with Matlab, " CRC Press,2005

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	1	3	-	-
2	2	1	-	-	-	-	-	-	-	-	-	2	3	-	-
3	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
4	3	2	1	1	-	-	-	-	-	-	-	2	2	-	-
5	3	3	2	2	-	-	-	-	-	-	-	1	3	-	-
6	3	2	1	1	-							1	3	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-

23EC062	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

Fundamental 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.

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, Homo-morphic filtering.

UNIT III	IMAGE RESTORATION	9

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

UNIT IV	IMAGE SEGMENTATION	9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting

and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.		
UNIT V	**IMAGE COMPRESSION AND RECOGNITION**	**9**
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching. Case study.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Explain the fundamentals of digital image processing, such as digitization, sampling, quantization
CO2:	Apply the techniques of smoothing, sharpening and enhancement on images
CO3:	Analyse the restoration concepts and filtering techniques of images
CO4:	Build segmentation, features extraction, compression and recognition methods for colour models.
CO5:	Illustrate image compression concepts and standards
CO6:	Analyse the types of descriptors and pattern recognition concept in image processing

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

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	3	2	-	-
2	3	2	1	1	1	-	-	-	-	-	-	2	3	1	-
3	3	3	2	2	1	-	-	-	-	-	-	2	3	1	-
4	3	2	1	1	-	-	-	-	-	-	-	2	3	-	-
5	2	1	-	-	-	-	-	-	-	-	-	2	2	-	-
6	3	3	2	2	1	-						2	3	1	
Overall Correlation	3	2	2	1	1	-	-	-	-	-	-	2	3	1	-

23EC063	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Study the fundamentals of speech signal and extracts various speech features
- To understand different speech coding techniques for speech compression applications
- To 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:	
After completion of the course, the students will be able to:	
CO1:	Summarize the fundamentals of speech.
CO2:	Examine various speech features for speech related applications
CO3:	Explain speech compression techniques
CO4:	Choose an appropriate speech coder for a given application.
CO5:	Build a speech enhancement system.
CO6:	Apply 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.
3	Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999.
4	Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	-	-	-	-	-	-	-	1	3	-	-
2	3	3	2	2	-	-	-	-	-	-	-	1	2	-	-
3	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	-
5	3	2	1	1	-	-	-	-	-	-	-	1	2	-	-
6	3	2	1	1	-	-	-	-	-	-	-	1	2	-	-
Overall Correlation	3	2	1	1	-	-	-	-	-	-	-	1	2	-	-

23EC064	SOFTWARE DEFINED RADIO	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To introduce the concepts of software radios
- To know about RF implementation challenges for software defined radios
- To understand the digital generation of signals
- To learn the software and hardware requirements for software defined radios

UNIT I	INTRODUCTION TO SOFTWARE RADIO	6

The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

UNIT II	RF IMPLEMENTATION	6

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	6

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	6

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT V	HARDWARE AND SOFTWARE FOR SDR AND CASE STUDIES	6
DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.		
TOTAL: 30 PERIODS		
PRACTICAL EXERCISES:		
1. Study of SDR hardware kit. 2. Design and Implementation of digital modulation schemes using SDR. 3. Implementation of synchronization techniques using SDR. 4. Channel Coding Techniques using SDR. 5. Study of channel estimation techniques using SDR. 6. Study of MIMO concepts using SDR.		
TOTAL:30 PERIODS		
COURSE OUTCOMES:		
After completion of the course, the students will be able to:		
CO1:	Summarize the Characteristics, benefits and Design Principles of Software Radio (SDR).	
CO2:	Analyze Radio frequency implementation issues.	
CO3:	Outline various digital synthesis procedures.	
CO4:	Utilize various Smart antenna techniques for SDR.	
CO5:	Make use of various Hardware modules in SDR.	
CO6:	Analyze various Software modules and case studies required in SDR	
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.	
REFERENCES:		
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.
4	Ram, Amithesh Pandey, "Practical Approach to Software Defined Radio", BUKKS, January 2019.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	2	-	1	-	3	2	2	2
2	3	3	2	2	2	2	-	2	-	1	-	2	3	2	2
3	2	1	-	-	2	-	-	1	-	-	-	3	2	2	1
4	3	2	1	1	3	-	-	2	-	-	-	3	3	3	2
5	3	2	1	1	3	-	-	2	-	-	-	3	3	3	2
6	3	3	2	2	2	2	-	2	-	1	-	2	3	2	2
Overall Correlation	**3**	**2**	**1**	**1**	**3**	**1**	**-**	**2**	**-**	**1**	**-**	**3**	**3**	**3**	**2**

23EC065	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To Study the architecture of programmable DSP processors.
- To implement various standard DSP algorithms in DSP Processors.
- To Use the Programmable DSP Processors to build real-time DSP systems.
- To develop skills in the development of DSP algorithms.
- To Study the applications of DSP Processors.

UNIT I	ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS	6

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	6

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	6

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	6

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	6

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: 30 PERIODS

PRACTICAL EXERCISES:

1. Real-Time Sine Wave Generation
2. Programming examples using C, Assembly and linear assembly.
3. Implementation of moving average filter.
4. FIR implementation with a Pseudorandom noise sequence as input to a filter.
5. Fixed point implementation of IIR filter.
6. FFT of Real-Time input signal.

HARDWARE & SOFTWARE SUPPORT TOOLS:

- TMS320C54xx/TMS320C67xx DSP Development board.
- Code Composer Studio (CCS)
- Function Generator and Digital Storage Oscilloscope.
- Microphone and speaker.

TOTAL:30 PERIODS

COURSE OUTCOMES:

After completion of the course, the students will be able to:

CO1:	Summarize the architectural features of DSP Processors.
CO2:	Utilize the organization of TMS320C54xx DSP processors.
CO3:	Build solutions using TMS320C6x DSP Processor

CO4:	Apply the various DSP algorithms using DSP development platform.
CO5:	Develop the adaptive filters and FFT algorithms for frequency analysis.
CO6:	Analyze 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	Rulph Chassaing 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
3	The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997.
4	Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	2	2	-	-	-	1	-	3	2	2	-
2	3	2	1	1	2	2	-	-	-	1	-	2	3	2	-
3	3	2	1	1	2	2	-	-	-	1	-	2	2	2	-
4	3	2	1	1	2	2	-	-	-	1	-	2	2	2	-
5	3	2	1	1	2	2	-	-	-	1	-	2	2	2	-
6	3	3	2	2	2	2	-	-	-	1	-	2	2	2	-
Overall Correlation	3	2	1	1	2	2	-	-	-	1	-	3	3	2	-

23EC066	FUNDAMENTALS OF COMPUTER VISION	L	T	P	C
		2	0	2	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 in 3D reconstruction.
- To understand image-based rendering and recognition

UNIT I	IMAGE FORMATION AND PROCESSING	6

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	6

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 AND MOTION ESTIMATION	6

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	6

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos.

UNIT V	IMAGE BASED RENDERING AND RECOGNITION	6

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes -Video-based rendering-Object detection - Face recognition - Instance recognition – Category recognition - Context and scene understanding- Recognition databases and test sets

TOTAL: 30 PERIODS

PRACTICAL EXERCISES:

LABORATORY EXPERIMENTS:

Software needed:

1. OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or equivalent.
2. OpenCV Installation and working with Python.
3. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection.
4. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images.
5. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection.
6. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment.
   Image segmentation using Graphcut / Grabcut.
7. Pose Estimation.
8. 3D Reconstruction – Creating Depth map from stereo images.
9. Object Detection and Tracking using Kalman Filter, Camshift.

	TOTAL:30 PERIODS
COURSE OUTCOMES:	
After completion of the course, the students will be able to:	
CO1:	Summarize the concepts of Image Transforms, Operations and Global Optimization.
CO2:	Make use of Image feature detection, Matching and Image Segmentation techniques.
CO3:	Utilize feature-based alignment methods for 2D and 3D Images.
CO4:	Apply the different motion estimation techniques to Image Processing.
CO5:	Develop various 3D reconstruction techniques for Image Processing
CO6:	Apply various Image based rendering techniques for facial recognition, object detection, category recognition, context and scene understanding, test database.
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
2	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006.
3	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
4	Joseph Howse, Joe Minichino, Learning OpenCV 4 Computer Vision with Python 3, Packt Publications, 2020.

Cos	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	1	-	-	1	-	-	1	2	1	3	2	2	1	1
2	3	2	1	1	3	-	1	2	2	1	2	2	3	3	2
3	3	2	1	1	3	-	-	2	1	1	2	2	3	3	2
4	3	2	1	1	3	-	-	3	2	1	2	3	2	3	3
5	3	2	1	1	2	2	-	3	3	1	2	3	3	2	3
6	3	2	1	1	3	-	-	3	2	1	2	3	2	3	3
Overall Correlation	3	2	1	1	3	1	1	2	2	1	3	2	3	3	2