VELS



INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
ACCREDITED BY NAAC WITH 'A' GRADE
Marching Beyond 30 Years Successfully
INSTITUTION WITH UGC 12B STATUS

B.E.

Electronics and Communication Engineering

Curriculum and Syllabus

Regulation 2022

(Based on Choice Based Credit System (CBCS) and Outcome Based Education (OBE))

Effective from the Academic year
2022 – 2023

Department of Electronics and Communication Engineering
School of Engineering
VISTAS

VISION

To be a centre of excellence in the field of Electronics and Communication Engineering (ECE) equipped with the state of art technologies to produce highly competent, resourceful and ethical young professionals who create innovative solutions to the needs of the society and excel in the varied professional trends globally.

MISSION

M1: To impart strong theoretical and experimental fundamentals in electronics and communication engineering that enable students to be competent in the growing technical demands and challenges.

M2: To facilitate appropriate technical exposure on the latest and cutting edge technological trends through academic and collaborative interactions with industry, academia and research organizations.

M3: To foster an environment of excellence in theoretical and applied research evident through product development, patents, projects, publications in SCI and WOS journals, books and conferences.

M4: To participate in the development of the nation through social and ethical commitments by promoting innovation, research and entrepreneurship

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Implement the acquired sound technical knowledge in core and specialized subjects of Electronics & Communication Engineering to be creative and innovative in solving engineering problems in the current scenario.

PEO2: Professionally competent with a high degree of employability in National and International Industries with the ability to handle any complicated technical issues.

PEO3: Induce critical thinking with the awareness of recent and future technological developments to contribute effectively towards Research and Development.

PEO4: Inculcate Life-long learning, Collective responsibility, Managerial capabilities and Leadership qualities by adapting to new technologies for societal benefits.

PROGRAMME OUTCOMES (POs)

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

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

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

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

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

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

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Design and analyze the concepts and applications in the field of Communication, Cognitive Networks, Signal & Image processing, Embedded systems, Data Science and Artificial Intelligence to find solutions to the real world problems.

PSO2: Demonstrate the acquired professional and competitive skills for successful carrier, demonstrating the practice of Professional Ethics and the concerns for Social and Environmental impact.

COMPETANCIES AND PERFORMANCE INDICATORS

PO 1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.			
1.1	Demonstrate competence in mathematical modelling	1.1.1	Apply mathematical techniques such as Calculus, Linear Algebra, Probability theory and Random process, Fourier series, Fourier Transform, Laplace Transform, and Z-Transform to solve problems.
		1.1.2	Apply advanced mathematical techniques to model and solve Electronics and Communication engineering problems.
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to an engineering problem.
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply fundamental engineering concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply Electronics and Communication engineering concepts to solve engineering problems.
PO 2: Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.			
2.1	Demonstrate an ability to identify and formulate complex engineering problem	2.1.1	2.1.1 Articulate problem statements and identify objectives
		2.1.2	2.1.2 Identify engineering systems, variables, and parameters to solve the problems
		2.1.3	2.1.3 Identify the mathematical, engineering and other relevant knowledge that applies to a given problem
2.2	Demonstrate an ability to formulate a solution plan and methodology for an engineering problem	2.2.1	Reframe complex problems into interconnected sub-problems
		2.2.2	Identify, assemble and evaluate information and resources.
		2.2.3	Identify existing processes/solution methods for solving the problem, including forming justified approximations and assumptions
		2.2.4	Compare and contrast alternative solution processes to select the best process.

2.3	Demonstrate an ability to formulate and interpret a model	2.3.1	Combine scientific principles and engineering concepts to formulate model/s (mathematical or otherwise) of a system or process that is appropriate interms of applicability and required accuracy.
		2.3.2	Identify assumptions (mathematical and physical) necessary to allow modeling of a system at the level of accuracy required.
2.4	Demonstrate an ability to execute a solution process and analyze results	2.4.1	Apply engineering mathematics and computations to solve mathematical models
		2.4.2	Produce and validate results through skillful use of contemporary engineering tools and models
		2.4.3	Identify sources of error in the solution process, and limitations of the solution.
		2.4.4	Extract desired understanding and conclusions consistent with objectives and limitations of the analysis
PO 3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.			
3.1	Demonstrate an ability to define a complex/ open-ended problem in engineering terms	3.1.1	Recognize that need analysis is key to good problem definition
		3.1.2	Elicit and document, engineering requirements from stakeholders
		3.1.3	Synthesize engineering requirements from a review of the state-of-the-art
		3.1.4	Extract engineering requirements from relevant engineering Codes and Standards such as IEEE, ISO, ITU-R, ITU-T etc.
		3.1.5	Explore and synthesize engineering requirements considering health, safety risks, environmental, cultural and societal issues
		3.1.6	Determine design objectives, functional requirements and arrive at specifications
3.2	Demonstrate an ability to generate a diverse set of alternative design solutions	3.2.1	Apply formal idea generation tools to develop multiple engineering design solutions
		3.2.2	Build models/prototypes to develop a diverse set of design solutions
		3.2.3	Identify suitable criteria for the evaluation of alternate design solutions

3.3	Demonstrate an ability to select an optimal design scheme for further development	3.3.1	Apply formal decision-making tools to select optimal engineering design solutions for further development
		3.3.2	Consult with domain experts and stakeholders to select candidate engineering design solution for further development
3.4	Demonstrate an ability to advance an engineering design to defined end state	3.4.1	Refine a conceptual design into a detailed design within the existing constraints (of the resources)
		3.4.2	Generate information through appropriate tests to improve or revise the design
PO 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.			
4.1	Demonstrate an ability to conduct investigations of technical issues consistent with their level of knowledge and understanding	4.1.1	Define a problem, its scope and importance for purposes of investigation
		4.1.2	Examine the relevant methods, tools and techniques of experiment design, system calibration, data acquisition, analysis and presentation
		4.1.3	Apply appropriate instrumentation and/or software tools to make measurements of physical quantities
		4.1.4	Establish a relationship between measured data and underlying physical principles.
4.2	Demonstrate an ability to design experiments to solve open-ended problems	4.2.1	Design and develop an experimental approach, specify appropriate equipment and procedures
		4.2.2	Understand the importance of the statistical design of experiments and choose an appropriate experimental design plan based on the study objectives
4.3	Demonstrate an ability to analyze data and reach a valid conclusion	4.3.1	Use appropriate procedures, tools and techniques to conduct experiments and collect data
		4.3.2	Analyze data for trends and correlations, stating possible errors and limitations
		4.3.3	Represent data (in tabular and/or graphical forms) so as to facilitate analysis and explanation of the data, and drawing of conclusions
		4.3.4	Synthesize information and knowledge about the problem from the raw data to reach appropriate conclusions

PO 5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.			
5.1	Demonstrate an ability to identify/ create modern engineering tools, techniques and resources	5.1.1	Identify modern engineering tools and techniques and resources for engineering activities.
		5.1.2	Create/adapt/modify/extend tools and techniques to solve engineering problems
5.2	Demonstrate an ability to select and apply discipline-specific tools, techniques and resources	5.2.1	Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.
		5.2.2	Demonstrate proficiency in using discipline-specific tools
5.3	Demonstrate an ability to evaluate the suitability and limitations of tools used to solve an engineering problem	5.31	Discuss limitations and validate tools, techniques and resources
		5.3.2	Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use.
PO 6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.			
6.1	Demonstrate an ability to describe engineering roles in a broader context, e.g. pertaining to the environment, health, safety, legal and public welfare	6.1.1	Identify and describe various engineering roles; particularly as pertains to protection of the public and public interest at the global, regional and local level
6.2	Demonstrate an understanding of professional engineering regulations, legislation and standards	6.2.1	Interpret legislation, regulations, codes, and standards relevant to your discipline and explain its contribution to the protection of the public

PO 7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and the need for sustainable development.			
7.1	Demonstrate an understanding of the impact of engineering and industrial practices on social, environmental and in economic contexts	7.1.1	Identify risks/impacts in the life-cycle of an engineering product or activity
		7.1.2	Understand the relationship between the technical, socio-economic and environmental dimensions of sustainability
7.2	Demonstrate an ability to apply principles of sustainable design and development	7.2.1	Describe management techniques for sustainable development
		7.2.2	Apply principles of preventive engineering and sustainable development to an engineering activity or product relevant to the discipline
PO 8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.			
8.1	Demonstrate an ability to recognize ethical dilemmas	8.1.1	Identify situations of unethical professional conduct and propose ethical alternatives
8.2	Demonstrate an ability to apply the Code of Ethics	8.2.1	Identify tenets of the IEEE professional code of ethics.
		8.2.2	Examine and apply moral & ethical principles to known case studies
PO 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.			
9.1	Demonstrate an ability to form a team and define a role for each member	9.1.1	Recognize a variety of working and learning preferences; appreciate the value of diversity on a team
		9.1.2	Implement the norms of practice (e.g., rules, roles, charters, agendas, etc.) of effective team work, to accomplish a goal.
9.2	Demonstrate effective individual and team operations--communication, problem- solving,	9.2.1	Demonstrate effective communication, problem-solving, conflict resolution and leadership skills
		9.2.2	Treat other team members respectfully
		9.2.3	Listen to other members

	conflict resolution and leadershipskills	9.2.4	Maintain composure in difficult situations
9.3	Demonstrate success ina team-based project	9.3.1	Present results as a team, with smooth integration of contributions from all individual efforts
PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions			
10.1	Demonstrate an ability to comprehend technical literature and document project work	10.1.1	Read, understand and interpret technical and non-technical information.
		10.1.2	Produce clear, well-constructed, and well-supported written engineering documents.
		10.1.3	Create flow in a document or presentation - a logical progression of ideas so that the main point is clear.
10.2	Demonstrate competence in listening, speaking, and presentation	10.2.1	Listen to and comprehend information, instructions, and viewpoints of others
		10.2.2	Deliver effective oral presentations to technical and non-technical audiences
10.3	Demonstrate the ability to integrate different modes of communication	10.3.1	Create engineering-standard figures, reports and drawings to complement writing and presentations
		10.3.2	Use a variety of media effectively to convey a message in a document or a presentation
PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team, to manage projects and in multidisciplinary environments.			
11.1	Demonstrate an ability to evaluate the economic and financial performance of an engineering activity	11.1.1	Describe various economic and financial costs/benefits of an engineering activity
		11.1.2	Analyze different forms of financial statements to evaluate the financial status of an engineering project
11.2	Demonstrate an ability to compare and contrast the costs/benefits of alternate proposals for an engineering activity	11.2.1	Analyzeandselectthemostappropriateproposalbasedoneconomicandfinancial considerations.

11.3	Demonstrate an ability to plan/manage an engineering activity within time and budget constraints	11.3.1	Identify the tasks required to complete an engineering activity, and the resources required to complete the tasks.
		11.3.2	Use project management tools to schedule an engineering project, so it is completed on time and on budget.
PO 12: Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.			
12.1	Demonstrate an ability to identify gaps in knowledge and a strategy to close these gaps	12.1.1	Describe the rationale for the requirement for continuing professional development
		12.1.2	Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
12.2	Demonstrate an ability to identify changing trends in engineering knowledge and practice	12.2.1	Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
		12.2.2	Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field.
12.3	Demonstrate an ability to identify and access sources for new information	12.3.1	Source and comprehend technical literature and other credible sources of information
		12.3.2	Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.
PSO 1: Design and analyze the concepts and applications in the field of Communication, Cognitive Networks, Signal & Image processing, Embedded systems, Data Science and Artificial Intelligence to find solutions to the real world problems.			
13.1	Demonstrate an ability to investigate complex problems	13.1.1	Identify problem statements in the various applications of Electronics and Communication Techniques
		13.1.2	Articulate the problems to the listeners with probable solutions for the same
13.2	Demonstrate an ability to design and evaluate solutions systematically	13.2.1	Systematically evaluate and choose the optimal solution
		13.2.2	Investigate all the probable solutions towards the solution of the identified problem
		13.2.3	Specify the design tools that may help in finding the solution

PSO 2: Demonstrate the acquired professional and competitive skills for successful carrier, demonstrating the practice of Professional Ethics and the concerns for Social and Environmental impacttechnologies.			
14.1	Demonstrate an ability to develop solutions using engineering principles and practices	14.1.1	Describe the rationale forchoosing solutions based on engineering principles
		14.1.2	Conduct feasibility analysis, cost-benefit analysis for finding solutions
14.2	Demonstrate an ability to understand the social and economic impact of technology	14.2.1	Design solutions for engineering problems by considering its effect and society and environment
		14.2.2	Recognize the economic impact of the various process and methods in designing solutions.

Members of Board of Studies

S. NO	NAME	AFFILIATION	ROLE
1.	Dr.V.Rajendran	Professor & Director /ECE	Convener
2.	Dr.S.Karthikeyan	Professor, Department of Electronics and Communication Engineering, Sathyabama Institute of Science &Technology, Chennai.	Academic Expert
3.	Mr.S.O.Dinesh Babu	Director, Samhitha Marine Private Limited, Chennai.	Industrial Expert
4.	Ms.T. Aruna Jacintha	Lecturer, Little Flower Polytechnic, Chennai	Alumni
5.	Dr.S. Jerritta	Professor and Head /ECE	Member
6.	Dr.G. R. Jothilakshmi	Associate Professor/ECE	Member
7.	Dr.Vijayalakshmi.P	Associate Professor/ECE	Member
8.	Mr.C.Arul Stephen	Assistant Professor/ECE	Member
9.	Dr.R.Kumudham	Assistant Professor/ECE	Member

B.E. – ELECTRONICS AND COMMUNICATION ENGINEERING
COURSES OF STUDY AND SCHEME OF ASSESSMENT
(MINIMUM CREDITS TO BE EARNED: 173)

	SEMESTER I	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BSC	Chemistry	3	-	-	3	40	60	100
BSC	Mathematics-I (Calculus and Linear Algebra)	3	1	-	4	40	60	100
ESC	Programming for Problem solving	3	-	-	3	40	60	100
ESC	Basic Civil and Mechanical Engineering	3	-	-	3	40	60	100
ESC	Workshop and Manufacturing Practices	1	-	4	3	40	60	100
BSC	Chemistry Laboratory	-	-	2	1	40	60	100
ESC	Programming for problem solving Laboratory	-	-	2	1	40	60	100
MC	Student Induction Program	-	-	-	-	-	-	-
MC	Universal Human Values **:** Understanding Harmony	3	-	-	3			100
		16	**1**	**8**	**21**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER II	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
HSC	English	2	-	-	2	40	60	100
BSC	Physics(Oscillations Waves and Optics)	3	-	-	3	40	60	100
BSC	Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4	40	60	100
ESC	Basic Electrical and Electronics Engineering	3	-	-	3	40	60	100
ESC	Engineering Graphics &Design	1	-	4	3	40	60	100
HSC	English Laboratory	-	-	2	1	40	60	100
BSC	Physics Laboratory	-	-	2	1	40	60	100
ESC	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1	40	60	100
MC	Constitution of India	**2**	-	-	-			100
		14	**1**	**10**	**18**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER III	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BSC	Mathematics-III (Fourier Series and Transforms)	3	1	-	4	40	60	100
PCC	Signals and Systems	3	-	-	3	40	60	100
PCC	Electronic Devices	3	1	-	4	40	60	100
PCC	Digital System Design	3	1	-	4	40	60	100
PCC	Network Theory	3	-	2	4	40	60	100
PCC	Electronic Devices Laboratory	-	-	2	1	40	60	100
PCC	Digital System Design Lab	-	-	2	1	40	60	100
HSC	Personality Development I (Effective Technical Communication)	2	-	-	2	40	60	100
MC	Basic Life Skills	2	-	-	-			100
		19	**3**	**6**	**23**			

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER IV	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
BSC	Probability and Random Processes	3	1	-	4	40	60	100
PCC	Control Systems	3	-	-	3	40	60	100
PCC	Communication Systems	3	-	-	3	40	60	100
PCC	Analog Electronic Circuits	3	-	-	3	40	60	100
PCC	Linear Integrated Circuits	3	-	2	4	40	60	100
PCC	Communication Systems Laboratory	-	-	2	1	40	60	100
PCC	Analog Electronic Circuits Laboratory	-	-	2	1	40	60	100
HSC	Personality Development II	2	-	-	2	40	60	100
BSC	Environmental Science and Engineering	3	-	-	3	40	60	100
MC	Gender, Institution and Society	2	-	-	-	-	-	100
		22	**1**	**6**	**24**	-	-	-

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER V	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PCC	Electromagnetic Waveguides and Applications	3	1	-	4	40	60	100
PCC	Digital Signal Processing	3	1	-	4	40	60	100
PEC	Professional Elective Course– I	3	-	-	3	40	60	100
OEC	Open Elective Course - I	3	-	-	3	40	60	100
PCC	Microprocessors and Microcontrollers	3	-	2	4	40	60	100
PCC	Electromagnetic Waveguides and Applications Laboratory	-	-	2	1	40	60	100
PCC	Digital Signal Processing Laboratory	-	-	2	1	40	60	100
HSC	Personality Development III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/Mathworks) - Minimum 4 weeks	-	-	4	2			100
		17	**2**	**10**	**24**	-	-	-

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER VI	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PCC	VLSI Design	3	-	-	3	40	60	100
PCC	Computer Networks	3	-	-	3	40	60	100
PEC	Professional Elective Course– II	3	-	-	3	40	60	100
PEC	Professional Elective Course– III	3	-	2	4	40	60	100
OEC	Open Elective Course - II	3	-	-	3	40	60	100
PCC	Computer Networks	-	-	2	1	40	60	100
PCC	VLSI Design Lab	-	-	2	1	40	60	100
HSC	Personality Development - IV	2	-	-	2	40	60	100
PCC	Summer Internship (4 weeks)	-	-	4	2	-	-	100
		17	**0**	**10**	**22**	-	-	-

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER VII	Hours/Weeks				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PCC	Optical and Microwave Engineering	3	-	-	3	40	60	100
OEC	Open Elective Course - III	3	-	-	3	40	60	100
OEC	Open Elective Course - IV	3	-	-	3	40	60	100
PEC	Professional Elective Course– IV	3	-	-	3	40	60	100
PEC	Professional Elective Course– V	3	-	2	4	40	60	100
PCC	Optical and Microwave Laboratory	-	-	2	1	40	60	100
Project	Project Phase I	-	-	8	5	40	60	100
		15	**0**	**12**	**22**	-	-	-

CA - Continuous Assessment, **SEE -** Semester **End Examination**

	SEMESTER VIII	Hours/Week				Maximum Marks		
Category	**Course Title**	**Lecture**	**Tutorial**	**Practical**	**Credits**	**CA**	**SEE**	**Total**
PEC	Professional Elective Course– VI	3	-	-	3	40	60	100
OEC	Open Elective Course - V	3	-	-	3	40	60	100
OEC	Open Elective Course - VI	3	-	-	3	40	60	100
Project	Project Phase II	-	-	20	10	40	60	100
		9	**0**	**20**	**19**	-	-	-

CA - Continuous Assessment, **SEE -** Semester **End Examination**

LIST OF COURSES

HUMANITIES AND SOCIAL SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
HSC – 01	English	2	-	-	2
HSC – 02	English Laboratory	-	-	2	1
HSC – 03	Personality Development I	2	-	-	2
HSC – 04	Personality Development II	2	-	-	2
HSC – 05	Personality Development III	2	-	-	2
HSC – 06	Personality Development IV	2	-	-	2

BASIC SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
BSC - 01	Chemistry	3	-	-	3
BSC - 02	Mathematics I (Calculus and Linear Algebra)	3	1	-	4
BSC – 03	Chemistry Laboratory	-	-	2	1
BSC - 04	Physics (Oscillations, Waves and Optics)	3	-	-	3
BSC - 05	Mathematics II (Calculus, Ordinary Differential Equations and Complex Variable)	3	1	-	4
BSC – 06	Physics Laboratory	-	-	2	1
BSC - 07	Mathematics III (Fourier Series and Transforms)	3	1	-	4
BSC - 08	Mathematics IV (Probability and Random Processes)	3	1	-	4
BSC - 09	Environmental Science and Engineering	3	-	-	3

ENGINEERING SCIENCES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
ESC - 01	Programming for Problem Solving	3	-	-	3
ESC- 02	Basic Civil and Mechanical Engineering	3	-	-	3
ESC – 03	Workshop and Manufacturing Practices	1	-	4	3
ESC – 04	Programming for Problem Solving Laboratory	-	-	2	1
ESC - 05	Basic Electrical and Electronics Engineering	3	-	-	3
ESC – 06	Engineering Graphics & Design	1	-	4	3
ESC – 07	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1

PROFESSIONAL CORE COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PCC-01	Signals and Systems	3	-	-	3
PCC-02	Electronic Devices	3	1	-	4
PCC-03	Digital System Design	3	1	-	4
PCC-04	Network Theory	3	-	2	4
PCC-05	Electronic Devices Laboratory	-	-	2	1
PCC-06	Digital System DesignLaboratory	-	-	2	1
PCC-07	Control Systems	3	-	-	3
PCC-08	Communication Systems	3	-	-	3
PCC-09	Analog Electronic Circuits	3	-	-	3
PCC-10	Linear Integrated Circuits	3	-	2	4
PCC-11	Communication Systems Laboratory	-	-	2	1
PCC-12	Analog Electronic Circuits Laboratory	-	-	2	1
PCC-13	Electromagnetic Waves	3	1	-	4
PCC-14	Digital Signal Processing	3	1	-	4
PCC-15	Microprocessors & Microcontrollers	3	-	2	4
PCC-16	Electromagnetic WaveLaboratory	-	-	2	1
PCC-17	Digital Signal Processing Laboratory	-	-	2	1

PCC-18	**Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/Mathworks) - Minimum 4 weeks**	**-**	**-**	**4**	**2**
PCC-19	**VLSI Design**	**3**	**-**	**-**	**3**
PCC-20	**Computer Networks**	**3**	**-**	**-**	**3**
PCC-21	**Computer Networks Laboratory**	**-**	**-**	**2**	**1**
PCC-22	**VLSI Design Laboratory**	**-**	**-**	**2**	**1**
PCC-23	**Summer Internship (4 weeks)**	**-**	**-**	**4**	**2**
PCC-24	**Optical and Microwave Engineering**	**3**	**-**	**-**	**3**
PCC-25	**Optical and Microwave Laboratory**	**-**	**-**	**2**	**1**

PROFESSIONAL ELECTIVE COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PEC–01	**Antennas and Wave Propagation**	**3**	**-**	**-**	**3**
PEC–02	**Microstrip Antennas**	**3**	**-**	**-**	**3**
PEC–03	**Mobile Communication and Networks**	**3**	**-**	**-**	**3**
PEC–04	**Information Theory and Coding**	**3**	**-**	**2**	**4**
PEC–05	**Adaptive Signal Processing**	**3**	**-**	**-**	**3**
PEC–06	**Digital Image and Video Processing**	**3**	**-**	**2**	**4**
PEC–07	**Wavelet Transforms and Techniques**	**3**	**-**	**2**	**4**
PEC–08	**Introduction to MEMS**	**3**	**-**	**-**	**3**
PEC–09	**Bio-Medical Electronics**	**3**	**-**	**-**	**3**
PEC–10	**CMOS Design**	**3**	**-**	**-**	**3**
PEC–11	**High Speed Electronics**	**3**	**-**	**-**	**3**
PEC–12	**Nano Electronics**	**3**	**-**	**-**	**3**
PEC–13	**Transmission Lines and Waveguides**	**3**	**-**	**-**	**3**
PEC–14	**Electromagnetic Interference and Compatibility**	**3**	**-**	**-**	**3**

PEC–15	**Computer Architecture and Organization**	**3**	**-**	**-**	**3**
PEC–16	**Wireless Networks**	**3**	**-**	**-**	**3**
PEC–17	**Mobile Ad-hoc Networks**	**3**	**-**	**-**	**3**
PEC–18	**Satellite Communication**	**3**	**-**	**-**	**3**
PEC–19	**Wireless Sensor Networks**	**3**	**-**	**-**	**3**
PEC–20	**Cognitive Radio Networks**	**3**	**-**	**2**	**4**
PEC–21	**Cryptography and Network Security**	**3**	**-**	**-**	**3**
PEC–22	**Medical Signal and Image Processing**	**3**	**-**	**2**	**4**
PEC–23	**Embedded Systems**	**3**	**-**	**-**	**3**
PEC–24	**Electronic System Design**	**3**	**-**	**-**	**3**
PEC–25	**Robotics**	**3**	**-**	**-**	**3**
PEC–26	**Optical Network**	**3**	**-**	**2**	**4**
PEC–27	**Under water Communication Systems**	**3**	**-**	**2**	**4**
PEC–28	**Software Defined Networks**	**3**	**-**	**2**	**4**
PEC–29	**High Speed Networks**	**3**	**-**	**-**	**3**
PEC–30	**Quantum Mechanics**	**3**	**-**	**-**	**3**
PEC - 31	**5G and Beyond 5G**	**3**	**-**	**-**	**3**
PEC - 32	**Advanced Mobile Communication**	**3**	**-**	**2**	**4**

PROJECT/DISSERTATION

Code No.	**Course Title**	**Hours / Week**			**Credits**
		Lecture	**Tutorial**	**Practical**	
Project–01	**Project Phase I**	**-**	**-**	**8**	**5**
Project–02	**Project Phase II**	**-**	**-**	**20**	**10**

MANDATORY COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
MC–01	Student Induction Pro Gram	-	-	-	-
MC–02	Universal Human Values: Understanding Harmony	3	-	-	3
MC–03	Constitution of India	2	-	-	-
MC–04	Basic Life Skills	2	-	-	-
MC–05	Gender, Institution and Society	2	-	-	-

OPEN ELECTIVES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
OEC–01	High Speed Networks	3	-	-	3
OEC–02	Mobile Ad-hoc Networks	3	-	-	3
OEC–03	Remote Sensing	3	-	-	3
OEC–04	Robotics	3	-	-	3
OEC–05	Satellite Communication	3	-	-	3
OEC–06	Wireless Sensor Networks	3	-	-	3
OEC–07	Introduction to MATLAB	3	-	-	3
OEC–08	Radar and Navigational Aids	3	-	-	3
OEC–09	Cognitive Radio Networks	3	-	-	3
OEC–10	Cryptography and Network Security	3	-	-	3
OEC–11	Medical Signal and Image Processing	3	-	-	3
OEC–12	VHDL and Verilog HDL Programming	3	-	-	3
OEC–13	Electronic Devices and Circuits	3	-	-	3
OEC–14	Analog and Digital Communication	3	-	-	3
OEC–15	Embedded Systems	3	-	-	3
OEC–16	VLSI Circuits	3	-	-	3
OEC–17	Advanced Digital Signal Processing	3	-	-	3
OEC–18	5G based Internet Of Things	3	-	-	3
OEC–19	Digital Image processing	3	-	-	3
OEC–20	Wavelet Transforms and Techniques	3	-	-	3
OEC–21	Microcontroller based System Design	3	-	-	3
OEC–22	Digital Electronics	3	-	-	3
OEC–23	Digital Signal Processing	3	-	-	3

SEMESTER I

BSC-01	CHEMISTRY	3	0	0	3

COURSE OBJECTIVES:

- To learn about the molecular orbitals, ionic interactions and periodic properties.
- Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electro negativity.
- List major chemical reactions that are used in the synthesis of molecules.

UNIT I ATOMIC AND MOLECULAR STRUCTURE, INTERMOLECULAR FORCES AND POTENTIAL ENERGY SURFACES 9

Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene, benzene and aromaticity. Valence Bond Theory and the energy level diagrams for transition metal ions and their magnetic properties. Ionic, dipolar and van Der Waals interactions, potential energy surfaces of H_3, H_2F and HCN.

UNIT II SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 9

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational, rotational spectroscopy of diatomic molecules, Morse equations and Mossbauer spectroscopy. Applications. Diffraction and scattering

UNIT III USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA 9

Thermodynamic functions: energy, entropy , free energy and fugacity. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

UNIT IV PERIODIC PROPERTIES 9

Variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, diagonal relationship, anomalous behaviour of Lithium, carbon and Nitrogen, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

UNIT V ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE 9

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, Coupling reaction and ring openings. Synthesis of a commonly used drug molecule.

TOTAL: 45 hours

TEXT BOOKS:

T1: Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
T2: Fundamentals of Molecular Spectroscopy, by C. N. Banwell
T3: Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.

REFERENCE BOOKS:

R1: P. W. Atkins, "Physical Chemistry", Oxford University Press, International 11th, Edition, 2018.

R2: K. P. C. Volhardt and N. E.Schore, "Organic Chemistry: Structure and Function ", 5th Edition.
R3: B. H. Mahan, "University chemistry" Pearson Education India, 2009.

WEBLINKS:

W1: https://opentextbc.ca/chemistry/chapter/10-1-intermolecular-forces/
W2: https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod2.pdf
W3: https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Thermodynamics/Chemical_Energetics/Free_Energy_and_Equilibrium
W4: https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Descriptive_Chemistry/Periodic_Trends_of_Elemental_Properties/Periodic_Properties_of_the_Elements
W5: https://www.bcebhagalpur.ac.in/wp-content/uploads/2020/03/Organic-Reactions-Synthesis-of-Drug-Molecule.pdf

COURSE OUTCOMES:

CO1	Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces	**K4**
CO2	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	**K5**
CO3	Analyze bulk properties and processes using thermodynamic considerations.	**K4**
CO4	Classify the properties and reactivity of different types of elements based on the periodic table.	**K5**
CO5	Apply the basic terms involved in an Organic reactions and synthesis of a drug molecule.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	2	1	-	1	-	1	1	-	1	2	-
CO2	-	2	1	1	1	-	-	-	1	-	-	-	-	-
CO3	-	1	1	1	-	-	-	-	-	1	-	-	-	-
CO4	-	1	1	1	-	-	-	-	-	-	-	-	-	1
CO5	-	1	-	1	-	-	1	-	-	-	-	-	-	1
Avg	**2**	**1.2**	**1**	**1.2**	**1**	-	**1**	-	**1**	**1**	-	**1**	**2**	**1**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

BSC-02	MATHEMATICS-I (CALCULUS AND LINEAR ALGEBRA)	3	1	0	4

COURSE OBJECTIVES:

- Explain the prospective engineers with techniques in calculus, multivariate analysis and linear algebra.
- Develop the students with standard concepts and tools at an intermediate to advanced level.

UNIT I CALCULUS 12

Rolle's theorem-Mean value theorems-Taylor's and Maclaurin theorems -Indeterminate forms and L'Hospital's rule-Curvature-radius of curvature – Evolutes and envelopes.

UNIT II MULTIVARIABLE CALCULUS 12

Limits-continuity- partial derivative – total derivative – maxima and minima- saddle points-method of Lagrange multipliers.

UNIT III SEQUENCE AND SERIES 12

Convergence of sequence and series – test for convergence- power series – Comparison test-Root test, D'Alembert's test and Leibnitz's test.

UNIT IV MATRICES 10

Introduction to Matrices- Rank of matrix- Linear systems of equations-symmetric- skew symmetric matrix and orthogonal matrices-Eigen values and Eigen vectors Diagonalization of matrices- Cayley-Hamilton theorem and orthogonal transformation.

UNIT V VECTOR SPACES 14

Vector Space- linear Independence and dependence of vectors, basis, dimension- Linear transformations (maps), range and kernel of a linear map, rank and nullity- Inner product spaces-Gram-Schmidt Orthogonalization.

TOTAL: 60 hours

TEXT BOOKS:

T1: G.B.Thomas and R.L.Finney, Calculus and Analytic geometry, 9thEdition,Pearson,Reprint,2002.

T2: RamanaB.V., Higher Engineering Mathematics,Tata McGraw Hill New Delhi, 11,Reprint,2010.

T3: N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

REFERENCE BOOKS:

R1: P. Sivaramakrishna Das and C. Vijayakumari, Mathematics-I, First Edition, Pearson India Education services Pvt. Ltd.

R2: Erwinkreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley&Sons, 2006.

R3: VeerarajanT. "Engineering Mathematics for first year",TataMcGraw-Hill,NewDelhi,2008.

WEBLINKS:

W1: https://www.khanacademy.org/math/multivariable-calculus/applications-of-multivariable-derivatives/optimizing-multivariable-functions/a/maximums-minimums
W2: https://www.geeksforgeeks.org/rolles-and-lagranges-mean-value-theorem/
W3: https://home.iitk.ac.in/~arlal/MTH102/la.pdf

COURSE OUTCOMES:

CO1	Apply the concept of differential calculus and to evaluate the curvature, radius of curvature and envelope.	**K3**
CO2	Evaluate the concept of limits, continuity and to evaluate derivatives.	**K5**
CO3	Analyze the convergence of the series using root test, D'Alembert's test, Leibniz's test	**K5**
CO4	Determine the concept of limits, continuity and to evaluate derivatives with functions of several variables that is essential in most branches of engineering.	**K5**
CO5	Evaluate the linear independence and dependence of vectors, linear transformations and inner product space.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	2	-	-	-	-	-	-	-	2	2
CO2	3	2	-	2	1	-	-	-	-	-	-	-	3	-
CO3	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	2	2	1	2	-	-	-	-	-	-	-	2	2
Avg	**2.4**	**2.0**	**2.0**	**2.0**	**1.75**	-	-	-	-	-	-	-	**2.2**	**2.0**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		

ESC-01	PROGRAMMING FOR PROBLEM SOLVING	3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of programming – Flow chart, Pseudocode
- To learn the fundamentals of C programming – declarations, operators, expressions and control statements.
- To learn the manipulation of strings, functions, pointers and file operations
- To understand the concepts of arrays, basic sorting and searching algorithms.
- To find the order of time complexity of basic algorithms

UNIT I INTRODUCTION TO PROGRAMMING 9

Introduction to Programming (Flow chart/pseudo code, compilation etc.), Variables (including data types) -Arithmetic expressions and precedence, Conditional Branching and Loops - Writing and evaluation of conditionals and consequent branching - Iteration and loops

UNIT II ARRAYS AND BASIC ALGORITHMS 9

Arrays (1-D, 2-D), Character arrays and Strings, Searching, Basic Sorting Algorithms, Finding roots of equations, Notion of order of time complexity through example programs

UNIT III FUNCTIONS AND POINTERS 9

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Recursion with example programs such as Finding Factorial, Fibonacci series, etc. Pointers- Defining pointers, Use of Pointers in self-referential structures.

UNIT IV STRUCTURES AND UNIONS 9

Structures - Defining structures and Array of Structures, Structures containing Pointers, Unions - Storage classes: auto, static, extern, register – Dynamic memory allocation.

UNIT V STRING FUNCTIONS AND FILES 9

Strings - library string functions, pointers in strings, pointers and function arguments, Files - file Operations, processing a file, Preprocessor directives, use of typedef, Command line arguments, Enumerated data types.

TOTAL: 45 hours

TEXT BOOKS:

T1: Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill, 4th Edition, 2018.

T2: E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill. 3rd Edition, 2015.

REFERENCE BOOKS:

R1: Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language",PrenticeHall of India

R2: YashavantKanetkar, "Let Us C", BPB Publications, BPB Publications, 18th edition, 2021.

R3: Ashok.N.Kamthane, "Computer Programming", Pearson Education India, 3rd edition,2015.

COURSE OUTCOMES:

CO1	Construct a pictorial representation with a stepwise procedure for solving complex Problems	**K3**
CO2	Develop a high-level programming code using C languages	**K3**
CO3	Evaluate the various functional operations for solving problem	**K5**
CO4	Make use of various c operations like array, pointer, strings and searching method	**K3**
CO5	Develop a C module for a given set of instruction	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3	3	-	-	-	-	-	-	-	-	2
CO2	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO4	3	2	1	3	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	3	3	-	-	-	-	-	-	-	-	3
Avg	**2.8**	**2**	**2.2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

ESC-02	**BASIC CIVIL AND MECHANICAL ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To provide the students an illustration of the significance of the Civil and MechanicalEngineering profession in satisfying the societal needs.
- To help students acquire knowledge in the basics of surveying and the materials used for construction.
- To provide an insight to the essentials of components of a building and the infrastructure facilities.
- To explain the component of power plant units and detailed explanation to IC engines their working principles.
- To explain the Refrigeration & Air-conditioning system.

UNIT I PART A: OVERVIEW OF CIVIL ENGINEERING ` 5

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index - Types of buildings: Residential buildings, Industrial buildings.

PART B: OVERVIEW OF MECHANICAL ENGINEERING 4

Overview of Mechanical Engineering - Mechanical Engineering Contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering – Manufacturing, Automation, Automobile and Energy Engineering - Interdisciplinary concepts in Mechanical Engineering.

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying: Objects – Classification – Principles – Measurements of Distances and angles – Leveling – Determination of areas– Contours. Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, Decorative Panels, Water Proofing Materials. Modern uses of Gypsum, Pre-fabricated Building component (brief discussion only)

UNIT III BUILDING COMPONENTS AND INFRASTRUCTURE 9

Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring – Plastering. Types of Bridges and Dams – Water Supply Network - Rain Water Harvesting – Solid Waste Management - Introduction to Highways and Railways - Introduction to Green Buildings.

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 9

Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants- Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of Boilers-Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps, Concept of hybrid engines. Industrial safety practices and protective devices

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner. Properties of air - water mixture, concepts of psychometric and its process.

TOTAL: 45 hours

TEXT BOOKS:

T1: G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw HillEducation; First edition, 2018.

REFERENCE BOOKS:

R1: Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2018.

R2: Ramamrutham S., "Basic Civil Engineering",Dhanpat Rai Publishing Co.(P) Ltd, 2013.

R3: Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.

R4: Shantha Kumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications,Mayiladuthurai 2000.

WEBLINKS:

W1: https://nptel.ac.in/courses/105106201
W2: https://geekztrainerblog.wordpress.com/basic-civil-and-mechanical-engineering/

COURSE OUTCOMES:

CO1	Understanding profession of Civil and Mechanical engineering.	**K2**
CO2	Summarise the planning of building, infrastructure and working of Machineries.	**K2**
CO3	Apply the knowledge gained in respective discipline	**K3**
CO4	Illustrate the ideas of Civil and Mechanical Engineering applications.	**K2**
CO5	Appraise the material, Structures, machines and energy.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	2	2	2	-	-	-	-	-	-	2	1
CO2	1	2	2	3	3	3	-	-	-	-	-	-	3	2
CO3	1	2	2	3	3	3	-	-	-	-	-	-	3	2
CO4	1	2	2	3	3	3	-	-	-	-	-	-	2	3
CO5	2	3	2	2	3	2	-	-	-	-	-	-	2	3
Avg	**1.2**	**2**	**2**	**2.6**	**2.8**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2.2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓		✓		✓	

ESC-03	WORKSHOP AND MANUFACTURING PRACTICES	1	0	4	3

COURSE OBJECTIVES:

- To study bench fitting drawings for making male and female fittings as per the given dimensions and Tolerances.
- To study sheet metal development drawings for making common metal parts/components as per the given dimensions.

LIST OF EXPERIMENTS

MECHANICAL ENGINEERING PRACTICE

1. Welding

To make single V, butt, lap and T fillet joint by arc welding with the back hand and fore hand welding techniques as per the given dimensions.

2. Basic Machining

To make Simple Turning and Taper turning in the lathe.

3. Fitting Work

To make square, hexagonal, V joint in bench fitting as per the given dimensions and Tolerances.

4. Sheet Metal Work

To make simple Cubical blocks, Rectangular trays in sheet metal with the jigs as per the given dimensions.

CIVIL ENGINEERING PRACTICE

1. Buildings

a. Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

2. Plumbing Works

a. Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
b. Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

TOTAL: 45 hours

TEXT BOOKS:

T1: Jeyachandran K., Natarajan S. & Balasubramanian S., A Primer on Engineering Practices Laboratory, Anuradha Publications, 2007.

T2: Jeyapoovan T., Saravanapandian M. & Pranitha S., Engineering Practices Lab Manual, Vikas Publishing House Pvt.Ltd, 2006.

T3: Bawa H.S., Workshop Practice, Tata McGraw, 2007.

REFERENCES:

R1: Rajendra Prasad A. &Sarma P.M.M.S., Workshop Practice, Sree Sai Publication, 2002.

WEBLINKS:

W1: http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3783

W2: https://www.slideshare.net/jeandedieuiyakaremye3/workshop-practice-ii-lecture-notes

COURSE OUTCOMES:

CO1	Experiment with facing, Turning and various types of fitting joint	**K 1**
CO2	Develop the half lap joint, TEE Lap joint carpentry and welding.	**K 5**
CO3	Practice casting, moulding, & smithy trades	**K 2**
CO4	Developments of sheet metal jobs from GI sheets, knowledge of basic concepts of soldering	**K 5**
CO5	Make a Basic pipe connections for Mixed pipe material connection and Pipe connectionswith different joining components	**K 1**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	3	1	2	-	2	-	2	-	1	2	1	2
CO2	3	1	3	1	3	-	2	-	2	-	1	2	2	2
CO3	3	1	3	1	2	-	2	-	3	-	1	2	1	1
CO4	3	1	2	1	2	-	2	-	2	-	1	2	1	1
CO5	3	1	3	1	2	-	2	-	1	-	1	2	2	2
	3	1	2.8	1	2.2	-	2	-	2	-	1	2	1.4	1.6

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
		✓	✓	✓	

BSC-03	CHEMISTRY LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To estimate rate constants of reactions from concentration of reactants/products as a function of time.
  To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- To synthesize a small drug molecule.

LIST OF EXPERIMENTS

1. Determination of the rate constant of a reaction.
2. Determination of the partition coefficient of a substance between two immiscible liquids.
3. Determination of surface tension and viscosity.
4. Thin layer chromatography.
5. Determination of chloride content in water.
6. Determination of cell constant and conductance of solutions.
7. Synthesis of a polymer/drug.
8. Determination of saponification / acid value of an oil.
9. Determination of redox potentials and emf by Potentiometric method.
10. Estimate the adsorption of acetic acid by charcoal.

TOTAL: 30 hours

TEXT BOOKS:

T1: S. Sundaram and K. Raghavan "Practical Chemistry", S. Viswanathan. Co. 3rdedition 2011.

T2: Gnanaprakasam, Ramamurthy, "Organic Chemistry Lab Manual" S. Viswanathan Pvt. Ltd. 3rdedition 2011.

REFERENCE BOOKS:

R1: Vogel's, "Textbook of qualitative organic Analysis",Longmann, 12thedition, 2011.

R2: J. N. Gurtu and R. Kapoor "Advanced experimental Chemistry", S. Chand and Co. 6thedition, 2010.

WEBLINKS:

W1: https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:kinetics/x2eef969c74e0d802:introduction-to-rate-law/v/experimental-determination-of-rate-laws

W2: https://www.youtube.com/watch?v=qdmKGskCyh8

W3: https://www.youtube.com/watch?v=7_6_dKlo67k

COURSE OUTCOMES:

CO1	Estimate the rate constants of reactions and partition coefficient of immiscible liquids.	**K5**
CO2	Find the viscosity and to test the purity of the compound.	**K3**

CO3	Estimate the amount of chlorine content present in drinking water and to know the conductance of a solution	**K5**
CO4	Develop a small drug molecule and to know the saponification of an oil.	**K5**
CO5	Find out the unknown element by Potentiometric method and to remove some of the toxic chemical by charcoal method	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	1	3	1	-	-	-	-	-	-	-	-	-
CO2	-	1	1	2	1	-	-	-	-	-	-	-	1	-
CO3	-	1	2	3	2	3	3	-	-	-	2	-	2	3
CO4	-	1	2	3	3	3	3	-	-	-	2	-	2	2
CO5	-	1	1	2	3	2	1	-	-	-	-	-	2	2
	-	**1**	**1.4**	**2.6**	**2**	**2.67**	**2.33**	**-**	**-**	**-**	**2**	**-**	**1.75**	**2.33**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
		✓	✓	✓	

ESC-04	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To design and develop C Programs for various applications

List of Experiments:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems
5. 1D Array manipulation
6. Matrix problems
7. String operations
8. Simple functions
9. Solving Numerical methods problems
10. 10 .Recursive functions
11. Pointers and structures
12. File operations

TOTAL: 30 hours

TEXT BOOKS:

T1: Byron Gottfried, "Schaum's Outline of Programming with C", McGraw-Hill, 4th Edition, 2018.

T2: E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill. 3rd Edition, 2015.

REFERENCE BOOKS:

R1: Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India

R2: Yashavant Kanetkar, "Let Us C", BPB Publications, BPB Publications, 18th edition, 2021.

R3: Ashok. N.Kamthane, "Computer Programming", Pearson Education India, 3rd edition, 2015.

COURSE OUTCOMES:

CO1	Determine the advanced features of the C language	**K5**
CO2	Develop the model data using primitive and structured types.	**K5**
CO3	Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.	**K4**
CO4	Develops the ability to analyze a problem, develop an algorithm to solve it.	**K5**
CO5	Develops the use of the C programming language to implement various algorithms, and develops the basic concepts and terminology of programming in general.	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	3	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	3	-	-	-	-	-	-	3	1	3
	2.4	2.2	2.2	2.4	2.6	-	-	-	-	-	-	2.2	2.4	2.4

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

MC - 02	UNIVERSAL HUMAN VALUES: UNDERSTANDING HARMONY	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 - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION 9

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 fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT II UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF 9

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 Health; correct appraisal of Physical needs, meaning of Prosperity indetail, Programs to ensure Sanyam andHealth

UNIT III UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP 9

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) 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): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva*as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to worldfamily!.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE 9

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding

Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS 9

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identifythescopeandcharacteristicsofpeople-friendlyandeco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

TOTAL: 45 hours

TEXT BOOKS:

T1: R R Gaur, R Sangal, G P Bagaria, Human Values and Professional Ethics Excel Books, New Delhi, 2010

REFERENCE BOOKS:

R1: Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

R2: E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond &Briggs, Britain.

R3: Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991

R4: Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.

COURSE OUTCOMES:

CO1	Understand the need, basic guidelines, content and process of value education,	**K2**
CO2	Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.	**K2**
CO3	Understand the value human-human relationships and explore their role in ensuring a harmonious society	**K2**
CO4	Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.	**K2**
CO5	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	2	-	-	-	-
CO2	-	-	-	-	-	3	3	2	3	2	-	-	-	-
CO3	-	-	-	-	-	3	3	2	3	2	-	-	-	-
CO4	-	-	-	-	-	3	3	2	3	2	-	-	-	-
CO5	-	-	-	-	-	3	3	2	3	2	-	-	-	-
Avg	-	-	-	-	-	**3**	**3**	**2**	**3**	**2**	-	-	-	-

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓				✓	

SEMESTER II

HSC-01	ENGLISH	2	0	0	2

COURSE OBJECTIVES:

- To acquire ability to speak effectively in real life situations.
- To write letters and reports effectively in formal and business situations.
- To develop listening skills for academic and professional purposes.
- To gain effective speaking and listening skills in communication.
- To develop the soft skills and interpersonal skills to excel in their career.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment procedures.

UNIT I VOCABULARY BUILDING 8

General Vocabulary –Nouns--Compound nouns, Synonyms , Antonyms, Prefixes and Suffixes, Homonyms, Homographs and Homophones, Changing words from one form to another, Acronyms and Abbreviations.-Instructions.

UNIT II BASIC WRITING 8

Sentences structures –Kinds of sentences, Types of sentences, Clauses and Phrases, Punctuations, Blending and Clipping, Framing questions- Yes/No types and "Wh" questions, Summarizing, Precise writing, Paragraph Writing.

UNIT III IDENTIFYING COMMON ERRORS IN ENGLISH 8

Articles, Prepositions, Subject-verb Agreement, Pronouns - Relative pronouns, Demonstrative pronouns, Misplaced Modifiers, Redundancies, Clichés, Infinitives&Gerund , Checklist.

UNIT IV NATURE AND STYLE OF SENSIBLE WRITING 8

Situational Dialogues, Process description, Definitions, Numerical Expressions, Recommendation, Information Transfer- Flow chart Bar chart and Pie chart, ,Writing introduction and conclusion.

UNIT V WRITING PRACTICES 8

Active voice and Passive voice,Making negative sentences ,Tenses,Letter Writing- Formal & Informal Letters, Report Writing- Letter Report, Accident Report, Investigation Report and Survey, Essay writing, Reading Comprehension Passages.

TOTAL: 40 hours

TEXT BOOKS:

T1: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd., Chennai: 2012.

T2: Department of Humanities and Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.

T3: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.

T4: Department of Humanities and Social Sciences, Anna University, ''English for Engineers and Technologists'' Combined Edition (Volumes 1 and 2), Chennai: Orient Longman Pvt. Ltd., 2006.

T5: M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

REFERENCE BOOKS:

R1: Practical English Usage. Michael Swan. OUP. 1995.

R2: Remedial English Grammar. F.T. Wood. Macmillan.2007

R3: On Writing Well. William Zinsser. Harper Resource Book. 2001

R4: Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

R5: Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.

R6: Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

WEBLINKS:

W1: https://ehlion.com/magazine/technical-english/

W2: https://www.kkcl.org.uk/pdf/KKCL_Technical_English_for_Engineers_Brochure.pdf

COURSE OUTCOMES:

CO1	Improve the language proficiency of a technical under-graduate in English with emphasis on Learn, Speak, Read and Write skills.	**K3**
CO2	Develop listening skills for academic and professional purposes	**K3**
CO3	Acquire the ability to speak effectively in English in real life situations	**K2**
CO4	Provide learning environment to practice listening, speaking, reading and writing skills.	**K2**
CO5	Variety of self-instructional modes of language learning and develop learner autonomy.	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	1	-	2	2	-	1	1	-	1	-	-
CO2	2	2	1	2	2	2	1	2	1	3	-	2	-	1
CO3	1	2	1	2	-	2	1	2	2	2	1	2	1	-
CO4	2	1	1	1	1	-	2	-	2	3	-	2	1	1
CO5	1	1	1	1	-	2	-	-	1	2	-	2	-	1
Avg	**1.6**	**1.4**	**1**	**1.4**	**1.5**	**2**	**1.5**	**2**	**1.4**	**2.2**	**1**	**1.8**	**1**	**1**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

BSC-04	PHYSICS (OSCILLATIONS, WAVES AND OPTICS)	3	0	0	3

COURSE OBJECTIVES:

- To learn the basic ideas of oscillations, waves-optics, and lasers.
- To apply these fundamental principles to solve practical problems involving optical systems used in engineering applications.

UNIT I OSCILLATIONS 9

Harmonic oscillator – Differential equation and solution of simple harmonic oscillator – Simple pendulum – damped harmonic oscillator: Equation of motion and its solution, qualitative description of heavy, critical and light damping - Differential equation for forced harmonic oscillator – Forced oscillations.

UNIT II NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES 9

Waves, travelling waves - Characteristics of a waves - Longitudinal and transverse waves- Acoustics, waves and speed of sound- Characteristics of musical sound, quality of tone, decibel- Noise pollution- Acoustics of buildings - Reverberation - Reverberation time – Sabine's formula for reverberation time (derivation).

UNIT III GEOMETRIC OPTICS 9

Fermat's principle of stationary time - Fresnel equations, reflectance and transmittance - Brewster's angle - Total internal reflection – Dispersion - Dispersive power of prism - Defect of lenses - spherical aberration in lens - coma- Achromatic lenses.

UNIT IV WAVE OPTICS 9

Huygens' Principle - Superposition of waves - Young's double slit experiment- Newton's rings- Michelson interferometer - Mach Zehnder interferometer - Fraunhofer diffraction from a single slit and a circular aperture - Plane diffraction grating - Dispersion power and resolving power of grating.

UNIT V LASERS 9

Introduction - Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles - Einstein's theory of matter radiation interaction and A and B coefficients - Population inversion - Different types of lasers: gas lasers (He-Ne, **CO_2**), solid-state lasers (ruby, Neodymium), dye lasers - Applications of lasers in science, engineering and medicine.

TOTAL: 45 hours

TEXT BOOKS:

T1: Mechanics, D. S. Mathur and P. S. Hemne, S. Chand & Co. Pvt Ltd., New Delhi

T2: A text book of waves and oscillations, Brij Lal and N. Subrahmanyam, Vikas Publishing

T3: A text book of optics, M. N. Avadhanulu, Brij Lal and N. Subrahmanyam, S. Chand & Co. Pvt .Ltd.New Delhi

REFERENCE BOOKS:

R1: I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
R2: H. J. Pain, The physics of vibrations and waves, Wiley, 2006.
R3: E. Hecht, "Optics", Pearson Education, 2008.
R4: A. Ghatak, "Optics", McGraw Hill Education, 2012.
R5: O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
R6: N.K. Bajaj, "The Physics of Waves and Oscillations", Tata McGraw-Hill, 1988.
R7: K. Uno Ingard, "Fundamentals of Waves & Oscillations", Cambridge University Press, 1988.

WEBLINKS:

W1: https://nptel.ac.in/courses/115102124
W2: https://nptel.ac.in/courses/122106034

COURSE OUTCOMES:

CO1	Analyze the basic concepts of simple harmonic oscillator.	**K4**
CO2	Identify the remedies for acoustic of building.	**K3**
CO3	Analyze the different types of aberration in lens.	**K4**
CO4	Distinguish between Fresnel and Fraunhofer diffraction.	**K2**
CO5	Classify the different types of lasers and their applications	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	-	-	-	-	-	-	-	1	-
CO2	-	1	1	1	1	3	1	-	-	-	-	-	2	3
CO3	1	1	1	2	1	2	-	-	-	-	-	-	2	1
CO4	-	1	1	1	-	-	-	-	-	-	-	-	1	-
CO5	2	1	2	2	3	2	3	-	-	-	-	-	2	3
Avg	**1.67**	**1.2**	**1.2**	**1.6**	**1.5**	**2.33**	**2**	**-**	**-**	**-**	**-**	**-**	**1.6**	**2.33**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

BSC-05	MATHEMATICS-II (CALCULUS, ORDINARY DIFFERENTIAL EQUATIONSAND COMPLEX VARIABLE)	3	1	0	4

COURSE OBJECTIVES:

- To learn deal with advanced level of mathematics and applications that would be essential for their disciplines.
- To introduce the fundamental ideas of the functions of complex variables and developing a clear understanding of fundamental concepts of Complex Analysis.

UNIT I **MULTIVARIABLE CALCULUS (INTEGRATION) 12**

Multiple Integration: Double integrals (Cartesian)-change of order of integration in double integrals-Change of variables (Cartesian to polar)- Triple integrals(Cartesian)-orthogonal curvilinear coordinates- Green, Gauss and Stokes theorems (statement only)-Simple problems.

UNIT II FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 12

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT III ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER 12

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials,

UNIT IV COMPLEX VARIABLE –DIFFERENTIATION 12

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

UNIT V: COMPLEX VARIABLE-INTEGRATION 12

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula(without proof)-Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine.

TOTAL: 60 hours

TEXT BOOKS:

T1: G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson,Reprint,2002.

T2: S.L. Ross, Differential Equations, 3rd Edition, Wiley dia 1984.

T3: E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice HalIndia,1995.

T4: N.P. Bali and Manish Goyal, A text bookof Engineering Mathematics, Laxmi Publications, Reprint,2008.

T5: B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36thEdition,2010.

REFERENCE BOOKS:

R1: Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons,2006.

R2: E.L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.

R3: J.W. Brown and R.V. Churchill, "Complex Variables and Applications", 7th Edition., Mc-Graw Hill, 2004.

R4: W.E. Boyce and R.C. DiPrima, "Elementary Differential Equations and Boundary ValueProblems", 9th Edn.,Wiley India, 2009.

WEBLINKS:

W1: https://nptel.ac.in/courses/111105134
W2: https://nptel.ac.in/courses/111108081
W3: https://nptel.ac.in/courses/111106100
W4: https://nptel.ac.in/courses/111107111
W5: https://nptel.ac.in/courses/111103070
W6: https://nptel.ac.in/courses/111106141

COURSE OUTCOMES:

CO1	Apply integral calculus to improper integrals.	**K3**
CO2	Analyze the Applications of Differential equations in engineering	**K4**
CO3	Extend the ordinary differential equation for learning advanced Engineering Mathematics.	**K2**
CO4	Create the functions of several variables that is essential in most branches of engineering.	**K6**
CO5	Decide the essential tool of complex variable (Integration) in engineering.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	-	-	-	-	-	2	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	-	-	2	-
CO3	2	-	-	2	2	-	-	-	-	-	3	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO5	3	3	3	3	3	-	-	-	-	-	3	-	3	-
Avg	**2.6**	**2.75**	**2.75**	**2.6**	**2.4**	-	-	-	-	-	2.66	**-**	**2.33**	**3**

ASESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

ESC-05	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

- To obtain basic knowledge on electrical quantities such as current, voltage, power and energy.
- To provide employability skill of adequate working knowledge on basic DC and AC circuits used in electrical and electronic devices. To understand the working principle, construction, applications of DC machines, AC machines & measuring instruments.

UNIT I DC CIRCUITS 9

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, Mesh and Nodal analysis, Analysis of simple circuits with dc excitation, Wye↔Delta Transformation, Superposition, Thevenin and Norton Theorems.

UNIT II AC CIRCUITS 9

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT III TRANSFORMERS 9

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT IV ELECTRICAL MACHINES AND POWER CONVERTERS 9

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Construction of Single phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. DC-DC buck and boost converters, duty ratio control. Single phase Bridge Rectifier, Single Phase voltage source inverters.

UNIT V BASICS OF ELECTRONICS 9

Intrinsic semiconductors, Extrinsic semiconductors – P-type and N-type, P-N junction, VI Characteristics of PN junction diode, Zener effect, Zener diode, Zener diode Characteristics. Binary Number System — Boolean Algebra theorems– Logic gates- Introduction to sequential Circuits– Flip-Flops**.**

TOTAL:45 hours

TEXT BOOKS:

T1: D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

T2: D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, 2020.

T3: D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2ndedition ,2019.

T4: John Bird, "Electrical Circuit theory and technology", Routledge; 5thedition,2013

REFERENCE BOOKS:

R1: L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

R2: E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

R3: V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

WEBLINKS:

W1: https://www.electricaltechnology.org/category/basic-electrical-fundamentals

W2: https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES:

CO1	Understand and analyse DC circuits	**K2**
CO2	Understand and analyse AC circuits	**K2**
CO3	Explain the construction, operation and characteristics of transformer and classify the types of three –phase transformer connections.	**K3**
CO4	Understand and examine the various electrical machines and converter circuits	**K2**
CO5	Identify the basics of electronics	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1	1	1	2	1	-	-	1	-	1	3	2
CO2	3	3	1	1	2	-	-	-	-	1	-	2	3	1
CO3	2	1	2	2	1	3	3	2	-	2	1	1	-	2
CO4	2	-	1	1	1	3	2	1	-	2	2	1	1	2
CO5	2	1	1	1	1	2	0	-	-	1	-	1	2	1
	2.20	**2.00**	**1.20**	**1.20**	**1.20**	**2.50**	**1.50**	**1.50**	**-**	**1.40**	**1.50**	**1.20**	**2.25**	**1.60**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

ESC-06	ENGINEERING GRAPHICS & DESIGN	1	0	4	3

COURSE OBJECTIVES:

- To familiarize the students in basic concept of conic sections, projections and developments of objects.
- To develop the imagination and drafting skills of students and pictorial projections.

UNIT I DIMENSIONING AND GEOMETRICAL CONSTRUCTION 12

BIS - Lettering - Two systems of dimensioning, Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid, Epicycloid, Hypocycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

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

UNIT III PROJECTION OF SOLIDS 12

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

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

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

UNIT V ORTHOGRAPHIC PROJECTION AND ISOMETRIC PROJECTION 12

General principles of orthographic projection – Need for importance of multiple views and their placement - layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones.

TOTAL: 60 hours

TEXT BOOKS:

T1: Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

T2: Parthasarathy N.S. and Vela Murali, "Engineering Drawing", Oxford University Press, New Delhi, 1st Edition,2015.

REFERENCE BOOKS:

R1: Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 31st Edition,2018.
R2: Basant Agrawal and Agrawal C.M., "Engineering Drawing, Tata McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2013.

WEBLINKS:

W1: https://nptel.ac.in/courses/112103019
W2: https://alison.com/course/diploma-in-engineering-drawing-and-computer-graphics

COURSE OUTCOMES:

CO1	Sketch the drawing standards, conventions, and practices in engineering drawing	**K1**
CO2	Draw the orthographic projections of points, straight lines and plane surfaces for solving some of the engineering problems in day-to-day applications.	**K1**
CO3	Sketch the orthographic projections for the points, straight lines or solids using the change of position method.	**K1**
CO4	Draw projections of sectioned solids and development of lateral surfaces and apply the concept to simple sheet metal work.	**K6**
CO5	Draw the isometric projections for the given solids and combination of solids using box method and create 3D models	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	-	2	-	-	-	-	3	-	2	2	1
CO2	2	3	2	-	2	-	-	-	-	3	-	3	2	3
CO3	2	2	2	-	2	-	-	-	-	3	-	2	2	2
CO4	2	2	2	-	2	-	-	-	-	3	-	2	2	2
CO5	2	2	2	-	2	-	-	-	-	3	-	3	2	2
	2	2	2	-	2	-	-	-	-	3	-	2.4	2	2

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓		✓		✓	

HSC-02	ENGLISH LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To enable the student to explore the knowledge in communication skills.
- To gain knowledge in the process of Placement Interviews, Group Discussions and other recruitment procedures.

LIST OF EXPERIMENTS

1. Introduction to English sounds
2. Consonants and vowels
3. Syllable and Stress
4. Intonation
5. Communication Skills
6. Summarizing
7. Report Writing
8. Information Transfer
9. Presentation Skills
10. Group Discussion
11. Letter Writing
12. Cover letter and Resume

TOTAL: 30 hours

TEXT BOOKS:

T1: Department of English, Anna University, Mindscapes, 'English for Technologists and Engineers', Orient Longman Pvt. Ltd, Chennai: 2012.

T2: M.AshrafRizvi, "Effective Technical Communication", Tata McGraw-Hill Publishing Company Limited, New Delhi.2009.

REFERENCE BOOKS:

R1: Michael Swan. "Practical English Usage", Oxford University Press ,1995.

R2: Sanjay Kumar and PushpLata, "Communication Skills" Oxford University Press. 2011.

R3: Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

WEBLINKS:

W1: https://onlinemasters.ohio.edu/blog/engineering-communication/

W2: https://online.rice.edu/courses/communication-skills-for-engineers-specialization

COURSE OUTCOMES:

CO1	Distinguish various listening & written contexts for understanding the implied meanings and responding to them accordingly.	**K2**
CO2	Use appropriate pronunciation and rhythm of spoken language in oral communication.	**K2**
CO3	Draft and interpret the written communication in officialcontexts like narrative, descriptive, creative, critical and analytical reports.	**K5**
CO4	Infer implied meanings of different genres of texts and critically analyze and evaluate them for ideas, as well as for method of oral presentation.	**K4**
CO5	Make use of suitable communicative strategies to express their point of views convincingly in any type of discussions, negotiation and conversations.	**K3**

MAPPING OF PROGRAM OUTCOMES WITH COURSE OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	2	-	-	-	-	-	-	2
CO2	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO3	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO4	3	2	1	1	3	1	3	3	-	-	-	-	-	3
CO5	3	2	1	1	3	1	3	3	-	-	-	-	-	3
	2.8	1.8	1	-	2.8	-	-	-	-	-	-	-	-	2.8

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

BSC-06	**PHYSICS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To enable the student to explore the field of Properties of Matter and Optics.
- To gain knowledge in the scientific methods and learn the process of measuring different Physical variables.

List of Experiments

1. Determination of Rigidity Modulus – Torsional pendulum
2. Determination of wavelength and particle size using laser
3. Ultrasonic Interferometer
4. Determination of band gap of a semiconductor material
5. Hooke's law – Determination of spring constant
6. Determination of Young's Modulus – Uniform Bending
7. Determination of Young's Modulus – Non Uniform Bending

8. Determination of Viscosity of a liquid - Poiseuille's method
9. Spectrometer – Grating
10. Deflection Magnetometer - Tan A position
11. Deflection Magnetometer - Tan B position
12. Potentiometer - Calibration of low range Voltmeter

TOTAL: 30 hours

TEXT BOOKS:

T1:C. C. Ouseph, U. J. Rao, V. Vjiayendran, Practical Physics,1st Edition, 2015.

T2: Biswajit Saha, Practical Physics Book, LAP LAMBERT Academic Publishing, 1st Edition, 2020.

REFERENCE BOOKS:

R1: G.L. Squires, Practical Physics, 4th Edition, Cambridge University Press, 2001.

R2: Chattopadhyay, P.C. Rakshit, B. Saha, "An Advanced Course in Practical Physics", 2nd ed., Books & Allied Ltd., Calcutta, 1990.

WEBLINKS:

W1: http://amrita.olabs.edu.in/?sub=1&brch=5&sim=155&cnt=2

W2: https://vlab.amrita.edu/index.php?sub=1&brch=280&sim=1509&cnt=4

COURSE OUTCOMES:

CO1	Measure the wavelength and particle size of semiconductor diode laser.	**K5**
CO2	Analyze the wavelength of spectral lines using spectrometer	**K4**
CO3	Estimate the band gap energy of given semiconductor material.	**K5**
CO4	Determine the compressibility of the liquid using ultrasonic interferometer.	**K4**
CO5	Measure the Young's modulus of the given solid materials.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	1	2	3	3	2	2	-	-	-	-	-	2	2
CO2	-	1	1	2	-	-	-	-	-	-	-	-	1	-
CO3	-	1	2	3	2	2	2	-	-	-	-	-	2	2
CO4	-	1	1	2	1	-	-	-	-	-	-	-	1	-
CO5	-	1	2	3	3	2	-	-	-	-	-	-	2	2
Avg	-	1	1.6	2.6	2.25	2	2	-	-	-	-	-	1.6	2

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
		✓	✓	✓	

ESC-07	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To provide comprehensive idea about AC and D C circuit analysis, working principles and applications of basic machines in electrical engineering.
- To expose the students to learn experimental skills about Transformers,DC Motor, Converters.

LIST OF EXPERIMENTS

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter,ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage, phase-to-neutral voltage, line and phase currents).
5. Load Characteristics of a DC Motor
6. Torque - Slip Characteristic of an Induction motor
7. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
8. Demonstration of DC-DC Converter.
9. Demonstration of DC-AC converter.
10. Demonstration of AC-DC converter.

TOTAL: 30 hours

TEXT BOOKS:

T1: D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.

T2: D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.

T3: John Bird, "Electrical Circuit theory and technology", Routledge; 5thedition,2013

REFERENCE BOOKS:

R1: L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.

R2: E. Hughes, "Electrical and Electronics Technology," Pearson, 2010.

R3: V. D. Toro, "Electrical Engineering Fundamentals," Prentice Hall India, 1989 Text book 1

WEBLINKS:

W1: https://www.electricaltechnology.org/category/basic-electrical-fundamentals

W2: https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/

COURSE OUTCOMES:

CO1	Understand the basic safety precautions and learn to make use of measuring instruments.	**K2**
CO2	Analyse the steady state response of R-L, R-C circuits.	**K3**
CO3	Experiment with loading of transformer to measure the primary and secondary voltages, currents and power and classify the different types of transformer connections.	**K3**
CO4	Understand and Experiment with single phase induction motor and three phase induction motor.	**K2**
CO5	Demonstrate DC-DC, DC-AC and AC-DC converters.	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO 2	3	2	2	3	2	-	-	-	-	-	-	-	3	3
CO 3	3	3	2	3	3	-	-	-	-	-	-	-	3	3
CO 4	3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO 5	3	3	3	3	3	-	-	-	-	-	-	-	3	3
Avg	**3**	**2.6**	**2.4**	**2.8**	**2.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.8**	**2.8**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

MC - 03	**CONSTITUTION OF INDIA**	**2**	**0**	**0**	**0**

COURSE OBJECTIVES:

- The purpose of the course is to acquaint the students with basic principles of the Constitution of India and its working.
- To help students be familiar with the historical and significant aspects of the constitution of India.
- To make students aware of their fundamental duties and rights.
- To know about central and state government functionalities in India.

UNIT I NATURE, OBJECT AND SCOPE OF THE CONSTITUTION 6

Nature, object and scope of Constitutional Law and Constitutionalism – Historical Perspective of the Constitution of India – Salient Features and Characteristics of Constitution of India.

UNITII FUNDAMENTAL RIGHTS 6

Nature and scope of Fundamental Rights – Scheme of Fundamental Rights – Right to Equality – Right to Freedom of Speech and Expression – Right to Life – Right against Exploitation – Right to Religious Freedom – Minority Rights.

UNIT III DIRECTIVE PRINCIPLES OF STATE POLICY AND FUNDAMENTAL DUTIE 6

Directive Principles of State Policy – Importance and Implementation – Scheme of Fundamental Duties and its Legal Status.

UNIT IV FEDERAL STRUCTURE 6

Federal Structure – Distribution of Legislative and Financial Powers between the Union and the States – Parliamentary Form of Government in India – Constituent Powers and Status of the President of India.

UNITV AMENDMENT AND EMERGENCY PROVISIONS 6

Amendment of the Constitution – Procedure – Historical Perspective of the Constitutional Amendments in India – Emergency Provisions – National Emergency – President Rule – Financial Emergency – Local Self Government – Constitutional Scheme in India.

TOTAL: 30 hours

TEXT BOOKS:

T1: V.N. Shukla, Constitutional Law of India

T2: D.D. Basu, Commentary on the Constitution of India

T3: J.N. Pandey, Constitution of India

T4: Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

T5: R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

T6: Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.

T7: K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCES BOOKS:

R1: V.D. Mahajan, "Constitutional Law of India",State Mutual Book & Periodical Service, Limited, 1991.

R2: H.M. Seervai, "Constitution of India",Universal Law Publishing - An imprint of LexisNexis, 4thEdition, 2015

R3: Sharma, Brij Kishore, "Introduction to the Constitution of India",Prentice Hall of India, New Delhi.

R4: U.R.Gahai, "Indian Political System", New Academic Publishing House, Jalaendhar.

R5: R.N. Sharma, "Indian Social Problems",Media Promoters and Publishers Pvt. Ltd.

WEBLINKS:

W1: https://www.writinglaw.com/constitution-pdf-download/
W2: https://www.academia.edu/33739388/The_Constitution_of_India_Bare_Acts_
W3: https://en.wikipedia.org/wiki/Constitution_of_India

COURSE OUTCOMES:

CO1	Elaborate the constitution of India and its salient features.	**K2**
CO2	Know the fundamental rights and duties.	**K1**
CO3	Discuss the Parliamentary Form of Government in India.	**K4**
CO4	Recognize the Directive Principles of State Policy.	**K2**
CO5	Understand and abide the rules of the Indian constitution and to appreciate different culture among the people.	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO 1	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO 2	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO 3	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO 4	-	-	-	-	-	3	3	2	-	-	-	-	-	-
CO 5	-	-	-	-	-	3	3	2	-	-	-	-	-	-
Avg	-	-	-	-	-	**3**	**3**	**2**	-	-	-	-	-	-

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

SEMESTER III

BSC-07	MATHEMATICS-III (FOURIER SERIES AND TRANSFORMS)	3	1	0	4

COURSE OBJECTIVES:

- To learn the concept of Fourier Series and Transforms for various functions in the given interval.
- To Solve the boundary value problems using finite and infinite transforms

UNIT I FOURIER SERIES 12

Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series- Parseval's identity – Harmonic Analysis.

UNIT II FOURIER TRANSFORM 12

Fourier integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem Parseval'sidentity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations - singular integrals- Solutions of standard types of first order partial differential equations – Lagrange's linear equation -Linear partial differential equations of second and higher order with constant coefficients of homogeneous functions.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification PDE-Method of separation of variables – One dimensional wave equation and One dimensional heat equation of heat conduction – Steady state solution of two-dimensional heat equation of heat conduction (square plate only)

UNIT V Z -TRANSFORM AND DIFFERENCE EQUATIONS 12

Z-transform –Introduction- properties – Inverse Z-transform(using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using Z- transform.

TOTAL: 60 hours

TEXT BOOKS:

T1: Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, Delhi, 43rdEdition, 2013.

T2: Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill PublishingCompany, New Delhi, 6threprint,2008.

T3: SivaramakrishnaDas.P&Vijayakumari.C, A Text book of Engineering Mathematics-III.

REFERENCE BOOKS:

R1: Bali.N.P. and Manish Goyal. "A Textbook of Engineering Mathematics", LaxmiPublications, 9th Edition,2011.

R2: ErwinKreyszig, "Advanced Engineering Mathematics", Wiley India, 9thEdition, 2011.

R3: Glyn James, "Advanced Modern Engineering Mathematics", PearsonEducation,3rdEdition, 2012.

WEBLINKS:

W1: https://nptel.ac.in/courses/111107098

W2: https://nptel.ac.in/courses/111106046

W3: https://nptel.ac.in/courses/111106111

W4: https://www.youtube.com/watch?v=lkAvgVUvYvY

W5: https://www.youtube.com/watch?v=1JnayXHhjlg

COURSE OUTCOMES:

CO1	Develop Fourier series for different types of functions.	**K3**
CO2	Analyze the transforms for various functions.	**K4**
CO3	Identify the basic concepts of Partial differential equations for solving standardPartial differential equations.	**K3**
CO4	Analyze the heat flow problemsused in various situations.	**K4**
CO5	Identifythe applications of z-transforms and its properties for various functions.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	-	-	-	1	1	-	1	-	-
CO2	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO3	2	1	1	1	2	-	-	-	-	1	-	1	2	-
CO4	1	1	1	1	2	-	-	-	-	1	-	1	1	1
CO5	1	1	1	1	2	-	-	-	-	1	-	1	2	3
Avg	**1.6**	**1**	**1**	**1**	**1.8**				**1**	**1**		**1**	**1.75**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PCC - 01	SIGNALS AND SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To study the properties and representation of discrete and continuous signals.
- To study and analyse continuous time system using CTFT and Laplace transform
- To study and analyse discrete systems using z–transforms.
- To study the analysis and synthesis of discrete time systems.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Classification of Signals: Continuous time signals and Discrete time signals: Unit step, Unit ramp, Unit impulse, Unit impulse function – Periodic and Aperiodic signals – Symmetric (Even) and Anti-Symmetric odd signals – Energy and power signals – Complex exponential and Sinusoidal signals.

Classification of Systems: Continuous time systems and Discrete time systems – linear and non-linear systems, Time invariant and time-variant systems, causal and non causal systems.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Continuous-time Fourier Transform (CTFT) – Properties of the CTFT – Inverse Continuous-time Fourier Transform - Laplace Transform – S - plane, region of convergence, properties - Inverse Laplace Transform.

UNIT III LINEAR TIME INVARIANT –CONTINUOUS TIME SYSTEMS 9

Solution of Differential equation: Natural response, forced response, Total response – Convolution Integral - Impulse response: systems connected in series / parallel – Analysis and characterization of Linear Time Invariant (LTI) system using Laplace transform (LT) methods.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Discrete time Fourier transform (DTFT) and its properties - Z–transform: Definition, ROC of finite duration sequence, properties of ROC – properties of Z–transform– Inverse Z transform: Partial fraction method.

UNIT V LINEAR TIME INVARIANT – DISCRETE TIME SYSTEMS 9

Solution of Difference equations: Zero-input response, Zero-state response, Total response, Block diagram representation: Direct Form I, Direct Form II, cascade form - State variable model for discrete time system.

TOTAL:45 hours

TEXT BOOKS:

T1: A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 2015.

T2: R.F. Ziemer, W.H. Tranter and D.R. Fannin, “Signals and Systems - Continuous and Discrete”, 4thedition, Prentice Hall, 1998.

T3: B.P. Lathi, “Signal Processing and Linear Systems”, Oxford University Press,1998.

T4: Douglas K. Lindner, “Introduction to Signals and Systems”, McGraw Hill International Edition: c1999.

T5: Simon Haykin, Barry van Veen, “Signals and Systems”,John Wiley and Sons (Asia) Private Limited, c1998.

REFERENCE BOOKS:

R1: Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.

R2: J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

R3: P.Ramesh Babu, R.Anandanatarajan, Signals and Systems, 4th edition, Scitech Publications(India) PVT LTD, 2018.

WEBLINKS:

W1: https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011

W2: https://onlinecourses.nptel.ac.in/noc21_ee28/preview

COURSE OUTCOMES:

CO1	Classify and differentiate different types of signals and systems.	**K2**
CO2	Apply Fourier Transform and Laplace Transform along with their properties and analyze continuous time signals.	**K3**
CO3	Analyse Z transform and its variants like Unilateral and Bilateral Z transform, inverse Z-transform, their Region of convergence and properties.	**K4**
CO4	Simplify Linear Time Invariant Continuous Time (LTI CT) system in terms of differential equation and understand its impulse and frequency response.	**K4**
CO5	Evaluate discrete time systems using state variable equations and matrix representation**.**	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO 1	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO 2	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO 3	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO 4	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO 5	3	2	1	2	1	-	-	-	-	-	-	2	2	3
Avg	**3**	**2**	**1**	**2**	**1**	-	-	-	-	-	-	**2**	**2**	**3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PCC– 02	ELECTRONIC DEVICES	3	1	0	4

COURSE OBJECTIVES:

- To gain insights about basic electronic devices.
- To be familiar with the theory, construction, and operation of Basic electronic devices.

UNIT I INTRODUCTION TO SEMICONDUCTOR PHYSICS 12

Review of Quantum Mechanics, Energy Quanta, Wave-Particle Duality, the Uncertainty Principle, Schrodinger's Wave Equation. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity.

UNIT II SEMICONDUCTOR DIODES 12

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

UNIT III BIPOLAR JUNCTION AND FIELD EFFECT TRANSITORS 12

Bipolar Junction Transistor, Study of CE, CB and CC configurations and comparison of their characteristics – MOSFET, I-V characteristics, Enhancement and depletion types–structure and operation – comparison of BJT with MOSFET, small signal models of MOS transistor.

UNIT IV POWER AND DISPLAY DEVICES 12

Unijunction Transistor, Silicon controlled rectifier,Diac, Triac, Light-emitting diode (LED), Liquid-crystal display,Photo transistor, Photo diode, Opto Coupler, Solar cell -Working Principle -V-I-characteristics and Applications.

UNIT V INTEGRATED CIRCUIT FABRICATION PROCESS 12

Silicon Wafer Preparation, Epitaxial Growth, Oxidation, Photolithography - Chemical vapor deposition, Sputtering, diffusion, Ion implantation, Isolation techniques, Metallization, Assembly Processing and Packaging - Twin-tub CMOS process.

TOTAL: 60 hours

TEXT BOOKS:

T1: G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th Edition,Pearson,2014.

T2: D. Neamen,D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education

T3: S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd Edition, John Wiley&Sons, 2006.

REFERENCE BOOKS:

R1: C.T. Sah, "Fundamentals of Solid-Stateelectronics," World Scientific Publishing Co. Inc,1991.

R2: Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," OxfordUniv.Press, 2011.

WEBLINKS:

W1: http://www.rtna.ac.th/departments/elect/Data/EE306/Electronic%20Devices%20and%20Circuit%20Theory.pdf

W2: https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_ECE_EDC%20NOTES.pdf

COURSE OUTCOMES:

CO1	Explain the quantum mechanics and its principles, Energy band, drift current	**K2**
CO2	Analyze the characteristics of PN junction diode, Zener diode and Schottky diode	
CO3	Interpret the equivalent circuits of Bipolar Junction Transistors and Field effect transistors	**K5**
CO4	Design the basic electronic devices such as Power control devices, LED, LCD and other Opto-electronic devices.	**K6**
CO5	Explain the processes involved in circuit fabrication	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	3	3
CO2	3	3	2	2	-	-	-	-	2	2	2	2	3	2
CO3	3	2	3	2	-	-	-	-	2	2	2	2	3	1
CO4	2	2	3	3	-	-	-	-	3	2	2	3	2	3
CO5	2	3	3	2	-	-	-	-	3	2	3	2	2	2
Avg	**2.6**	**2.6**	**2.6**	**2.2**	-	-	-	-	**2.6**	**2.2**	**2.4**	**2.4**	**2.6**	**2.2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PCC – 03	DIGITAL SYSTEM DESIGN	3	1	0	4

COURSE OBJECTIVES:

- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.

UNITI LOGIC GATES, BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES 12

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De-Morgan's Theorem, Minimum of Boolean Expressions, Minterm, Maxterm, Sum Of Products (SOP) & Product Of Sums (POS) forms, Canonical forms, Karnaugh maps, Quin McCluskey method of minimization

UNIT II COMBINATIONAL LOGIC DESIGN 12

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Adder, Parallel Subtractor, Look Ahead Carry Generator, BCD Adder, Code Converters, Magnitude Comparator, Multiplexer, Demultiplexer, Encoder, Decoder.

UNIT III SEQUENTIAL LOGIC DESIGN 12

Flip Flop design: S-R, JK, D and T Flip Flop, Realization of Flip flops, Counters: Modulo N Counter, UP/DOWN Counter, Ripple Counter, Ring Counter, Shift registers- SISO, SIPO, PIPO, PISO and Universal Shift Register, Algorithmic State Machines Charts, Cycles, Races, Hazards.

UNIT IV MEMORIES, PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES 12

Memories: ROM, PROM, EPROM, EEPROM, RAM, Static RAM cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM CELL. Programmable logic devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA). Logic Families: TTL, ECL, CMOS.

UNIT V VHDL CONCEPTS IN DIGITAL DESIGN 12

Design entry: Different modelling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modelling, VHDL constructs and codes for combinational and sequential circuits.

TOTAL:60 hours

TEXT BOOKS:

T1: R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.

T2: Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.

T3: M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd.2003.

T4: M. Morris Mano, Digital Design, ,Pearson Education (Singapore) Pvt. Ltd., New Delhi,3rd Edition 2003.

REFERENCE BOOKS:

R1: W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.

R2: D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.

R3: Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition2012.

R4: Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

WEBLINKS:

W1: www.tutorialspoint.com/digital_electronics/index.asp

W2: www.coertvonk.com/hw/logic/synchronous-sequential-logic-30712

COURSE OUTCOMES:

CO1	Explain the quantum mechanics and its principles, Energy band, drift current	**K2**
CO2	Analyze the characteristics of PN junction diode, Zener diode and Schottky diode	**K4**
CO3	Interpret the equivalent circuits of Bipolar Junction Transistors and Field effect transistors	**K5**
CO4	Design the basic electronic devices such as Power control devices, LED, LCD and other Opto-electronic devices.	**K6**
CO5	Explain the processes involved in circuit fabrication	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**P O4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO3	1	3	3	2	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	1	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	1	2	2	2
Avg	**2**	**2.2**	**2.2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.6**	**2**	**2**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PCC-04	**NETWORK THEORY**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuits using network theorems
- To introduce the phenomenon of resonance and coupled circuits.
- To understand the transient response of circuits.
- To analyze circuits using Laplace Transform

UNIT I BASIC CIRCUIT ANALYSIS 9

Resistive elements, Ohm's Law, Resistors in series and parallel circuits, Kirchhoff's laws, Node and Mesh Analysis, matrix approach of network containing voltage and current sources, andreactances.

UNIT II NETWORK THEOREMS AND REDUCTION FOR DC AND ACCIRCUIT 9

Voltage and current division, source transformation, duality, star delta conversion, Thevenin's and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Tallegen's theorem, Reciprocity Theorem, Millman's theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance –frequency response – Quality factor and Bandwidth – Self and mutual inductance – Coefficient of coupling and energy concepts– Tuned circuits – Single tuned circuits– – Introduction to Transformers and its working principle.

UNIT IV TRANSIENT RESPONSE ANALYSIS 9

Analysis of Transient responses of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input, step input response and analysis of steady state and transient stability ofCircuit.

UNIT V LAPLACE TRANSFORMS AND PROPERTIES 9

Partial fractions,Analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms, evaluation of initial conditions.

TOTAL: 45 hours

TEXT BOOKS:

T1: Van, Valkenburg, "Network analysis",Prentice Hall of India, 2000.

T2: Sudhakar, A., Shyammohan, S. P., "Circuits and Network"; Tata McGraw-Hill NewDelhi, 1994.

REFERENCE BOOKS:

R1: A William Hayt, "Engineering Circuit Analysis" 9thEdition, McGraw-Hill Education, 2019.

R2: S P Ghosh and A. K. Chakraborty, "Network Analysis & Synthesis", McGraw-Hill, 2009.

WEBLINKS:

W1: https://docs.google.com/file/d/0B_O5jg0LZ_ZXSGNYc0FWTzRXYWc/edit?resourcekey=0-3B21KThG10DTXELVyg_BPg

W2: https://archive.nptel.ac.in/courses/108/105/108105159/

W3: https://gateschool.co.in/content/prepare-network-theory-gate-electronics-communication-engineering/

COURSE OUTCOMES:

CO1	Understand the fundamentals of Circuit analysis using basic laws.	**K2**
CO2	Apply the knowledge for Network reductionusing different theorem.	**K3**
CO3	Analyze the performance of resonance and coupled circuits.	**K4**
CO4	Evaluate the transient response of RL,RC and RLC circuits	**K5**
CO5	AnalyzeRC, RL, and RLC networks with and without initial conditions using Laplace transforms	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO2	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO3	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO4	2	2	2	2	2	-	-	-	1	1	-	-	2	2
CO5	2	2	2	2	2	-	-	-	1	1	-	-	2	2
Avg	**2**	**2**	**2**	**2**	**2**	-	-	-	**1**	**1**	-	-	**2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PCC– 05	ELECTRONIC DEVICES LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To study and experiment the behaviour of diode, BJT and FET, optoelectronic devices.
- To verify practically the characteristics of various semiconductor devices.

LIST OF EXPERIMENTS

1. PN Junction Diode Characteristics.
2. Zener Diode Characteristics.
3. Zener Diode as a Voltage Regulator.
4. Half Wave Rectifier with and without filter.
5. Full Wave Rectifier with and without filter
6. Characteristics of CE configuration.
7. Characteristics of CB configuration.
8. Characteristics of Photodiode and Phototransistor.
9. FET Characteristics.
10. UJT Characteristics.

TOTAL: 30 hours

TEXT BOOKS:

T1: G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.

T2: D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.

T3: S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley&Sons, 2006.

REFERENCE BOOKS:

R1: C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc,1991.

R2: Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," OxfordUniv.Press, 2011.

R3: Salivahanan S., Suresh Kumar. N. and Vallavaraj A., Electronic Devices and Circuits, 2nd Edition, TMH, 2007.

WEBLINKS:

W1: https://nptel.ac.in/courses/117103063

W2: https://nptel.ac.in/courses/108108112

COURSE OUTCOMES:

CO1	Experiment with various diodes and determine the characteristics.	**K3**
CO2	Evaluate the performance of Zener diode as voltage regulator.	**K5**
CO3	Analyze the characteristics of CE, CC and CB transistors.	**K4**
CO4	Compare the characteristics of photodiodes and phototransistors.	**K5**
CO5	Analyze the characteristics of FET, UJT.	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO2	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO3	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO4	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO5	3	2	1	2	1	-	-	-	-	-	-	1	2	3
Avg	**3**	**2**	**1**	**2**	**1**	-	-	-	-	-	-	**1**	**2**	**3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

PCC – 06	DIGITAL SYSTEM DESIGN LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To provide students with an understanding of how to analyze, build, and troubleshoot digital circuits.
- To understand the relationships between combination logic and Boolean algebra, and between sequential logic and finite state machines;
- To analyze and design combinational logic circuits at the transistor level
- To design and implement the synchronous and asynchronous sequential circuits.

LIST OF EXPERIMENTS

1. Study of logic gates
2. Verification of Boolean logic theorems
3. Implementation of Half and Full Adder/Subtractor using logic gates.
4. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
5. Design and implementation of code converters using logic gates
    a. BCD to excess–3 code and vice versa
    b. Binary to gray and vice–versa
6. Design and verification of Magnitude Comparator using logic gates
7. Design of 16 bit odd/even parity checker generator using IC74180.
8. Design and implementation of Multiplexer and De-multiplexer using logic gates
9. Design and implementation of encoder and decoder using logic gates
10. Construction and verification of Mod N Counters
11. Implementation of SISO, SIPO, PISO and PIPO shift registers
12. Simulation of combinational circuits using VHDL programs
13. Simulation of sequential circuits using VHDL programs

TOTAL: 30 hours

TEXT BOOKS:

T1: R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4thedition, 2009.

T2: Douglas Perry, "VHDL", Tata McGraw Hill, 4thedition, 2002.

T3: M. Morris Mano, Digital Design, 3rdEdition, Prentice Hall of India Pvt. Ltd.2003.

T4: M. Morris Mano, "Digital Design",Pearson Education (Singapore) Pvt. Ltd., New Delhi,3rdEdition 2003.

REFERENCE BOOKS:

R1: W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2ndedition, 2006.

R2: D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.

R3: Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2ndedition2012.

R4: Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

WEBLINKS:

W1: www.tutorialspoint.com/digital_electronics/index.asp

W2: www.coertvonk.com/hw/logic/synchronous-sequential-logic-30712

W3: www.tutorialspoint.com/digital_circuits/digital_circuits_multiplexers.htmL

W4: www.circuitglobe.com/half-adder-and-full-adder-circuit.html

COURSE OUTCOMES:

CO1	Experiment with logic gates and verify the truth table.	**K3**
CO2	Examine and verify the working of combinational logic circuits.	**K4**
CO3	Analyze the working of Code Convertors using logic gates.	**K4**
CO4	Develop Shift registers & Counters using logic gates.	**K3**
CO5	Evaluate the performance of combinational and logical circuits using VHDL programs.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO2	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO3	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO4	2	2	2	2	2	-	-	-	2	2	2	2	2	2
CO5	2	2	2	2	1	-	-	-	2	2	2	2	2	2
Avg	**2**	**2**	**2**	**2**	**1.8**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

HSC-03	**PERSONALITY DEVELOPMENT I**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To nurture and develop winning personalities and eventually leading them to become dynamic and socially responsible leaders
- To avoid negative spiritual experiences it's important to keep the balance between spiritual and physical life.
- To guide and orient students into becoming effective and exceptional communicators

UNIT I SOFT SKILLS I 6

Introduction to Personality Development – Meaning–Features of personality – Dimensions of Personality Determinants of Personality–Features and Traits– Components of self concept– Barriers–Self analysis

UNIT II SOFT SKILLS II 6

Importance of Soft Skills – First impression–Work Place requirements–Discipline –Cleanliness Hygiene –general Appearance—Building Confidence—Concept of Thinking and Usage – Value of Time–Focus & Commitment.

UNIT III SOFT SKILLS IN ACTION 6

Grooming – Attire – Understanding others – Stability & Maturity Development – Strength's – Weakness – Opportunities–threats – Merits of SWOT Analysis – Components – how to convert weakness into strengths – Goal Settings

UNIT IV SELF AWARENESS AND SELF ESTEEM 6

Definitions – Components of Self Awareness – Developing Self Awareness – Self esteem – meaning –Steps to improve Self Esteem.

UNIT V SELF MOTIVATION 6

Motivation – Meaning –Techniques of self-motivation–Motivation & goal setting – Motivation and emotion – Motivation at work.

TOTAL: 30 hours

TEXT BOOKS:

T1: Barun Mitra, "Personality Development and Soft Skills", Oxford University Press, 2012.

T2: Stephen R. Covey "The 7 Habits of Highly Effective People Powerful Lessons in Personal Change", Simon & Schuster, 2013.

T3: V Bastin Jerome, Alagra Antony "Soft Skills for Career Success",Educreation Publishing, 2018.

REFERENCE BOOKS:

R1: Nathan C. & Thomas Goetz, "Emotion, motivation and Self-Regulation", Hall, McGill University.

R2: Jossey – Bass, Nathaniel Branden, Nash "Psychology of Self-esteem", 1st edition.

R3: Heidi R. Thomas, "Influences and Importance of Self-Awareness, Self-Evaluation and Self-Esteem, Psychology Research Progress, 2022.

R4: D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021.

WEBLINKS:

W1: http://www.osou.ac.in/eresources/Soft-Skills-ccs04.pdf

W2: https://www.static-contents.youth4work.com/university/Documents/Colleges/CollegeSummaryAttach/29f57018-6412-4dee-b24b-ac29e54a0f9e.pdf

W3: https://acs.dypvp.edu.in/NAAC/Personality-Development-Vishal-Gaikwad-BBA.pdf

W4: https://www.bib.irb.hr/1182399/download/1182399.978-1-68507-532-3.pdf

W5: http://www.wright.edu/~scott.williams/LeaderLetter/selfawareness.html

W6: http://www.al-edu.com/wp-content/uploads/2014/05/TheMotivationalHandbook.pdf

COURSE OUTCOMES:

CO1	Summarize the features, Traits, dimensions and determinants of personality	**K2**
CO2	Develop and make a good first impression in professional and other situations	**K3**
CO3	Develop and make use of qualitative Skills like confidence, punctuality to improve the quality of commitment as an engineer	**K3**
CO4	Set goals for development and Criticize using SWOT analysis	**K5**
CO5	Develop self-awareness and improve self esteem	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO1	PO1	PSO	PSO

	1	2	3	4	5	6	7	8	9	0	1	2	1	2
CO 1	-	-	-	-	1	2	2	-	3	3	1	2	2	2
CO 2	-	-	-	-	2	2	2	2	3	3	1	2	3	2
CO 3	-	-	-	-	2	2	2	2	3	3	2	2	3	2
CO 4	-	-	-	-	2	2	2	2	3	2	1	2	2	3
CO 5	-	-	-	-	2	2	3	2	3	2	2	2	3	1
Avg	-	-	-	-	**1.8**	**2**	**2.2**	**2**	**3**	**2.6**	**1.4**	**2**	**2.6**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

MC – 04	BASIC LIFE SKILLS	2	0	0	0

COURSE OBJECTIVE:

- To provide value education to improve the students' character, understanding of principled life, physical health, maintaining youthfulness, measures and methods in five aspects of life.

UNIT I PHYSICALHEALTH 6

Manavalakalai (SKY) Yoga: Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.Simplified Physical Exercises: Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.Yogasanas: Pranamasana – HasthaUttanasana - PadaHasthasana – AswaSanjalana Asana – ThuvipathaasvaSanjalana asana – AstangaNamaskara - Bhujangasana–AthaMukthaSavasana – AswaSanjalana Asana - PadaHasthasana–HasthaUttanasana - Pranamasana.Pranayama: Naddisuddi - Clearance Practice - Benefits.

UNIT II LIFE FORCE 6

Reasons for Diseases - Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds). Philosophy of Kaya kalpa - Physical body - Sexual vital fluid - Life force -Bio-Magnetism - Mind. Maintaining youthfulness. Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid Measure and method in five aspects of life - Controlling undue Passion.Kayakalpa practice - Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

UNIT III MENTAL HEALTH 6

Mental Frequencies - Beta, Apha, Theta and Delta wave - Agna Meditation explanation - benefits. Shanthi Meditation explanation – Benefits - Thuriya Meditation explanation –

Benefit. Benefits of Blessing - Self blessing (Autosuggestion) - Family blessing - Blessing the others - World blessing - Divine protection

UNIT IV VALUES 6

Human Values Self-control - Self-confidence - Honesty Contentment - Humility – Modesty Tolerance - Adjustment - Sacrifice – ForgivenessPurity (Body, Dress, Environment) -Physical purity - Mental purity- Spiritual puritySocialValues:Non-violence– ServicePatriotism – EqualityRespect for parents and elders - care and protection - Respect for teacher Punctuality - Time Management.

UNIT V MORALITY (VIRTUES) 6

Importance of Introspection - I - Mine (Ego, Possessiveness).Six Evil Temperaments - Greed - Anger - Miserliness - Immoral sexual passion - Inferiority and superiority Complex – Vengeance.Maneuvering of Six Temperaments - Contentment - Tolerance - Charity - Chastity - Equality - Pardon (Forgiveness).Five essential Qualities acquired through Meditation: Perspicacity - Magnanimity - Receptivity - Adaptability – Creativity. Improved Memory Power - Success in the Examination.

TOTAL: 30 hours

TEXT BOOKS:

T1: Vethathiri Maharishi, Yoga for Modern Age, Vethathiri Publications, Erode,16th Ed..2013.

T2: Vethathiri Maharishi, Simplified Physical Exercises, Vethathiri Publications, Erode,2014.

T3: Vethathiri Maharishi, "Kayakalpam",Vethathiri Publications, Erode,3rd Edi.2014.

T4: Rev.Dr.G.U. Pope, Thirukkural, Giri Trading Agency,2016

T5: Vethathiri Maharishi, Mind, Vethathiri Publications, Erode,1994.

REFERENCE BOOKS:

R1: Chandrasekaran.K, Sound Health through yoga, Sedapati, Tamilnadu, Premkalyan Publications,1999.

R2: Iyengar, B.K.S., "Light on Yoga", Noida, UP India, Harber Collins Publishing India Ltd., 2008.

R3: K. R. Dhanalakshmi and N. S. Raghunathan, "Personality Enrichment, Margham Publications.

WEBLINKS:

W1: https://ncert.nic.in/pdf/publication/otherpublications/tiyhwlups1.pdf.

W2: https://yogabog.com/sites/default/files/files/Iyengar_B_K_S__The_Illustrated_Light_On_Yoga.pdf

COURSE OUTCOMES:

CO1	Utilize skills developed through participation in Manavalakalai (SKY) Yoga to help maintain lifelong health and fitness.	**K2**
CO2	Demonstrate foundational standing, sitting, balance postures with proper alignmentand maintain youthfulness through kaya kalpa practice.	**K3**
CO3	Explore relaxation techniques to observe thoughts and to manage emotions and stress, and reflect on those techniques which are most effective to them.	**K2**
CO4	Demonstrate an understanding of anatomy and physiology as it applies to the intentional integration of breath, postures, and movement within the practice of yoga to understand the human values.	**K3**
CO5	Achieve a greater sense of awareness, wisdom, introspection, and a deeper sense	**K3**

	of relaxation through meditation to keep up morality in life.	

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO2	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO3	-	-	-	-	-	3	3	2	3	-	-	3	2	-
CO4	-	-	-	-	-	3	2	2	3	-	-	3	2	-
CO5	-	-	-	-	-	3	3	3	3	-	-	3	2	-
Avg	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**	**-**	**-**	**3**	**2**	**-**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

SEMESTER IV

BSC-08	MATHEMATICS-IV (PROBABILITY AND RANDOM PROCESS)	3	1	0	4

COURSE OBJECTIVES:

- To develops the mathematical theory of random variables and random processes forTelecom Engineers.
- To apply the theoretical concepts and techniques for solving problems that arises in practice.

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables — Moment generating functions and their properties – Binomial – Poisson – Geometric – Uniform – Exponential and Normal distributions

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and regression – Central limit theorem

UNIT III CLASSIFICATION OF RANDOM PROCESSES 12

Definition and examples – First order – Second order – Strictly stationary – Wide-sense stationary and Ergodic process – Markov process – Poisson and Normal process – Sine wave process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITY 12

Auto correlation – Cross correlation – Properties – Power spectral density – Cross spectral density – Properties – Wiener-Khintchine relation – Relationship between cross power spectrum and cross correlation function .

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 12

Linear Time Invariant System – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of Input and Output – White Noise.

TOTAL: 60 hours

TEXT BOOKS:

T1: Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", 1st Indian Reprint, Elsevier, 2007.

T2: Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", 4th Edition, TMH Publishers, 2002.

REFERENCE BOOKS:

R1: Miller, S.L. and Childers, S.L., "Probability and Random Processes with Applications to Signal Processing and Communications", 1st Indian Reprint, Elsevier Inc., 2007.

R2: Stark, H. and Woods, J.W., "Probability and Random Processes withApplications to Signal Processing", 3rd Edition, Pearson Education, 2002.

R3: Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", 8th Edition, TMH, 2004.

WEBLINKS:

W1: https://nptel.ac.in/courses/117105085

W2: https://nptel.ac.in/courses/117103067

W3: http://nptel.iitm.ac.in

COURSE OUTCOMES:

CO1	Determine the distributions of functions of random variables.	**K5**
CO2	Apply moment generating and Characteristic functions.	**K3**
CO3	Understand the classifications of random processes and concepts such asStrict stationary, wide-sense stationary and ergodicity&Markov chains.	**K2**
CO4	Analyze the concepts of correlation functions and power spectral density.	**K4**
CO5	Apply the concepts of filtering and prediction of a random process	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	2	3	2	-	-	-	-	-	3	-	-	3
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	2	3	3	2	2	-	-	-	-	-	3	-	3	3
Avg	**2.60**	**2.33**	**2.50**	**2.66**	**2.00**	-	-	-	-	-	3	-	**2.33**	**3.00**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

PCC-07	**CONTROL SYSTEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the elements of control system and their modelling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To Characterize any system in Laplace domain to illustrate different specification of the system using transfer function concept.

UNIT I INTRODUCTION TO CONTROL SYSTEM MODELING 9

Basic building blocks of Control System – Open loop and Closed loop systems – Differential equation – Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems – Block diagram reduction Techniques – Signal flow graph

UNIT II TIME RESPONSE ANALYSIS 9

Time response analysis – First Order Systems – Impulse Response analysis of second order systems –step response system of second order system, Steady state errors – P, PI, PD and PID Compensation Analysis using MATLAB

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response – Bode Plot, Polar Plot, Nyquist Plot – Frequency Domain specifications from the plots – Constant M and N Circles – Nichol's Chart – Use of Nichol's Chart in Control System Analysis. Series, Parallel, series–parallel Compensators – Lead, Lag, and Lead Lag Compensators.

UNIT IV STABILITY ANALYSIS 9

Stability, Routh–Hurwitz Criterion – Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram – Nyquist Stability Criterion – Relative Stability. Analysis using MATLAB.

UNIT V STATE VARIABLE ANALYSIS & DIGITAL CONTROL SYSTEMS 9

State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations – Concepts of Controllability and Observability – State space representation for Discrete time systems. Sampled Data control systems – Sampling Theorem

TOTAL: 45 hours

TEXT BOOKS:

T1: J.Nagrath and M.Gopal,"Control System Engineering", New Age International Publishers, 6thEdition, 2017.

T2: K. Ogata, 'Modern Control Engineering', 5thedition, Pearson Education, New Delhi, PHI, 2015.

REFERENCE BOOKS:

R1: Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7thEdition, 2014.

R2: M. Gopal, Digital "Control and State Variable Methods," 2ndEdition, TMH, 2007.

R3: Schaum's Outline Series, "Feedback and Control Systems' Tata Mc-Graw Hill, 2007.

R4: John J. D'azzo& Constantine H. Houpis, "Linear Control System Analysis and design",Tata Mc-GrawHill, Inc., 2003.

R5: Richard C. Dorf& Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 2010.

WEBLINKS:

W1: https://nptel.ac.in/courses/107106081

W2: https://nptel.ac.in/courses/108103007

W3: https://nptel.ac.in/courses/108103007

W4: https://www.vidyalankar.org/gate/assets/docs/notes/ec-control.pdf

W5: https://www.vssut.ac.in/lecture_notes/lecture1423904331.pdf

COURSE OUTCOMES:

CO1	Explain the fundamentals of control systems and different transitional and rotational mechanical system	**K2**
CO2	Analyze the methods of time domain response in first order and second order systems	**K5**
CO3	Analyze the time and frequency-domain response of first and second-order systems using plots and charts	**K5**
CO4	Analyze the Performance stability analysis using various methods	**K5**
CO5	Analyze different sampling theorems and state variable analysis of continuous and discrete time system Characterize a system and find its study state behavior.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	2	2	2	1	2	-	-	-	-	-	-	1	2	2
CO 2	2	2	2	1	-	-	-	-	-	-	-	1	2	2
CO 3	2	2	2	1	-	-	-	-	-	-	-	1	2	2
CO 4	3	2	2	1	-	-	-	-	-	-	-	1	2	3
CO 5	2	2	2	1	2	-	-	-	-	-	-	1	2	3
Avg	**2.2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**2.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

PCC-08	**COMMUNICATION SYSTEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To analyze various Amplitude, Angle and Pulse modulation systems.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.
- To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To understand baseband and band pass signal transmission and reception techniques.

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theoryof Amplitude Modulation – Evolution and Description of DSB, SSB and VSB

Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II BASEBAND FORMATTING TECHNIQUESFORDIGITAL COMMUNICATION 9

Introduction to Analog Pulse Communication Systems – Digital Communication Systems – Performance Measure; Geometric representation of Signals, Bandwidth, Noise trade off, Sampling –Quantization -Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM), Differential pulse code modulation, Delta modulation, Adaptive delta modulation

UNIT III BANDPASS SIGNAL TRANSMISSION AND RECEPTION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV BASEBAND RECEPTION TECHNIQUES 9

Noise in Communication Systems; Receiving Filter – Correlator type, Matched Filter type; Equalising Filter- Signal and system design for ISI elimination, Implementation of Equalizing filter, Eye Pattern analysis; Synchronisation- symbol Synchronisation, carrier Synchronisation.

UNIT V BASEBAND CODING TECHNIQUES 9

Error Control Codes - Block Codes, Cyclic codes, Convolutional Codes, Classification of line codes, desirable characteristics, and power spectra of line codes, viterbi algorithm.

TOTAL: 45 hours

TEXT BOOKS:

T1: Haykin S., "Communications Systems", John Wiley and Sons, 2001.

T2: Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

T3: Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", Kluwer Academic Publishers, 2004.

T4: Proakis J.G., "Digital Communications", 4th Edition, McGraw Hill, 2000.

REFERENCE BOOKS:

R1: Taub H. and Schilling D.L., "Principles of Communication System", Tata McGraw Hill, 2001.

R2: Wozencraft J. M. and Jacobs I. M. "Principles of Communication Engineering", John Wiley, 1965.

WEBLINKS:

W1: https://web.stanford.edu/class/ee179/Notes.html

W2: https://www.skylineuniversity.ac.ae/pdf/computer/An%20Introduction%20to%20Digital%20Multimedia.pdf

COURSE OUTCOMES:

CO1	Demonstrate generation and detection of Analog modulation techniques	**K2**
CO2	Analyze and design the various Pulse Modulation Techniques.	**K4**
CO3	Compare the different digitalmodulation techniques.	**K5**
CO4	Construct the filter and solution for inter symbol interference in band limited channels in digital communications.	**K3**
CO5	Discuss different parameters of source coding techniques and error control coding techniques	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO2	3	3	2	3	-	-	-	-	2	2	2	2	3	2
CO3	3	2	2	2	-	-	-	-	2	2	2	2	2	2
CO4	3	2	3	3	-	-	-	-	3	2	2	3	3	3
CO5	3	3	3	3	-	-	-	-	3	2	3	2	3	3
Avg	**3**	**2.6**	**2.4**	**2.6**	-	-	-	-	**2.6**	**2.2**	**2.4**	**2.4**	**2.6**	**2.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

PCC – 09	**ANALOG ELECTRONIC CIRCUITS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To help students design and analyze amplifier circuits using small – signal equivalent circuits and determine gain, input impedance and output impedance.
- To be familiar with power amplifiers, tuned amplifiers.

UNIT I MIDBAND ANALYSIS OF SMALL SIGNAL AMPLIFIERS 9

CE, CB and CC amplifiers – Method of drawing small signal equivalent circuit – Mid-band analysis of various types of single stage amplifiers to obtain gain, input impedance and output impedance – Comparison of CB, CE and CC amplifiers and their uses. Basic emitter coupled differential amplifier circuit :- DC analysis, AC analysis- Differential gain, Common Mode Gain, CMRR - Differential amplifier with active loading.

UNIT II FREQUENCY RESPONSE OF AMPLIFIERS 9

General shape of frequency response of amplifiers – Low frequency response of Transistor Amplifier: Effect of Emitter Bypass capacitor on low frequency response-Hybrid π equivalent circuit of BJT – High frequency analysis of BJT amplifiers: CE short circuit current gain, cut off frequency – fα, fβ and Gain Bandwidth Product – FET model at high Frequency: Common Source (CS) amplifier at high frequencies, Common Drain (CD) amplifier at high frequencies.

UNIT III LARGE SIGNAL AMPLIFIERS 9

Classification of amplifiers, Class A large signal amplifiers, transformer–coupled class A audio power amplifier – efficiency of Class A amplifiers. Class B amplifier – efficiency – push–pull amplifier – complementary–symmetry (Class B) push–pull amplifier, Class C amplifier.

UNIT IV FEEDBACK & TUNED AMPLIFIERS 9

Basic concept of feedback-Effects of negative feedback –types of negative feedback connections – voltage-series, voltage-shunt, current series, current shunt, Tuned amplifiers: Q-factor– Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – large signal tuned amplifiers: Class C tuned amplifier.

UNIT V OSCILLATORS 9

Classification, Barkhausen Criterion – General form of an LC Oscillator: Hartley, Colpitts - RC phase shift oscillators using cascade connection of low pass filters and high pass filters – Crystal oscillators: Quartz Crystal Construction, Electrical equivalent circuit of Crystal, Miller and Pierce Crystal oscillators.

TOTAL:45 hours

TEXT BOOKS:

T1: J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 2017.

T2: P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 2015.

T3: A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College.

REFERENCE BOOKS:

R1: Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9thEdition, Pearson Education / PHI, 2007.

R2: Salivahanan S., Suresh Kumar. N. and Vallavaraj A., Electronic Devices and Circuits, 2ndEdition, TMH, 2007.

WEBLINKS:

W1: https://semiengineering.com/knowledge_centers/integrated-circuit/ic-types/analog-circuits

W2: https://nptel.ac.in/courses/108102112

COURSE OUTCOMES:

CO1	Analyse CE, CB, CC amplifiers using small signal equivalent circuits.	**K4**
CO2	Perform high frequency analysis of BJT and FET amplifiers and determine its gain.	**K5**
CO3	Classify Class A, class B, class AB, class C and class D amplifiers on the basis of their operation and working.	**K4**
CO4	Analyse various types of negative feedback amplifiers and tuned amplifiers.	**K4**
CO5	Evaluate various LC, RC, Crystal oscillators and estimate its frequency.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	1	1	2	1	-	-	-	-	-	-	1	2	2
CO 2	3	1	1	2	1	-	-	-	-	-	-	1	2	2
CO 3	3	1	1	2	1	-	-	-	-	-	-	1	2	2

CO 4	3	1	1	2	1	-	-	-	-	-	-	1	2	2
CO 5	3	1	1	2	1	-	-	-	-	-	-	1	2	2
Avg	**3**	**1**	**1**	**2**	**1**	-	-	-	-	-	-	**1**	**2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

PCC – 10	LINEAR INTEGRATED CIRCUITS	3	0	2	4

COURSE OBJECTIVES:

- To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs.

UNITI IC FABRICATION 9

IC classification, fundamentals of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance and FETs.

UNIT II APPLICATIONS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; Instrumentation amplifier frequency response of OP-AMP; Basic applications of op-amp – summer, differentiator and integrator.

UNIT III CHARACTERISTICS OF OPAMP 9

Instrumentation amplifier, first and second order active filters, V/I & I/V converters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV SPECIAL ICs 9

555 Timer circuit – Functional block, characteristics & applications; 566-voltage controlled oscillator circuit; 565 – phase lock loop circuit functioning and applications, Analog multiplier ICs.

UNIT V APPLICATION ICs 9

IC voltage regulators - LM317, 723 regulators, switching regulator, MA 7840, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, Opto coupler, opto electronic ICs.

TOTAL: 45 hours

TEXT BOOKS:

T1: Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", 4th edition, Pearson Education, 2003 / PHI.(2000)

T2: Roy Choudhary, D.andSheilB.Jani, "Linear Integrated Circuits", 2nd Edition, New Age, 2003.

REFERENCE BOOKS:

R1: JacobMillman, Christos C.Halkias, "Integrated Electronics - Analog and Digital circuits system", Tata McGraw Hill, 2003.

R2: Robert F.Coughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education, 4th edition, 2002 / PHI.

R3: David A.Bell, "Op-amp & Linear ICs", Prentice Hall of India, 2nd edition, 1997

WEBLINKS:

W1: https://ekeeda.com/degree-courses/electronics-and-telecommunication-engineering/linear-integrated-circuits

W2: https://www.udemy.com/course/linear-integrated-circuits-and-applications-for-all-levels

COURSE OUTCOMES:

CO1	Explain the various processes involved in IC fabrication	**K2**
CO2	Analyse the DC , AC characteristics and frequency response of operational amplifiers	**K4**
CO3	Analyze the input and output signal of clippers, clampers, peak detector, S/H circuit, D/A converter,A/D converter and Design of filters using operational amplifier	**K4,K6**
CO4	Compare the working of various lCs and its application	**K4**
CO5	Illustrate the function of application specific ICs such as Voltage regulators, power amplifier, opto coupler etc	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	-	2	2	-	-	-	-	-	2	1
CO2	2	-	2	2	-	2	1	-	-	-	-	-	2	2
CO3	2	2	2	2	-	2	2	-	-	-	-	-	3	2
CO4	3	2	2	3	-	3	2	-	-	-	-	-	3	3
CO5	2	2	2	3	-	3	3	-	-	-	-	-	3	3
Avg	2.4	1.75	2	2.2	-	2.4	2	-	-	-	-	-	2.6	2.2

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

PCC – 11	COMMUNICATION SYSTEMS LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To visualize the effects of sampling and TDM
- To Implement AM & FM modulation and demodulation
- To implement PCM & DM
- To implement FSK, PSK and DPSK schemes

LIST OF EXPERIMENTS:

1. Amplitude modulation and Demodulation techniques.
2. Frequency Modulation and Demodulation techniques.
3. Pulse Modulation – PAM / PWM / PPM.
4. Pulse Code Modulation.
5. Delta Modulation, Adaptive Delta Modulation.
6. Digital Modulation & Demodulation – ASK, PSK, QPSK, FSK (Hardware & MATLAB)
7. Designing, Assembling and Testing of Pre–Emphasis / De–emphasis Circuits.
8. Line Coding/ Error Control Coding (Hardware & MATLAB)
9. Sampling & Time Division Multiplexing
10. Frequency Division Multiplexing.

TOTAL: 30 hours

TEXT BOOKS:

T1: Haykin S., "Communications Systems", John Wiley and Sons, 2001.

T2: Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

T3: Barry J. R., Lee E. A. and Messerschmitt D. G,"Digital Communication", Kluwer Academic Publishers, 2004.

T4: Proakis J.G, "Digital Communications", 4th Edition, McGraw Hill, 2000.

REFERENCE BOOKS:

R1: Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.

R2: Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering", John Wiley, 1965.

WEBLINKS:

W1: https://wiki.analog.com/university/labs/comms

W2: https://www.academia.edu/36017552/ANALOG_and_DIGITAL_COMMUNICATION_LAB_MANUAL

COURSE OUTCOMES:

CO1	Examine various modulation and demodulation techniques with experiment.	**K4**
CO2	Distinguish and explore the working of various pulse modulation techniques.	**K4**
CO3	Analyze and distinguish the working of Pre–Emphasis / De–emphasis Circuits.	**K4**

CO4	Evaluate various Error control coding schemes.	**K5**
CO5	Analyze and explore the working of TDM and FDM	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	3	2	2	-	-	-	-	3	3	3	3	2	2
CO 2	3	3	2	3	-	-	-	-	3	3	2	2	3	2
CO 3	3	2	2	2	-	-	-	-	3	2	2	2	2	2
CO 4	3	2	3	3	-	-	-	-	3	3	2	3	3	3
CO 5	3	3	3	3	-	-	-	-	3	2	3	2	3	3
Avg	**3**	**2.6**	**2.4**	**2.6**	**-**	**-**	**-**	**-**	**3**	**2.6**	**2.4**	**2.4**	**2.6**	**2.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

PCC– 12	**ANALOG ELECTRONIC CIRCUITS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To study the characteristics of CE, CB and CC Amplifiers, differential amplifiers.
- To obtain the frequency response of small signal amplifiers.
- To study the characteristics of large signal amplifiers.
- To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.

LIST OF EXPERIMENTS:

1. BJT Common Emitter Amplifier using voltage divider bias (self–bias).
2. BJT Common Collector Amplifier using voltage divider bias (self–bias).
3. Differential amplifier using BJT.
4. Class A Power Amplifier.
5. Class B complementary–symmetry (push-pull) Amplifier.
6. Current Series feedback amplifiers.
7. Voltage Shunt feedback amplifiers.
8. RC Phase shift oscillator.
9. Hartley Oscillator.
10. Colpitts Oscillator.

TOTAL: 30 hours

TEXT BOOKS:

T1: J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.

T2: P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.

T3: Roy Choudhary, DandSheilB. Jani, "Linear Integrated Circuits", 2nd Edition, New Age, 2003.

T4: Robert F.Coughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education, 4th edition, 2002 / PHI.

REFERENCE BOOKS:

R1: Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 9th Edition, Pearson Education / PHI, 2007.

R2: Salivahanan S., Suresh Kumar. N. and Vallavaraj A., Electronic Devices and Circuits, 2nd Edition, TMH, 2007.

WEBLINKS:

W1: https://semiengineering.com/knowledge_centers/integrated-circuit/ic-types/analog-circuits

W2: https://nptel.ac.in/courses/108102112

COURSE OUTCOMES:

CO1	Analyse the frequency response CB, CE and CC amplifiers and determine its gain and bandwidth.	**K4**
CO2	Design and analyze large signal amplifiers and plot its frequency response.	**K4,K6**
CO3	Analyse and estimate the midband gain of feedback amplifiers.	**K4**
CO4	Construct and evaluate the frequency of LC Oscillators.	**K5,K6**
CO5	Construct and evaluate the frequency of RC Oscillators.	**K5,K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO2	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO3	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO4	3	2	1	2	1	-	-	-	-	-	-	1	2	3
CO5	3	2	1	2	1	-	-	-	-	-	-	1	2	3
Avg	**3**	**2**	**1**	**2**	**1**	-	-	-	-	-	-	**1**	**2**	**3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

HSC-04	**PERSONALITY DEVELOPMENTII**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To help students be socially responsible and ethical citizens.
- To inculcate the need to lead a healthy lifestyle and manage stress
- To improve leadership quality
- To improve physical aspects of personality/posture & Good team spirit

UNIT I SOFT SKILLS III 6

Basic Etiquette – Email etiquette – Business etiquette – Telephone etiquette – Meeting etiquette – Adjustment of Role & Leadership – Team Management & Development

UNIT II QUANTITATIVE APTITUDE I 6

Percentage – Profit Loss –Discount – Ratio Proportion – Time & Work – Time, Speed & Distance. Problems relating to ages– Permutation & Combination–Probability

UNIT III QUANTITATIVE APTITUDE II 6

Mensuration – Clocks and Calendars – Boats – Simple Interest – Compound Interest – Fractions and Decimals – Square roots – Functions.

UNIT IV ANALYTICAL PROBLEMS 6

Introduction – Linear Sequencing – Seating Arrangements – Distribution/Double Line Up – Selection – Ordering and Sequencing – Binary Logic – Venn Diagrams –Directions.

UNIT V LOGICAL PROBLEMS 6

Introduction to Logical problems – Cause and Effect – Course of Action – Statement and Assumption – Letter and Symbol series – Analogies.

TOTAL: 30 hours

TEXT BOOKS:

T1: K. R. Dhanalakshmi and N S Raghunathan, "Personality Enrichment",Margham Publications, 2012.

T2: Barun Mitra Personality Development and Soft Skills, Oxford University Press, 2012.

T3: R. S. Agarwal, "Quantitative Aptitude for Competitive Examinations", S. Chand Publishers, 2017.

T4: R. V. Praveen, "Quantitative Aptitude and Reasoning", Prentice Hall India Pvt., Limited, 2016.

REFERENCE BOOKS:

R1: D. P. Sabharwal, Personality Development Handbook, Fingerprint publishing, 2021.

R2: A.K Gupta, Logical and Analytical Reasoning (English), Ramesh Publishing House, 2022.

R3: André Iland, Il and Business Pages Soft Skills-Be Professionally Proactive, S. Chand Limited, July 2009.

R4: Bradley H. Dowden, "Logical Reasoning", Wadsworth Publishing Company, 2011.

WEBSITE LINKS:

W1: http://www.osou.ac.in/eresources/Soft-Skills-ccs04.pdf

W2: https://acs.dypvp.edu.in/NAAC/Personality-Development-Vishal-Gaikwad-BBA.pdf

W3: https://en.wikipedia.org/wiki/Analytical_skill

W4: https://www.csus.edu/indiv/d/dowdenb/4/logical-reasoning.pdf

W5: https://www.sjsu.edu/people/anand.vaidya/courses/c4/s2/Logic-and-Critical-

Reasoning-Book.pdf

COURSE OUTCOMES:

CO1	Discuss sand summarize the basic, email, business, telephone and meeting etiquettes.	**K2**
CO2	Solve problems on ratio proportion related to profit and loss, discounts, time and work, Time, Speed and distance.	**K3**
CO3	Work with fractions, decimals and square roots.	**K3**
CO4	Analyze the cause, effect and course of action in logical problems.	**K4**
CO5	Solve problems on the letter and symbol series.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	1	2	2	2	2	2	3	2	2	2	2
CO2	-	-	-	1	3	2	2	2	3	3	2	2	3	2
CO3	-	-	-	1	3	2	2	2	3	3	2	2	3	2
CO4	-	-	-	1	3	2	2	2	3	2	3	2	2	3
CO5	-	-	-	1	3	2	3	2	3	2	2	2	3	1
Avg	-	-	-	1	**2.8**	**2**	**2.2**	**2**	**2.8**	**2.6**	**2.2**	**2**	**2.6**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

BSC	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future.
- To provide understanding of component of environment, their function,quality, issues related to environment,effect of quality degradation on human beings and their solutions

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition – Scope and importance – Need for public awareness – Concepts of an Ecosystem – Structure and Function of an Ecosystem –Producers, Consumers and Decomposers – Energy Flow in the Ecosystem – Ecological Succession – Food Chains, Food Webs and Ecological Pyramids – Introduction, Types, Characteristic Features, Structure and Function of the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries) – Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Bio-geographical Classification of India – Value

of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values – Biodiversity at Global, National and Local Levels – India as a Mega-Diversity Nation – Hot-Spots of Biodiversity – Threats to Biodiversity: Habitat Loss, Poaching of Wildlife, Man-Wildlife Conflicts – endangered and Endemic Species of India – Conservation of Biodiversity: In-Situ and Ex-Situ conservation of Biodiversity.Field Study of Common Plants, Insects and Birds.Field study of simple ecosystems - pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 9

Definition – Causes, Effects and Control Measures of (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of municipal solid Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management - Floods, Earthquake, Cyclone and Landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 9

Forest resources -Use and over – Exploitation – Deforestation – Case studies – Timber extraction –Mining – Dams and their ground water – Floods – Drought – Conflicts over water –Dams – Benefits and Problems – Mineral Resources- Use and Exploitation, Environmental Effects of Extracting and Using Mineral Resources, Case Studies – Food Resources: World Food Problems, Changes caused by Agriculture and Overgrazing, Effects of Modern Agriculture, Fertilizer- Pesticide Problems, Water Logging, salinity, Case Studies – Energy Resources:- Growing Energy Needs, Renewable and Non Renewable Energy Sources, Use of Alternate Energy Sources, Case Studies – Land Resources - Land as a Resource, Land Degradation, Man Induced Landslides, Soil Erosion and Desertification – Role of an Individual in Conservation of Natural Resources – Equitable use of Resources for Sustainable Lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 9

From Unsustainable To Sustainable Development – Urban Problems Related to energy – Water conservation, Rain Water Harvesting, Watershed Management – Resettlement and Rehabilitation of People, its Problems and Concerns, Case Studies Role of non – governmental organization - Environmental Ethics – Issues and Possible Solutions – Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion, Nuclear Accidents and Holocaust, Case Studies –Wasteland Reclamation – Consumerism and Waste Products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act –enforcement machinery involved in environmental Legislation – Central and state pollution control boards - Public Awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 9

Population Growth, Variation among Nations – Population Explosion Family Welfare Programme – environment and Human Health – Human Rights –Value Education – HIV /AIDS – Women and Child Welfare – Role of Information Technology in Environment and Human Health – Case Studies.

TOTAL: 45 hours

TEXT BOOKS:

T1: Gilbert M.Masters, "Introduction to Environmental Engineering and Science," 2nd edition, Pearson Education (2004).

T2: Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill,NewDelhi, (2006).

REFERENCE BOOKS:

R1: R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol.I and II, Enviro Media.

R2: Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.

R3: Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.

R4: Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

WEBLINKS:

W1: https://onlinecourses.nptel.ac.in/noc20_ge16/preview

W2: https://ggn.dronacharya.info/APSDept/Downloads/QuestionBank/ENVIRONMENTAL-STUDIES/NPTEL-Link.pdf

W3: http://eagri.org/eagri50/ENVS302/pdf/lec14.pdf

W4: https://onlinecourses.nptel.ac.in/noc19_ge22/preview

COURSE OUTCOMES:

CO1	Understand the core concepts, methods of ecological and physical sciences, their application in environmental problem-solving.	**K2**
CO2	Apply system concepts and methodologies to analyse, understand the interactions between social and environmental processes.	**K3**
CO3	Apply the ethical, cross-cultural, and historical context of environmental issues and the link between human and natural systems.	**K3**
CO4	Develop the understanding based on the observations and illustration	**K6**
CO5	Reflect critically about their roles and identities as citizens	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	1	1	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	1	-	-	-	-	-	2	-	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	1	-	-	-	2	1	1	-	1	-	-
Avg	1	**1**	-	**1**	-	-	-	**1.5**	**1**	**1**	**-**	**1**	-	-

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

MC-05	GENDER INSTITUTION AND SOCIETY	2	0	0	0

COURSE OBJECTIVES:

- To understand concepts of social justice and gender justice.
- To know of various institutions functioning worldwide which aim to eradicate discrimination against women.
- To aid students in understanding feminism and gender in relation to the society and to study the basic constitutional remedies available to women.

UNIT I FUNDAMENTAL CONCEPTS OF WOMEN'S STUDIES 6

Social Justice and Gender Justice – Theories relating to Social Justice – Theories relating to Gender Justice – Interrelationship between Gender justice and Social Justice.

UNIT II SOCIAL ISSUES & PROTECTION 6

International Conventions for protection of Women – Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) – National Commission for women – Constitutional remedies available for women under Indian Constitution.

UNIT III SOCIAL&ECONOMIC EMPOWERMENT 6

United Nations Entity for Gender Equality and the Empowerment of Women (UN Women) - Association for Women's Rights in Development (AWID) –Women kind worldwide – Centre for reproductive rights - Women's Environment and Development Organization (WEDO) - Global Fund for Women

UNIT IV WOMEN'S RIGHTS ORGANISATIONS &RESOURCES 6

International Center for Research on Women (ICRW) - European Institute for Gender Equality (EIGE) – Promundo - International Alliance of Women (IAW) - International Women's Development Agency (IWDA).

UNIT V WOMEN IN THE GLOBAL ECONOMY 6

World Health organisation – Sex and Gender – Feminism – Theories relating to Feminism – Gender and society.

TOTAL: 30 hours

TEXT BOOKS:

T1: Mamta Rao, "Law relating to Women and children, Eastern Book Company; 3rd Edition January 2012.

T2: Mona Lena Krook and Fiano Mackay, "Gender, Politics and Institutions: Towards a Feminist Institutionalism",2010

T3: Dr. Sheetal Kanwal, "Gender Justice and Feminist Jurisprudence",2015

T4: P.Jain, "Narain's Gender and society". Lakshmi Narain Agarwal publlishers, 2015.

REFERENCE BOOKS:

R1: Ishitha Chatterjee, "Gender Justice and feminist Jurisprudence",Central Law Publications, 1st Edition, 2017

R2: Moira Gatens and Alison Mackkinon, "Gender and Institutions",Cambridge University Press, Cambridge, 1999,214 pp

R3: Siddhartha Sarkar, "Women and Gender: Society and Community," Kalpaz Publications, Jan 2019.

COURSE OUTCOMES:

CO1	Understand the Concept of Social Justice and Gender Justice.	**K2**
CO2	Learning the International Conventions and constitutional remedies available for women.	**K2**
CO3	Identify the various gender Institutions and its functions for the development of women.	**K3**
CO4	Assessing the International agencies.	**K5**
CO5	Summarizing the study on feminism and relation of gender and society.	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	-	-	-	-	-	1	1	1	-	1	-	-
CO2	1	1	-	-	-	-	-	1	1	-	-	-	-	-
CO3	-	1	-	-	-	-	-	2	-	1	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	1	-	-	1	-	-	-	2	1	1	-	1	-	-
Avg	**1**	**1**	-	**1**	-	-	-	**1.5**	**1**	**1**	**-**	**1**	-	-

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
			✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

SEMESTER V

PCC-13	ELECTROMAGNETIC WAVEGUIDES AND APPLICATIONs	3	1	0	4

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a electromagnetic fields
- To provide the necessary basic concepts of a electromagnetic wave radiation from antennas
- To provide the necessary basic concepts of a electromagnetic wave propagation through transmission lines and waveguides

UNIT I INTRODUCTION TO ELECTROMAGNETICS 12

Basics of Vectors, Vector calculus, Coulombs Law, Gauss Law and its applications, Biot-Savart Law, Amperes Circuital law and its applications, Faradays Law, Maxwell's Equations.

UNIT II ELECTROMAGNETIC WAVES 12

Uniform plane wave in free space - phase velocity, Propagation constant, wavelength, Uniform plane wave in dielectric, Power flow and Poynting vector,, Uniform plane wave in good conductor-skin effect,Wave polarization - linear, elliptical, circular.

UNIT III TRANSMISSION LINES 12

Transmission Lines-Voltage and Current on Dissipationless Line, Propagation constant and characteristic impedance, Reflection coefficient and Standing Wave Ratio - VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power and impedance measurement on line, Impedance Matching- Quarter wave line.

UNIT IV WAVEGUIDES 12

Wave propagation in parallel plane waveguide, Transverse Electric (TE) waves, Transverse Magnetic (TM) Waves, Attenuation in parallel plane guides.

UNIT V ANTENNAS 12

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Monopole and Dipole antenna - power radiation.

TOTAL: 60 hours

TEXT BOOKS:

T1: William H. Hayt, John A. Buck, Mc Graw Hill Companies, 7 th edition, 2006.

T2: R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.

T3: E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice, Hall, India.

REFERENCE BOOKS:

R1: Narayana Rao, N: Engineering Electromagnetics, 3rded., Prentice Hall, 1997.

R2: David Cheng, Electromagnetics, Prentice Hall.

R3: Electromagnetic waves and Transmission Lines, U.A.Bakshi, A.V.Bakshi, Second Revised Edition, Technical Publications, 2009.

R4: Antenna and Wave Propagation, U.A.Bakshi, A.V.Bakshi, First Edition, Technical Publications, 2011.

WEBLINKS:

W1: https://nptel.ac.in/courses/115104088

W2: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-632-electromagnetic-wave-theory-spring-2003/

COURSE OUTCOMES:

CO1	Explain the basic laws for Electromagnetic wave propagation.	**K2**
CO2	Evaluate the characteristics and propagation of uniform plane waves in different media.	**K5**
CO3	Discuss the basics of transmission lines and estimate the parameters of voltage, current, impedance, power	**K5**
CO4	Elaborate the characteristics of wave propagation in waveguides.	**K4**
CO5	Determine the power radiation characteristics of various antennas.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO3	2	2	2	1	-	-	-	-	-	-	-	-	3	3
CO4	2	2	1	1	-	-	-	-	-	-	-	-	3	2
CO5	2	2	1	2	-	-	-	-	-	-	-	-	2	-
Avg	**2.4**	**2.2**	**1.4**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓			✓

PCC-14	**DIGITAL SIGNAL PROCESSING**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

- To be familiar with sampling and the various types of analysis performed on digital signals
- To design filters in accordance to the application.

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 12

Discrete time signals: Sequences; Representation of signals on orthogonal basis; Sampling quantization, quantization error, Nyquist rate, aliasing effect, Z-Transform and its properties, Analysis of LTI systems, frequency Analysis, Inverse Systems.

UNIT II ANALYSIS OF SIGNALS USING DFT – FFT ALGORITHMS 12

Discrete Fourier Transform (DFT)- DFT – properties – Frequency analysis of signals using DFT – FFT algorithms –Advantages over discrete computation of DFT – Radix 2 algorithms – DIT and DIF algorithms – Computation of IDFT using FFT– overlap add and save methods.

UNIT III INFINITE IMPULSE RESPONSE FILTER DESIGN 12

Design of Infinite Impulse Response Filter from Analog Butterworth and Chebyshev filters – Impulse invariance and bilinear methods of IIR digital filter design – realization using direct, cascade, and parallel and ladder forms.

UNIT IV FINITE IMPULSE RESPONSE FILTER DESIGN 12

Design of FIR filters using windowing technique–Rectangular – Hamming– Blackman windows. Realization of FIR filters – Transversal, linear phase and polyphase realization structures.

UNIT V SPECTRUM ESTIMATION AND MULTIRATE SIGNAL PROCESSING 12

Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation. Introduction to multirate signal processing – Decimation and Interpolation by integer factors – sub band coding of speech signals – QMF filters, Application of DSP.

TOTAL: 60 hours

TEXT BOOKS:

T1: Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007.

T2: A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.

T3: John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.

T4: L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

REFERENCE BOOKS:

R1: J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.

R2: D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

R3: Emmanuel C.Ifeachor&Barrie.W.Jervis "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.

WEBLINKS:

W1: https://nptel.ac.in/courses/117102060

W2: https://onlinecourses.iitk.ac.in/course/ee301a

W3: https://freevideolectures.com/course/2317/digital-signal-processing-iit-delhi

COURSE OUTCOMES:

CO1	Represent signals mathematically in time and frequency domain, analyze the performance of LTI systems.	**K4**
CO2	Analyze the response of signals using DFT and FFT algorithms	**K4**
CO3	Design IIR filters for various applications using Butterworth and Chebyshev approximations	**K6**
CO4	Estimate the performance of FIR filters using various windowing techniques.	**K5**
CO5	Compare the spectral estimation methods and analyzemultirate signal processing techniques	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	-	-	-	-	2	-	1	2	2
CO2	3	2	2	2	3	-	-	-	-	2	-	2	3	2
CO3	3	2	2	2	2	-	-	-	-	2	-	2	2	3
CO4	2	2	2	1	2	-	-	-	-	2	-	1	2	3
CO5	2	2	2	1	2	-	-	-	-	2	-	2	2	2
Avg	**2.6**	**2**	**2**	**1.6**	**2.2**	**-**	**-**	**-**	**-**	**2**	**-**	**1.6**	**2.2**	**2.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓			✓

PCC–15	**MICROPROCESSORS & MICROCONTROLLERS**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

- To gain knowledge about basic concept of processor, controllers, their architecture, internal organization and their functions.
- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To provide solid foundation on the fundamentals of microprocessors and applications, interfacing the external devices to the processor

UNIT I MICROPROCESSORS HARDWAREARCHITECTURE 9

Introduction to 8085 &8086 Microprocessor system and their building blocks –Addressing modes, concepts of interrupts and Direct Memory Access, Instruction set and assembler directives of microprocessors, (with examples of 8085 and 8086)

UNIT II MICROPROCESSOR PERIPHERAL INTERFACING AND MEMORY 9

Interfacing with peripherals – timer, serial I/O, parallel I/O, A/D and D/A converters, Arithmetic Coprocessors, System level interfacing design; Concepts of virtual memory, Cache memory, Advanced coprocessor Architectures- 286, 486, Pentium.

UNIT III MICROCONTROLLER 9

Microcontrollers vs Microprocessors– 8051 Micro Controller Hardware – I/O Pins, Instruction Set, Ports and Circuits – External Memory – Addressing modes - Counters and Timers – Serial Data I/O – Interrupts

UNIT IV INTERFACING MICROCONTROLLER 9

Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison of Microprocessor, Microcontroller, PIC and ARM processors

UNIT V INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems and Fundamental – Software for Embedded Systems – Stepper motor and waveform generation –Arduino –simple programs, PIC Microcontroller, Architecture, Introduction to RISC processors - ARM microcontrollers

TOTAL: 45 hours

TEXT BOOKS:

T1: Douglas V Hall, "Microprocessors Interfacing", Tata McGraw Hill, 3rd edition 2017.

T2: Ramesh. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing 5th Edition, 2013

T3: D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface", Morgan Kaufman Publishers, 2019.

T4: Kenneth J. Ayala, "The 8051 Microcontroller", Penram International Publishing, 2004.

REFERENCE BOOKS:

R1: K Bhurchandi "Advanced microcontrollers and peripherals" 3rd edition 2017.

R2: David. E.Simon, "An Embedded Software Primer", Pearson Education, 2001.

R3: MuhammadMazidi "8051 Microcontroller and Embedded systems" Pearson education, 2007.

R4: N Senthil Kumar, M Saravanan "Microprocessors & Microcontrollers" Oxford Publications, 2011.

WEBLINKS:

W1: https://www.tutorialspoint.com/microprocessor/microprocessor_io_interfacing_overview.html

W2: https://www.javatpoint.com/microprocessor-tutorial

W3: https://jntukucen.ac.in/ebook_files/155.pdf

COURSE OUTCOMES:

CO1	Sketch the architecture of microprocessors and microcontrollers	**K3**
CO2	Execute the design aspects of I/O and Memory Interfacing circuits	**K3**
CO3	Distinguish a microprocessor and a microcontroller	**K4**

CO4	Develop program microprocessors and microcontrollers for simple applications with supporting chips.	**K6**
CO5	To evaluate the functionality of PIC microcontrollers, ARM processors, Arduino, utilizing registers and memory.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	3	2	2
CO2	3	2	2	2	-	-	-	-	-	-	-	3	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	3	2	2
CO4	3	2	2	2	-	-	-	-	-	-	-	3	2	3
CO5	3	2	2	2	1	-	-	-	-	-	-	3	2	3
Avg	**2.8**	**2**	**2**	**2**	**1.5**	-	-	-	-	-	-	**3**	**2**	**2.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PCC-16	**ELECTROMAGNETIC WAVE LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To illustrate the basic concepts and laws of electromagnetic fields
- To illustrate the propagation of radio waves through various waveguides
- To illustrate the radiation patterns of antennas

LIST OF EXPERIMENTS

1. Analysis of Hertz Dipole.
2. Analysis of Monopole antenna on a finite ground plane.
3. Determination of RADAR Cross Section (RCS) of thin dielectric sheet.
4. Design and Analysis of Waveguide Power Divider.
5. Study of Maxwell's Equation based solvers MOM and MLFMM.
6. Calculation of surface current, poynting vector in a conducting surface.
7. Determination of power flow in a coaxial cable.
8. Wave propagation on a conductor and dielectric.
9. Analysis of an Isotropic radiator.
10. Determination of H-field around a conductor.
11. Coupling between a monopole antenna and a loaded transmission line.

TOTAL: 30 hours

TEXT BOOKS:

T1: R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India, 2005.

T2: E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice, Hall, India.

REFERENCE BOOKS:

R1: Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.

R2: David Cheng, Electromagnetics,2nd Ed. ,Prentice Hall,

WEBLINKS:

W1: https://nptel.ac.in/courses/115104088

W2: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-632-electromagnetic-wave-theory-spring-2003/

COURSE OUTCOMES:

CO1	Compute Maxwell's Equation using computational electromagnetics solvers	**K3**
CO2	Demonstrate the characteristics of wave propagation on transmission lines	**K4**
CO3	Determine the RCS, surface current, poynting vector, power flow, E-field and H-field of materials.	**K3**
CO4	Experiment wave propagation on various waveguides	**K4**
CO5	Evaluate the principle of radiation and radiation pattern of an antenna	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	1	3	-	-	-	-	1	-	-	2	1
CO2	3	1	-	2	3	-	-	-	-	1	-	-	2	-
CO3	2	2	-	2	3	-	-	-	-	1	-	-	3	-
CO4	3	3	-	2	3	-	-	-	-	2	-	-	3	2
CO5	3	3	1	3	3	-	1	-	-	2	-	-	3	2
Avg	**2.6**	**2.2**	**1**	**2**	**3**	**-**	**1**	**-**	**-**	**1.4**	**-**	**-**	**2.6**	**1.67**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

PCC-17	DIGITAL SIGNAL PROCESSING LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To implement Linear and Circular Convolution
- To implement FIR and IIR filters
- To study the architecture of DSP processor
- To demonstrate Finite word length effect

LIST OF EXPERIMENTS:

I. TMS320C5X/TMS320C 67XX/ADSP 218X/219X/BS531/532/561

1. Study of various addressing modes of DSP using simple programming examples
2. Implementation of Linear and Circular Convolution
3. Sampling of input signal and display
4. Waveform generation
5. Implementation of FIR filters Using windowing techniques**.**

II. MATLAB

1. Generation of Signals
2. Linear and circular convolution of two sequences
3. Sampling and effect of aliasing
4. Design of FIR filters using rectangular, hamming, Hanning, Blackman windows
5. Design of IIR filters using Analog Butterworth and Chebyshev filters

TEXT BOOKS:

T1: S.K.Mitra, Digital Signal Processing: A computer based approach.TMH

T2: A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.

T3: John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.

T4: L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

REFERENCE BOOKS:

R1: J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.

R2: D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

WEBLINKS:

W1: https://www.google.com/search?channel=trow5&client=firefox-b-d&q=dsp+lab+matlab+experiments+-nptel

W2: https://nptel.ac.in/courses/108105055

COURSE OUTCOMES:

CO1	Evaluate the concepts of digital signal processing using DSP kits.	**K5**
CO2	Sample Analog signals and generate the different waveforms.	**K4**
CO3	Differentiate the various types of signals using MATLAB programs	**K4**

CO4	Analyze, observe and compare the performance of FIR filters using the different windows like rectangular, hamming, Hanning and Blackman.	**K4**
CO5	Evaluate the magnitude and phase characteristics (Frequency response Characteristics) of digital IIR-Butterworth, Chebyshev filters. Perform linear and circular convolution using DSP kits	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	3	-	-	-	-	3	-	2	2	3
CO3	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	1	2	2
CO5	3	2	2	2	2	-	-	-	-	2	-	2	2	2
Avg	**2.4**	**2**	**2**	**2.2**	**2.4**	-	-	-	-	**2.2**	-	**1.6**	**2**	**2.2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

HSC – 05	**PERSONALITY DEVELOPMENTIII**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To improve the verbal and written communication skills.
- To enhance interpersonal and group skills.

UNIT I VERBAL APTITUDE - I 6

Phonetics / Neutral Accent / Pronunciation – Speech Mechanism / Mouth & Face Exercise – Vowels & Consonants – Sounds – Syllable and Syllable Stress/ Word Stress – Sentence Stress & Intonation Articulation Exercise – Rate of Speech / Flow of Speech / Idiomatic Phrases.

UNIT II VERBAL APTITUDE - II 6

Singular/plural – present tense / past tense – genders Prepositions – conjunctions – Choice of words –simple sentences – compound sentences – summarizing phrases Synonyms – Antonyms – Analogies –Similar Words.

UNIT III SOFT SKILLS - IV 6

Attitude – Meaning–Features of attitude – Formation – Personality Factors –Types of attitude – change in attitude – developing Positive attitude.

UNIT IV TIME MANAGEMENT 6

Definition – Meaning–Importance, Value of time as an important resource – comparison of

Time and Money – Circle of influence and circle of control – Definition of URGENT and IMPORTANT – Time Wasters and how to reduce – Procrastination – meaning and impact – 4 Quadrants.

UNIT V TEAM BUILDING 6

Meaning – Aspects of team building – Process of team building – Types of Teams – Team Ethics and Understanding – Team trust and commitment.

TOTAL: 30 hours

TEXT BOOKS:

T1: B N Ghosh, "Managing Soft Skills and Personality", McGraw Hill Publications.

T2: Shejwalkar and Ghanekar, "Principles and Practices of Management" McGraw Hill Latest.

REFERENCE BOOKS:

R1: RobertaRoesch, "Time management for Busy people", Tata McGraw–Hill Edition.

R2: Dr. V. M. Selvaraj, Personality Development, Bhavani Publications.

WEB LINK:

W1: http://livre2.com/LIVREE/E1/E001031.pdf

COURSE OUTCOMES:

CO1	Articulate ideas by varying the rate and flow of speech	**K2**
CO2	Appropriately choose words and phrases in any verbal communication	**K2**
CO3	Distinguish the positive and negative attitudes in handling any situation	**K4**
CO4	Categorize the tasks and prioritize them using the four-quadrant method	**K3**
CO5	Practice team ethics and understanding when working with teams. Articulate by understanding the rate and flow of speech.	**K4**

MAPPING OF COURSE OUTCOMES: WITH THE PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	3	3	2	3	3	3	3	-	3
CO2	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO3	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO4	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO5	-	-	-	-	-	3	3	2	3	3	3	3	-	3
Avg	-	-	-	-	-	**2.4**	**3**	**2**	**3**	**3**	**3**	**3**	-	**3**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

SEMESTER VI

PCC – 19	VLSI DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To learn the basic VLSI circuits
- To learn the concepts of modeling a digital system using Hardware Description Language.
- To learn the concepts of designing VLSI Subsystems.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V characteristics, C-V characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

UNIT IV DESIGN OF ARTHMETIC BUILDING BLOCK AND SUBSYSTEM 9

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

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL:45 hours

TEXTBOOKS

T1: JanRabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", 2ndedition, 2016.

T2: BehzadRazavi, "Design of Analog CMOS Integrated Circuits" 2ndedition, 2017

T3: M.J. Smith, "Application Specific Integrated Circuits",Addisson Wesley, 2008

REFERENCE BOOKS:

R1: N.Weste, Harris, "CMOS VLSI Design: A circuits and systems perspective, Fourth Edition, Pearson, 2015.

R2: R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2009

R3: A.Pucknell, Kamran Eshraghian, "Basic VLSI Design", Third Edition, Prentice Hall of India, 2007.

WEBLINK:

W1: https://nptel.ac.in/courses/108107129

COURSE OUTCOMES:

CO1	To understand the functionality of a device based on MOS capacitor	**K2**
CO2	To solve the Boolean operations and to determine the output of a combinational circuits as the Boolean function	**K3**
CO3	To create registers, counters and processors and also to construct a finite state machine	**K6**
CO4	To illustrates how to interface and designs a subsystem with other elements of a device	**K2**
CO5	To fabricate transistors in FPGA and will be able to understand the testing methods usedinpost-production.	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	2	-	-	-	-	-	2	2	2	2
CO2	2	2	2	-	-	-	-	-	-	-	2	2	2	2
CO3	2	2	2	-	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	-	-	-	-	-	-	-	2	3	3	3
CO5	2	2	2	-	2	-	-	-	-	-	0	-	3	3
Avg	**2**	**2**	**2**	-	**2**	-	-	-	-	-	**1.6**	**2.25**	**2.4**	**2.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PCC – 20	**COMPUTER NETWORKS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks.
- Be exposed to the required functionality at each layer.
- To learn the flow control and congestion control algorithms.

UNIT I DATA COMMUNICATIONS 9

Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Modems.

UNIT II DATA LINK LAYER 9

Error – detection and correction – Parity – LRC – CRC – Hamming code – Flow Control and Error control – stop and wait – go back–N ARQ – selective repeat ARQ– sliding window –

HDLC. – LAN – Ethernet IEEE 802.3 – IEEE 802.4 – IEEE 802.5 – IEEE 802.11 – FDDI – SONET – Bridges, Switches.

UNIT III NETWORK LAYER 9

Internetworks – circuit switching, Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing, Open shortest path first (OSPF). Border Gateway protocol (BGP), EGP – Routers.

UNIT IV TRANSPORT LAYER 9

Duties of transport layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of services (QOS) – Integrated Services– Differentiated services.

UNIT V APPLICATION LAYER\ 9

Domain Name Space (DNS) – SMTP –File Transfer protocol (FTP)– HTTP – WWW – Security– Cryptography – Symmetric key and Public Key algorithms–Conventional encryption techniques, electronic mail, Digital Signature.

TOTAL: 45 hours

TEXT BOOKS:

T1: Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw–Hill, 2004.

T2: Andrew S. Tanenbaum, "Computer Networks", PHI, Fourth Edition, 2003.

REFERENCE BOOKS:

R1: James F. Kurose and Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2003.

R2: Larry L. Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.

R3: William Stallings, "Data and Computer Communication", Sixth Edition, Pearson Education, 2000.

WEBLINKS:

W1: https://nptel.ac.in/courses/106105081

W2: https://www.journals.elsevier.com/computer-networks

COURSE OUTCOMES:

CO1	Identify the components required to build different types of networks.	**K3**
CO2	Choose the required functionality at each layer for given application.	**K2**
CO3	Explain the importance of IEEE standard employed in computer networking.	**K4**
CO4	Analyze the flow of information from one node to another node in the network by using different protocols.	**K4**
CO5	Explain the functions of Application layer paradigms and network security.	**K5**

MAPPING OF COURSE OUTCOMES: WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	1	-	-	1	-	-	-	1	2	2
CO2	2	2	2	2	2	-	-	2	-	-	-	1	3	-
CO3	1	2	2	2	2	-	-	1	-	-	-	1	3	1
CO4	-	1	2	3	2	-	-	2	-	-	-	-	3	3
CO5	1	1	3	2	3	-	-	2	-	-	-	1	3	2
Avg	**1.5**	**1.4**	**2.2**	**2.2**	**2**	-	-	**1.6**	-	-	-	**1**	**2.8**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PCC– 21	COMPUTER NETWORKS LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To learn to communicate between two desktop computers by implementing the different protocols
- Be familiar with socket programming and the various routing algorithms
- Be familiar with simulation tools. To understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer

LIST OF EXPERIMENTS:

1. Study of Networking Devices.
2. Study of network IP Address and connect the computers using Ethernet LAN Protocol.
3. Study and create the scenario for token bus protocol using LAN trainer kit
4. Study and create the scenario for token ring protocol using LAN trainer kit.
5. Study and Implementation of Stop and Wait protocol using trainer kit.
6. Study and Implementation of Go back N using LAN trainer kit.
7. Study and Implementation of Selective Repeat protocols using LAN trainer kit.
8. Implementation of Distance Vector Routing algorithm.
9. Implementation of Link Sate Routing algorithm.
10. Implementation of Data Encryption and Decryption.

TOTAL: 30 hours

TEXT BOOKS:

T1: Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw–Hill, 2004.

T2: Andrew S. Tanenbaum, "Computer Networks", PHI, Fourth Edition, 2003.

REFERENCE BOOKS:

R1: James F. Kurose and Keith W. Ross, "Computer Networking: A Top–Down Approach Featuring the Internet", Pearson Education, 2003.

R2: Larry L. Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.

R3: William Stallings, "Data and Computer Communication", Sixth Edition, Pearson Education, 2000.

WEBLINKS:

W1: http://www.facweb.iitkgp.ac.in/~isg/NWLAB/index.html

W2: https://www.slideshare.net/nitinbhasin3/computer-networking-lab-file.

COURSE OUTCOMES:

CO1	Analyse the concepts of various networking components and their uses.	**K4**
CO2	Construct topologies using networking devices.	**K6**
CO3	Analyse and implement error detection and flow control techniques	**K4**
CO4	Develop the various routing algorithms for finding of the shortest route.	**K3**
CO5	Create an algorithm for encryption and decryption and implement the same with proper simulations.	**K6**

MAPPING OF COURSE OUTCOMES: WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	1	-	-	-	3	3	2	2	2	2
CO2	2	3	2	2	2	-	-	-	3	3	2	3	3	-
CO3	2	3	2	2	2	-	-	-	3	3	2	2	3	1
CO4	2	2	2	3	2	-	-	-	3	3	2	2	3	3
CO5	2	2	2	2	3	-	-	-	3	3	2	2	3	2
Avg	**2**	**2.2**	**2**	**2.2**	**2**	-	-	-	3	**3**	**2**	**2.2**	**2.8**	**1.6**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

PCC – 21	VLSI DESIGN LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs

LIST OF EXPERIMENTS:

1. Design an Adder using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design and simulate a CMOS Basic Gates and Flip-Flops
6. Design and simulate a CMOS inverter using digital flow
7. Design and simulate a 4-bit synchronous counter using a Flip-Flops
8. Design and simulate a 4-bit synchronous counter using a Flip-Flops
9. Design and simulate a CMOS Inverting Amplifier.

TOTAL: 30 hours

TEXT BOOKS:

T1: JanRabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated Circuits: A DesignPerspective", 2nd edition, 2016.

T2: BehzadRazavi, "Design of Analog CMOS Integrated Circuits" 2nd edition, 2017

REFERENCE BOOKS:

R1: N.Weste, Harris, "CMOS VLSI Design: A circuits and systems perspective"FourthEdition,Pearson, 2015.

R2: Wayne Wolf, "Modern VLSI design", Pearson Education, 2003.

R3: M.J.S.Smith" Application Specific integrated circuits", Pearson Education, 1997.

R4: J.Bhasker" Verilog HDL primer", BS publication,2001

R5: Ciletti "Advanced Digital Design with the Verilog HDL", Prentice Hall of India, 2003.

WEBLINKS:

W1: https://nptel.ac.in/courses/106106088.

W2: https://vlsi-iitg.vlabs.ac.in/

W3: http://www.vlsiacademy.org/open-source-cad-tools.html

COURSE OUTCOMES:

CO1	To design CMOS logic circuits	**K5**
CO2	To simulate CAD tools	**K5**
CO3	To design and implement circuits using HDL	**K6**
CO4	To write HDL code for basic and advanced digital integrated circuits	**K3**
CO5	To design and extract the layouts of Digital and Analog IC circuits	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	3	2	-	-	-	-	-	-	1	2	2
CO2	2	1	2	3	2	-	-	-	-	-	-	1	2	2
CO3	2	1	2	3	2	-	-	-	-	-	-	1	2	2
CO4	2	1	2	3	2	-	-	-	-	-	-	2	2	2
CO5	2	1	2	3	2	-	-	-	-	-	-	1	2	2
Avg	**2**	**1**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1.2**	**2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Observation	Record
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
		✓	✓	✓	

HSC – 06	**PERSONALITY DEVELOPMENT IV**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To develop awareness of different job search techniques, including how to employ practical networking techniques
- To begin to recognize the skills developed during research and analyse how to present these effectively in written applications
- To critique the strengths and weaknesses of their own and colleagues' current CVs
- To understand interview processes and practice being interviewed in a supportive environment.

UNIT I SOFT SKILLS V 6

Assertiveness – Meaning – Importance of assertiveness – Characteristics of Assertive communication –Merits – forms of assertion – Causes of misunderstanding

UNIT II COMMUNICATION SKILLS 6

Meaning – Elements of Communication – Functions of Communication – Principles of Communication Formal and Informal Communication – Barriers in Communication – Characteristics of good – communication – Feedback – Communication systems.

UNIT III PRESENTATION SKILLS - I 6

Meaning – Importance of Presentation – Concept of 5 W's and one H – understanding the audience –Types of presentations – How to make effective presentation.

UNIT IV PRESENTATION SKILLS - II 6

Use of slide, PPT's and visuals – Rules for slide presentation – precautions – seminars and conferences – Steps to eliminate Stage fear

UNIT V CHANGE MANAGEMENT 6

Definition – Necessity – Resistance towards Change – 10 Principles of Change Management – Leader's approach – Effective Change management.

TOTAL:30 hours

TEXT BOOKS:

T1: Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002.

T2: Who Moved My Cheese , Spencer Johnson published by vermilion first edition.

REFERENCE BOOKS:

R1: Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.

R2: Business Communication Today: Bovee, Courtland L, John V. Thill& Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

WEBLINKS:

W1: https://www.researchgate.net/publication/227367804_Assertive_Communication_Skills

W2: https://nptel.ac.in/courses/109104031

COURSE OUTCOME

CO1	Develop and communicate assertively by knowing the causes of misunderstanding	**K5**
CO2	Analyze and overcome the barriers in formal and informal communication	**K4**
CO3	Prepare and present messages with a specific intent.	**K6**
CO4	Select powerful presentations that deliver effective messages.	**K3**
CO5	Manage the various principles of change	**K5**

MAPPING OF COURSE OUTCOMES: WITH THE PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	3	2	3	3	3	3	-	3
CO2	-	-	-	-	-	-	3	2	3	3	3	3	-	3
CO3	-	-	-	-	-	-	3	2	3	3	3	3	-	3
CO4	-	-	-	-	-	-	3	2	3	3	3	3	-	3
CO5	-	-	-	-	-	-	3	2	3	3	3	2	-	3
Avg	-	-	-	-	-	-	**3**	**2**	**3**	**3**	**3**	**2.8**	-	**3**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
			✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

SEMESTER VII

PCC-23	OPTICAL AND MICROWAVE ENGINEERING	3	0	0	3

COURSE OBJECTIVES:

- To inculcate understanding of the basics required for circuit representation of RF networks.
- To deal with the issues in the design of microwave amplifier.
- To in still knowledge on the properties of various microwave components.
- To deal with the microwave generation and microwave measurement techniques
- Understand the utility of Optical Fibers in Communications.

UNIT I TWO PORT NETWORK THEORY 9

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behaviour of Resistors, Capacitors and Inductors.

UNIT II RF AMPLIFIERS AND MATCHING NETWORKS 9

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

UNIT III PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC.

UNIT IV MICROWAVE GENERATION 9

Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of Two cavity Klystron Amplifier, Reflex Klystron oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT – V OPTICAL FIBERS 9

Optical Fiber types, Light Propagation, Optical fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

TOTAL:45 hours

TEXT BOOKS:

T1: Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.

T2: Reinhold. Ludwig and PavelBretshko "RF Circuit Design", Pearson Education, Inc., 2006.

T3: John M. Senior," Optical Fiber Communication", Pearson Education, Second Edition. 2007.

REFERENCEBOOKS:

R1: Robert. E.Collin, "Foundation of MicrowaveEngg", McGraw Hill.

R2: Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2004.

R3: M.M.Radmanesh, "RF & Microwave Electronics Illustrated", Pearson Education, 2007.

R4: D.M.Pozar, "Microwave Engineering", John Wiley &Son.

R5: Gerd Keiser Optical Fiber Communication, TMH, 4thEd., 2008.

WEBLINKS:

W1: https://nptel.ac.in/courses/108101112

W2: https://nptel.ac.in/courses/108106167

W3: https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/2.Microwave%20Engineering.pdf

COURSE OUTCOMES:

CO1	Analyze the scattering matrix for two port networks and its properties.,	**K4**
CO2	Determine the characteristics of RF Amplifiers and matching network	**K3**
CO3	Explain the fabrication techniques of Microwave Monolithic Integrated Circuit (MMIC) and. study the characteristics of various diodes	**K5**
CO4	Compare the principles of operation of Multicavity Klystron and Reflex Klystron.	**K2**
CO5	Understand the mechanism of light propagation through Optical Fibers.	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	2
CO2	2	2	1	2	2	-	-	-	-	-	-	-	2	1
CO3	2	2	1	2	2	-	-	-	-	-	-	-	1	1
CO4	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	1	2	1	1	2	-	-	-	-	-	-	-	2	2
Avg	**2.2**	**2**	**1.2**	**1.6**	**1.8**	-	-	-	-	-	-	-	**1.6**	**1.6**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PCC-25	OPTICAL AND MICROWAVE LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- Develop understanding of simple optical communication link and to Learn about the characteristics and measurements in optical fiber.
- To Understand the working principle of microwave components and their characteristics

LIST OF EXPERIMENTS:

I. OPTICAL COMMUNICATION

1. Attenuation Measurement and Measurement of Connector and Bending Losses.
2. Fiber Optic Analog and Digital Link
3. Numerical Aperture Determination for Fibers.

II. MICROWAVE COMMUNICATION

1. Reflex Klystron – Mode characteristics/ Gunn Diode – Characteristics
2. VSWR, Frequency and Wave Length Measurement
3. Directional Coupler – Directivity and Coupling Coefficient – S – parameter measurement
4. Isolator and Circulator – S – parameter measurement
5. Attenuation, Power and Antenna Gain Measurement.
6. S – matrix Characterization of E–Plane T, H–Plane T and Magic T.
7. Radiation Pattern of Antennas.

TOTAL: 30 hours

TEXT BOOKS:

T1: John M. Senior," Optical Fiber Communication", Pearson Education, Second Edition. 2007.

T2: Gerd Keiser, "Optical Fiber Communication," McGraw Hill, Third Edition. 2000.

T3: Samuel Y Liao, "Microwave Devices & Circuits", Prentice Hall of India, 2006.

T4: Reinhold. Ludwig and PavelBretshko "RF Circuit Design", Pearson Education, Inc., 2006.

REFERENCE BOOKS:

R1: J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

R2: RajivRamaswami, "Optical Networks", Second Edition, Elsevier , 2004.

R3: Robert. E.Collin, "Foundation of MicrowaveEngg", McGraw Hill.

R4: Annapurna Das and Sisir K Das, "Microwave Engineering", Tata McGraw Hill Inc., 2004.

WEBLINKS:

W1: https://www.vidyarthiplus.com/vp/Thread-EC2405-Optical-and-Microwave-Engineering-Lab-Manual-Edition-2014

W2: http://www.icet.ac.in/Uploads/Downloads/s7%20lab%20manual%20-final.pdf

COURSE OUTCOMES:

CO1	Examine the performance of fiber optic analog and link and estimate numerical aperture	**K4**
CO2	Determine the bending loss of optical fiber	**K4**
CO3	Determine the voltage and current characteristics of Gunn diode	**K5**
CO4	Estimate the Gain Measurement, Radiation Pattern of horn Antenna	**K5**
CO5	Determine the frequency and wavelength of rectangular waveguide	**K5**

MAPPING OF COURSE OUTCOMES: WITH THE PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	2	-	3	2	-	2	-	-	2	2	2
CO2	2	2	3	2	-	3	2	-	2	-	-	2	2	2
CO3	2	2	3	2	-	3	2	-	2	-	-	2	2	2
CO4	2	2	3	2	-	3	2	-	2	-	-	2	2	2
CO5	2	2	3	2	-	3	2	-	2	-	-	2	2	2
Avg	**2**	2	**3**	2	-	**3**	2	-	2	-	-	**2**	**2**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Observation**	**Record**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Viva**	**Demonstration/ Presentation**	**Open book test**
		✓	✓	✓	

PROFESSIONAL ELECTIVE COURSES

PEC-01	ANTENNAS AND PROPAGATION	3	0	0	3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES:

- To give insight of the radiation phenomena.
- To understand the radiation characteristics of different types of antennas
- To create awareness about the different types of propagation of radio waves at different frequencies

UNIT I RADIATION PRINCIPLES & INTRODUCTION TO ANTENNAS 9

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions .Radiation from Wires and Loops- Infinitesimal dipole, finite – Length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNITII APERTURE ANTENNAS 9

Aperture and Reflector Antennas – Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime – focus parabolic reflector and cassegrain antennas. Broadband Antennas – Log-periodic and Yagi– Uda antennas, frequency independent antennas, broadcast antennas.

UNIT III MCROSTRIP ANTENNAS 9

Micro strip Antennas – Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

UNIT IV ANTENNA ARRAYS 9

Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays and synthesis of antenna arrays using Schelkun off polynomial method, Woodward-Lawson method.

UNIT V BASIC CONCEPTS OF SMART ANTENNAS 9

Basic Concepts of Smart Antennas- Concept and benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming. Different modes of Radio Wave propagation ,Virtual height, MUF, Skip distance, OWF, Ionosphere abnormalities, Multi-hop propagations, Space wave propagation.

TOTAL: 45 hours

TEXT BOOKS:

T1: C. A. Balanis, Antenna Theory: Analysis and Design (3rd eds), John Wiley & Sons, Hoboken, NJ, 2005.

T2: J.D.Kraus, “Antennas”, 3rd Edition, Mc-Graw Hill book company, 2002.

T3: Robert E.Collin, “Antennas and Radio wave propagation”, McGraw Hill, 2002.

REFERENCE BOOKS:

R1: R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.

R2: K.D. Prasad, Antenna & Wave Propagation",2nd Edition, Satya Prakashan, 2005.

WEBLINKS:

W1: http://www.cpri.in/about-us/departmentsunits/library-and-information-centre/digital-library-links.html

W2: http://www.electronicagroup.com

COURSE OUTCOMES:

CO1	Explain the principles of electromagnetic and antenna characteristics such as radiation pattern and directivity.	**K2**
CO2	Determine the various design considerations of aperture and microstrip antenna.	**K4**
CO3	Analyze various feeding methods in micro strip antenna	**K4**
CO4	Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitude	**K4**
CO5	Explain the Concepts of various types of Antennas.	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	-	-	-	1	1	2
CO2	2	3	1	1	2	-	-	-	-	-	-	1	2	1
CO3	2	3	1	2	1	-	-	-	-	-	-	2	1	1
CO4	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	1	1	1	1	1	-	-	-	-	-	-	1	2	1
Avg	**1.8**	**2**	**1.2**	**1.4**	**1.4**	-	-	-	-	-	-	**1.4**	**1.6**	**1.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 02	MICROSTRIP ANTENNAS	3	0	0	3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES

- To give insight of the radiation phenomena from micro-strip antennas.
- To give thorough understanding of the radiation characteristics of micro-strip antennas.
- To create awareness about the different types of micro-strip antenna, its arrays and design.

UNIT I MICRO-STRIP LINES 9

Introduction of Planar Transmission Structures, Micro-strip Field Configuration, Micro-strip measurement, Design Considerations, Suspended and Inverted Micro-strip Lines, Thin Film Micro-strip (TFM), Valley Micro-strip Lines, Micro-strip Applications.

UNIT II SLOT-LINE 9

Introduction of Slot-lines, Slot-line Analysis, Design Considerations, Slot-line Discontinuities, Slot-line Transitions, Slot -- line Applications. Coplanar Lines and Wave Guides: Introduction of Coplanar Waveguide and Coplanar Strips.

UNIT III COUPLED MICRO-STRIP LINES 9

Introduction of Coupled Micro-strip Lines, General Analysis of Coupled Lines, Characteristics of Coupled Micro-strip Lines, Measurements on Coupled Micro-strip Lines, Design Considerations for Coupled Micro-strip Lines, Discontinuities in Coupled Micro-strip Lines.

UNIT IV MICRO-STRIP CIRCUIT DESIGN 9

Excitation techniques; Micro-strip dipole; Rectangular patch, Circular patch, Micro-stripYagi antenna, Micro-strip array, Gain improvement techniques in micro-strip antenna, Impedance transformers, filters, isolators and phase shifters.

UNIT V MICRO-STRIP ANTENNA ARRAYS 9

Array theory, Array calculations and analysis, array architectures, corporate array design, Resonant series fed array design, Series fed traveling wave array design. Planar Waveguide Analysis, Discontinuity Measurements.

TOTAL: 45 hours

TEXT BOOKS:

T1: R. Garg, Inder Bahl, Prakash Bhartia, "Microstrip Antenna Design Handbook", 1st Edition, 2000.

T2: Ramesh Garg, Prakash Bhatia, InderBahl, ApisakIttipiboon, "Microstrip Antenna Design Hand Book", Artech House Inc., 1988

T3: Sainiti, Robert A., "CAD of Micro-strip Antenna for Wireless Applications", Artech House(1996).

REFERENCE BOOKS:

R1: Lu, Wong Kim, Planar antennas for Wireless applications, John Wiley and Sons 2003.

R2: Simons, Rainee N., Coplanar Waveguide Circuits, Components, and Systems, John Wiley and Sons, 2001.

R3: C. A. Balanis, Antenna Theory: Analysis and Design, 3rd ed., John Wiley & Sons, Hoboken, NJ, 2005.

R4: Hubregt.J.Visser, "Antenna Theory and Applications" 1st Edition, John Wiley & Sons Ltd,NewYork,2012.

R5: John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", Fourth Edition, Tata McGraw-Hill, 2006.

R6: Zhijun Zhang, "Antenna Design for Mobile Devices" 1st Edition, John Wiley & Sons.

WEBLINKS:

W1: https://courses.egr.uh.edu/ECE/ECE6345/Short%20Course/Introduction%20to%20Microstrip%20Antennas.pdf

W2: https://www.pdfdrive.com/microstrip-antenna-design-handbook-e34331704.html

COURSE OUTCOMES:

CO1	Apply the principles of electromagnetic to explain the characteristics of micro-strip line and coupled micro-strip line	**K2**
CO2	Illustrate slotted lines and its types	**K2**
CO3	Design consideration of coupled microstrip line	**K6**
CO4	Evaluate the gain improvement techniques of micro-strip line	**K2**
CO5	Design of various micro-strip antennas with various excitation techniques	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	-	-	-	-	1	2
CO2	2	3	1	2	2	-	-	-	-	-	-	-	2	1
CO3	2	3	1	2	1	-	-	-	-	-	-	-	1	1
CO4	3	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	1	1	1	1	1	-	-	-	-	-	-	-	2	1
Avg	**2.2**	**2**	**1.2**	**1.6**	**1.4**	-	-	-	-	-	-	-	**1.6**	**1.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 03	MOBILE COMMUNICATION AND NETWORKS	3	0	0	3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

- To understand the working principles of the mobile communication systems.
- To understand the relation between the user features and underlying technology.
- To analyze mobile communication systems for improved performance

UNIT I CELLULAR ARCHITECTURE 9

Cellular concepts-Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G, 3G, LTE and 5G cellular standards.

UNIT II MOBILE RADIO PROPAGATION 9

Large Scale Fading, Free space propagation model, three basic propagation mechanisms, Reflection, Ground Reflection (Two-Ray)Model, Diffraction, Scattering, Practical link budget using path loss models.

Small Scale Fading: Multipath Propagation, Types of small-scale fading, Parameters of Mobile Multipath channels, fading effects due to multipath time delay Spread and Doppler spread.

UNIT III DIGITAL SIGNALING AND EQUALIZATION TECHNIQUES 9

Modulation schemes – BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM, Receiver structure – Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear – ZFE and adaptive, Decision Feedback Equalizer (DFE).

UNIT IV SPREAD SPECTRUM TECHNIQUES FOR WIRELESS STANDARDS 9

Multiple access schemes – FDMA, TDMA, CDMA and SDMA, MIMO and space time signal processing, spatial multiplexing. Performance measures – average SNR, Average Symbol/Bit Error Rate. System examples – GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

UNIT V ANTENNAS FOR MOBILE TERMINAL 9

Antennas-Antennas for mobile terminal – monopole antennas, Planar Inverted– F antenna (PIFA, base station antennas and arrays– Yagi-Uda antenna, Micro strip patch array, Aperture array, Slotted wave guide array.

TOTAL: 45 hours

TEXT BOOKS:

T1: Jochen H. Schiller Mobile Communications, Pearson, 2008.

T2: WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill,2008.

T3: Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.

T4: AJ Viterbi, "CDMA: Principles of Spread Spectrum Communications",Addison Wesley, 1995.

REFERENCE BOOKS:

R1: VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

R2: M.Meena, "Wireless Communication",Scientific International Publishing, 1st Edition.

WEBLINKS:

W1: https://www.researchgate.net/publication/327136258_Lecture_Notes_on_Mobile_Communication

W2: https://lecturenotes.in/subject/914/wireless-and-mobile-communication-wmc/note

W3: https://en.wikipedia.org/wiki/Cellular_network

COURSE OUTCOMES:

CO1	Demonstrate knowledge on cellular concepts like frequency reuse frequency reuse, cell splitting, channel assignment and handoff.	**K2**
CO2	Analyze the various propagation mechanisms and its effects	**K4**
CO3	Evaluate the various modulation schemes and Equalization techniques of mobile signals	**K5**
CO4	Analyze the different spread spectrum access techniques in mobile communication techniques using the various parameters.	**K4**
CO5	Compare the effects of the various antennas used in mobile terminals	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	3	3	3	3	2	3
CO2	3	2	2	2	-	-	-	-	2	2	2	2	2	1
CO3	1	1	2	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	2	3	-	-	-	-	3	2	2	3	3	2
CO5	2	3	3	2	-	-	-	-	3	2	3	2	3	3
Avg	**2.2**	**2**	**2.2**	**2.2**	**-**	**-**	**-**	**-**	**2.6**	**2.2**	**2.4**	**2.4**	**2.6**	**2.2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC 04	INFORMATION THEORY AND CODING	3	0	2	4

PREREQUISITE: ANALOG AND DIGITAL COMMUNICATION

COURSE OBJECTIVES:

- To understand the various concepts in Information Theory and Coding.
- To be familiar with the methods for the generation of these codes and their decoding techniques.
- To be aware of the concepts of multimedia communication.

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

UNIT II DATA AND VOICE CODING 9

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive sub-band coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT III ERROR CONTROL CODING 9

Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes.

UNIT IV COMPRESSION TECHNIQUES 9

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

UNIT V AUDIO AND VIDEO CODING 9

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

TOTAL: 45 hours

TEXT BOOKS:

T1: Ranjan Bose, Information Theory, Coding and Cryptography, Publication, 2008.

T2: K S Shivaprakash Muralidhar Kulkarni, "Information Theory and Coding", Wiley Publication, January 2019.

T3: Arijit. Manna Saha, Nilot Pal Manna, Surajit Mandal, "Information Theory, Coding and Cryptography" Pearson Education India, 2013.

T4: Cover, Thomas, and Joy Thomas. Elements of Information Theory. 2nd ed. New York, NY: Wiley-Interscience, 2006.

T5: Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.Simon Haykin, "Communication Systems", 4thEdition, John Wiley and Sons, 2001.

REFERENCE BOOKS:

R1: Shu Lin and D J Costello, "Error Control Coding" Pearson ,2ndedition, 2004

R2: Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002; Chapters: 3,4,5.

R3: Steven Roman, "Coding and Information Theory", Springer, 1992

R4: Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995.

WEBLINKS:

W1: http://www.nitjsr.ac.in/course_assignment/EC23EC4211ITC_PPT.pdf

W2: https://www.wileyindia.com/information-theory-and-coding.html.

W3: https://www.cl.cam.ac.uk/teaching/0910/InfoTheory/InfoTheoryLectures.pdf

COURSE OUTCOMES:

CO1	Analyze the Entropy, Information rate of channels using different coding techniques Shannon – Fano coding, Huffman coding, Extended Huffman coding etc.	**K4**
CO2	Compare different Pulse modulation schemes and Discuss on Speech coding - LPC/Vocoder	**K5**
CO3	Measure the syndrome using cyclic codes and estimate the errors during encoding and decoding of different codes Examine different compression techniques	**K5**
CO4	Analyze different Image format and coding text Compression Techniques	**K4**
CO5	Discuss different JPEG& MPEG standards and compare the encoding and decoding techniques data compression	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	3	-	-	-	-	-	-	-	2	2
CO2	3	2	2	2	3	-	-	-	-	-	-	-	2	1
CO3	2	2	3	2	3	-	-	-	-	-	-	-	2	1
CO4	3	2	3	2	3	-	-	-	-	-	-	-	2	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	2	1
Avg	**2.8**	**2**	**2.6**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC- 05	ADAPTIVE SIGNAL PROCESSING	3	0	0	3

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

- To provide the mathematical framework for the understanding of adaptive statistical signal processing.
- To know the basic tools of vector spaces and discrete–time stochastic process.
- To understand the various issues involved in adaptive filtering and be familiar with the various types of adaptive filters will be introduced and their properties will be studied, specifically convergence, tracking, robustness and computational complexity.
- To apply adaptive filter theory using prescribed case studies.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Adaptive Systems – Definition and characteristics – Properties – Applications and examples of an adaptive system. General concept of adaptive filtering, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule–Walker equations. Random variables and stationary random processes, Correlation structures, properties of correlation matrices.

UNIT II LINEAR ESTIMATION AND PREDICTION 9

Linear prediction – Forward and Backward prediction, Solution ofProny's normal equations, Least mean–squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix.

UNIT III ADAPTIVE FILTERS 9

Variants of the LMS algorithm: the sign LMS family, FIR adaptive filters – adaptive filter based on steepest descent method– Widrow–Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization.

UNIT IV SIGNAL SPACE CONCEPTS AND ORTHOGONALITY 9

Signal space concepts – introduction to finite dimensional vector space theory, subspace inner product space, orthogonality, Gram – Schmidt orthogonalization, concepts of orthogonal projection, Vector space of random variables, correlation as inner product, forward and backward projections.

UNIT V RLS ADAPTIVE FILTERS AND ITS ESTIMATION 9

Introduction to recursive least squares (RLS), vector space formulation of RLS estimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters, RLS adaptive algorithm.

TOTAL:45 hours

TEXT BOOKS:

T1: S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

T2: C.Widrow and S.D. Stearns, Adaptive signal processing, Pearson Education; 1st edition (2002).

REFERENCE BOOKS:

R1: TülayAdali, Simon Haykin, "Adaptive Signal Processing: Next Generation Solutions", John Wiley & Sons, 2010.

R2: L.D. Davisson, G.Longo, "Adaptive Signal Processing", Publisher: Springer Vienna,2014.

R3: Jacob Benesty, Yiteng Huang, "Adaptive Signal Processing Applications to Real-World Problems", Publisher: Springer Berlin Heidelberg, 2013.

R4: Aurelio Uncini, "Fundamentals of Adaptive Signal Processing", Springer International Publishing, 2014.

WEBLINKS:

W1: https://nptel.ac.in/courses/117105075

W2: https://www.sciencedirect.com/topics/engineering/signal-space

W3: https://course.ece.cmu.edu/~ece792/handouts/LO_Chap_AdaptiveFilters.pdf

COURSE OUTCOMES:

CO1	Evaluate the performance of adaptive filtering and random processes.	**K5**
CO2	Estimate and predict theleast mean–squared error of FIR and IIR Wiener filter using methods like Prony's normal equations	**K4**
CO3	Analyze the error probability of adaptive filters using LMS and normalized LMS algorithms.	**K4**
CO4	Summarize signal space concepts and differentiate the various types of projections	**K5**
CO5	Evaluate the mean square error Vector Space using RLS algorithm	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	-	-	-	-	-	-	2	2	3
CO2	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO3	3	2	2	3	2	-	-	-	-	-	-	3	2	2
CO4	3	2	2	3	2	-	-	-	-	-	-	2	3	2
CO5	2	2	1	2	2	-	-	-	-	-	-	1	2	2
Avg	**2.6**	**2**	**1.8**	**2.2**	**1.8**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2.2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 06	DIGITAL IMAGE AND VIDEO PROCESSING	3	0	2	4

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

- To be familiar with the fundamentals of digital images and videos.
- To perform simple image processing techniques such as image compression and segmentation.
- To represent image in form of features.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS 9

Basic steps of Image processing – System sampling and quantization of an Image – Basic relationship between pixels. Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

UNITII IMAGE PROCESSING TECHNIQUES 9

Image Enhancement Techniques: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering.

Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region-based segmentation.

UNIT III IMAGE COMPRESSION 9

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding , wavelet coding, JPEG standards

UNIT IV FUNDAMENTAL OF VIDEO PROCESSING & VIDEO CODING 9

Basic steps of Video Processing - Analog video, Digital Video, Time varying Image Formation models – 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.Waveform based coding, Block based transform coding, predictive coding-Temporal prediction and transform coding Application of motion estimation in video coding.

UNIT V 2–D MOTION ESTIMATION & ERROR CONTROL TECHNIQUES 9

Optical flow, general methodologies, pixel-based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Transport level error control Error resilient encoding Decoder error concealment Encoder - decoder interactive error control Error resilience Tools in H.263 and MPEG-4.

TOTAL: 45 hours

TEXT BOOKS:

T1: Gonzalez and Woods,"Digital Image Processing", 3rd edition, Pearson.

T2: AlBovic, "Handbook of Image and Video Processing",Elsevier, 2005.

T3: Yao wang, JoemOstarmann and Yaquin Zhang, "Video processing and communication 1st Edition.

T4: M.Tekalp, "Digital video Processing", Prentice Hall Signal Processing 2nd edition.

T5: Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson 2002.

REFERENCE BOOKS:

R1: Relf, Christopher G, "Image acquisition and processing with LabVIEW", CRC press

R2: Anerozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons.

R3: Chris Solomon, Toby Breckon "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons.

R4: K.R. Rao and J. J. Hwang, "Techniques and Standards for Image, Video and Audio Coding," Prentice Hall, Upper Saddle River, New Jersey.

WEBLINKS:

W1: Professor Bernd Girod's course page on Image Communication about video compression: http://www.stanford.edu/class/ee398b/

W2: Professor Edward J. Delp of Purdue University class home page gives lot of information related to video processing http://cobweb.ecn.purdue.edu/~ace/courses/ee695-vid/

W3: Professor Yao's Video processing course page http://eeweb.poly.edu/~yao/ EL6123

W4: Moving Picture Expert group home page: www.mpeg.org
W5: Advanced System Television committee home page: www.atsc.org
W6: Digital Video Broadcasting home page: www.dvb.org

COURSE OUTCOMES:

CO1	Apply 2D transforms and analyse a digital image in frequency domain.	**K3**
CO2	Analyze images using histogram based and segmentation techniques.	**K4**
CO3	Compare and Contrast lossy and lossless compression techniques.	**K4**
CO4	Analyze various techniques in the processing and coding of Analog and digital videos.	**K4**
CO5	Implement motion estimation and analyse various error control techniques	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	1
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	1
Avg	**3**	**3**	**3**	**2.8**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 07	**WAVELET TRANSFORMS AND TECHNIQUES**	**3**	**0**	**2**	**4**

PREREQUISITE: SIGNALS AND SYSTEMS
COURSE OBJECTIVES:

- To study the basics of Fourier transforms and short time Fourier transforms.
- To study the wavelet transform in both continuous and discrete domain.
- To understand Multi Resolution Analysis and Wavelet concepts.
- To understand the applications of Wavelet transform.

UNIT I INTRODUCTION 9

Fourier transform and properties, Introduction to Time-Frequency Analysis, Short Time Fourier transform and concepts, Classes of wavelets: Haar, Daubechies.

UNIT II CONTINUOUS WAVELET TRANSFORMS 9

Wavelet Transform – definition and properties – concept of scale and its relation with frequency – Continuous Wavelet Transform (CWT) – Scaling function and wavelet functions: Daubechies.

UNIT III DISCRETE WAVELET TRANSFORMS AND FILTER BANKS 9

Discrete Wavelet Transform: Haar scaling functions and function spaces, Translation and scaling of $\phi(t)$, Haar wavelet function, properties, Filter Bank and sub band coding principle – Wavelet Filters - Inverse DWT computation by Filter bank.

UNIT IV MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) – Haar basis – Construction of general orthonormal MRA - Wavelet basis– Continuous time MRA – Discrete time MRA.

UNIT V CASE STUDY 9

Signal processing: Time Frequency analysis, Image and video Compression techniques, Image denoising techniques, Biomedical Application, Underwater Application.

TOTAL: 45 hours

TEXT BOOKS:

T1: Mallat S., "Wavelet tour of Signal Processing", Academic Press, 3rdEdition, Dec 2008.

T2: I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.

T3: C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.

T4: Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.

T5: Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.

T6: P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

REFERENCE BOOKS:

R1: B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

R2: A.N. Akansu and R.A. Haddad, Multi resolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.

R3: Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.

R4: Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean Michel Poggi, John Wiley & Sons, 2010.

WEBLINKS:

W1: https://nptel.ac.in/courses/108101093

W2: https://towardsdatascience.com/the-wavelet-transform-e9cfa85d7b34

COURSE OUTCOMES:

CO1	Explain the significance and issues in Time frequency analysis.	**K2**
CO2	Evaluate Continuous Wavelet Transform using the different wavelet functions.	**K4**
CO3	Compute DWT and IDWT using filter banks and sub-band coding principles.	**K5**
CO4	Explain Multi Resolution Analysis (MRA) using Haar and Wavelet basis.	**K2**
CO5	Apply DWT and CWT for diverse applications and understand time-frequency analysis.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO2	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO3	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO4	3	2	1	2	1	-	-	-	-	-	-	2	2	3
CO5	3	2	1	2	1	-	-	-	-	-	-	2	2	3
Avg	**3**	**2**	**1**	**2**	**1**	-	-	-	-	-	-	**2**	**2**	**3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC– 08	**INTRODUCTION TO MEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be familiar with the characteristics of sensors and actuators using MEMS
- To understand the materials, etching and laws governing MEMS

UNIT I INTRODUCTION TO MEMS 9

Overview of MEMS - Intrinsic Characteristics of MEMS –Definitions-Transducers– Sensors and Actuators –Introduction to Micro fabrication – Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis– Flexural beam bending.

UNIT II SENSORS AND ACTUATORS 9

Electrostatic sensors – Parallel plate capacitors – Applications- Flow sensor, Pressure sensor – Interdigitated Finger capacitor –Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples –Thermal resistors – Applications – flow sensor – Magnetic Actuators – Micromagnetic components.

UNIT III ELECTROSTATIC SENSORS AND ACTUATOR 9

Piezoresistive sensors – Piezoresistive sensor materials – Stress analysis of mechanical elements –Applications to Inertia, Pressure and Flow sensors – Piezoelectric sensors and actuators –piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching –Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Basic surface micromachining processes – Structural and Sacrificial Materials – Assembly of 3D MEMS – Foundry process.

UNIT V ANALYSIS OF MEMS AND NEMS 9

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hooke's law, Poisson effect, Linear Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

TOTAL: 45 hours

TEXT BOOKS:

T1: Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.

T2: G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

REFERENCE BOOKS:

R1: S.E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano- and Micro-engineering (Vol. 8). CRC press, (2005).

R2: S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.

R3: M. Madou, Fundamentals of Micro-fabrication, CRC Press, 1997.

R4: G. Kovacs, Micro-machined Transducers Sourcebook, McGraw-Hill, Boston, 1998.

R5: M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

WEBLINKS:

W1: https://nptel.ac.in/courses/108106165

W2: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/lecture-notes/

COURSE OUTCOMES:

CO1	Explain the basic principles and process in MEMS.	**K2**
CO2	Sketch the fabrication of sensors and actuators using MEMS.	**K3**
CO3	Estimate the characteristics of transmission lines using Smith chart. Compare and contrast the working of the various sensors and actuators.	**K4**
CO4	Evaluate the various materials, etching and micromachining processes.	**K5**
CO5	Determine the laws and processes involved in modeling of electromechanical systems.	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	-	-	-	-	-	-	-	-	1	-
CO2	2	3	2	1	-	-	-	-	-	-	-	-	2	-
CO3	3	3	1	2	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	2	2	-	-	-	-	-	-	-	2	-
CO5	3	3	2	2	1	-	-	-	-	-	-	-	3	-
Avg	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 09	**BIO-MEDICAL ELECTRONICS**	**3**	**0**	**0**	**3**

PREREQUISITE: NIL

COURSE OBJECTIVES:

- To gain knowledge about the various physiological parameters both electrical and non-electrical and the methods of recording and also the method of transmitting these parameters.
- To study about the various assist devices used in the hospitals.
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

The origin of Bio–potentials; Bio-potential electrodes, biological amplifiers, Electro

Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), PCG, EOG, lead systems and recording methods, typical waveforms and signal Characteristics.

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9

Introduction to biochemical process PH, PO2, P**CO2**, PH**CO3**(Bio gasanalyzers), Electrophoresis, colorimeter, photometer, Auto analyzer, Blood flow meter, Cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood cell counters.

UNIT III ASSIST DEVICES 9

Cardiac pacemakers (Need, Pacing Modes and Pulse generators, Power Sources and Electromagnetic Interference), DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

UNIT IV RADIOLOGICAL EQUIPMENTS AND BIO-TELEMETRY 9

Introduction to radiological equipment-Ionizing radiation, Diagnostic X–ray equipment (X ray Machines– Exposure control), Radiation Therapy. Diathermy – Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Telemetry principles– Biotelemetry,Wearable devices – Implantable Units – Applications

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Laser in medicine, Tele-stimulation - Insulin Pumps, Radio pill, Endomicroscopy-Thermograph, endoscopy unit – Brain-computer interfaces (BCIs), Lab on a chip, Nanorobotics –Electrical safety in medical equipment (Physiological effects of electrical current, Shock hazards (Gross shock, Micro current shock) from electrical equipment).

TOTAL: 45 hours

TEXT BOOKS:

T1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", 3rd Edition TATA McGraw-Hill, New Delhi, 2014.

T2. R. Anandanatarajan, "Biomedical Instrumentation and Measurements", Technology &Engineering, PHI Learning Pvt. Ltd., 2011.

T3. Leislie Cromwell, "Biomedical instrumentation and Measurement", Prentice Hall of India, New Delhi, 2011.

T4. C. Raja Rao & S K Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, Jan 2000.

REFERENCES BOOKS

R1. Joseph J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 2004.

R2. John .G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 2007.

R3. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.

R4. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982.

WEBLINKS:

W1: http://www.snscourseware.org/snscenew/notes.php?cw=CW_5d0b35c5b3633

W2: https://pdfroom.com/books/biomedical-instrumentation-and-measurements/vxdzZ1wKdRV/download

COURSE OUTCOMES

CO1	Classify the bio-potentials, amplifiers, recording system of various bio signals and analysis of biomedical signals	**K3**
CO2	Measure and analyze the various biochemical processes and examine the function of Assist devices	**K4**
CO3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators	**K5**
CO4	Apply the principles of radiology and study the various equipment to analyze the biological signals.	**K3**
CO5	Discuss the various electrical hazards and safety issues in handling medical equipment and examine the medical applications eg. Lasers, thermograph, Diathermy etc.	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	2	3	3	0	-	-	-	-	-	1	2
CO2	2	2	2	3	3	3	0	-	-	-	-	-	2	1
CO3	2	2	3	3	3	3	1	-	-	-	-	-	1	1
CO4	3	2	3	3	3	3	3	-	-	-	-	-	2	2
CO5	2	2	3	2	3	3	3	-	-	-	-	-	1	1
Avg	**2.2**	**1.8**	**2.4**	**2.6**	**3**	**3**	**1.4**	**-**	**-**	**-**	**-**	**-**	**1.4**	**1.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓	✓	✓

PEC-10	CMOS DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge about the basic CMOS circuits and electrical properties of CMOS technology
- To learn techniques of chip design using programmable devices
- To Learn the basics of Fabrication and Layout of CMOS Integrated Circuits

UNIT I CMOS TECHNOLOGY 9

A brief History–MOS transistor, Ideal I–V characteristics, C–V characteristics, Non ideal IV effects, DC transfer characteristics – Basic CMOS technologies – nwell, pwell, twin tub, SOI process, Layout design Rules, CMOS process enhancements, Manufacturing issues, Physical design of logic gates– Inverter, NAND NOR

UNIT II CIRCUIT CHARACTERIZATION AND SIMULATION 9

Delay estimation, Logical effort and Transistor sizing, Power dissipation, Interconnect, Design margin, Reliability, Scaling– SPICE tutorial, Device models, Device characterization, Circuit characterization, Interconnect simulation

UNIT III COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN 9

Circuit families –Low power logic design – comparison of circuit families – Sequencing static circuits, circuit design of latches and flip flops, Static sequencing element methodology– sequencing dynamic circuits – synchronizers

UNIT IV CMOS TESTING 9

Need for testing– Testers Fault models, Stuck line (single and multiple), Bridging, Stuck open, Text fixtures and test programs– Logic verification– Silicon debug principles– Manufacturing test – Design for testability – Boundary scan– chip level and system level test techniques.

UNIT V SPECIFICATION USING VERILOG HDL 9

Basic concepts– identifiers– gate primitives, gate delays, operators, Data flow and RTL, structural gate level switch level modeling, Design hierarchies, Behavioral and RTL modeling, Test benches, Structural gate level description of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch and D flip flop. An overview of the features of advanced FPGAs, Comparison of ASICs, FPGAs

TOTAL: 45 hours

TEXT BOOKS:

T1: Neil H.E Weste and Harris "CMOS VLSI DESIGN: A Circuit System and Perspective" (Third edition) Pearson Education, 2016.

T2: Uyemura J.P "Introduction to VLSI Circuits and Systems", Wiley 2006.

REFERENCE BOOKS:

R1: K. Lal Kishore 'VLSI Design" Wiley 2019

R2: D.APucknell& K. Eshraghian "Basic VLSI Design", Third edition, PHI, 2003

R3: Wayne Wolf, "Modern VLSI design", Pearson Education, 2003

R4: M.J.S.Smith" Application specific integrated circuits", Pearson Education, 1997

R5: J.Bhasker" Verilog HDL primer", BS publication,2001 5. Ciletti "Advanced Digital Design with theVerilog HDL", Prentice Hall of India, 2003.

WEBLINK:

W1: https://nptel.ac.in/courses/108107129

COURSE OUTCOMES:

CO1	Apply the characteristics model of CMOS technology for the analysis and design of IC	**K3**
CO2	Calculate the functionality and the performance of a design with low static power consumption, delay and size reduction in a CMOS device	**K4**
CO3	Design combinational and sequential circuits at transistor level using flipflops and latches	**K6**
CO4	Verify the basic design correctness, specifications and test procedure.	**K4**
CO5	To design structural and behavioral modelling in register-transfer level**,** check the circuit functionality and the prototyping applications in Processors.	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	1	2	-	-	-	-	-	-	2	2	2
CO2	2	2	2	1	-	-	-	-	-	-	-	2	2	2
CO3	2	2	2	1	-	-	-	-	-	-	-	2	2	2
CO4	3	2	2	1	-	-	-	-	-	-	-	2	2	3
CO5	2	2	2	1	2	-	-	-	-	-	-	2	2	3
Avg	**2.2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC-11	HIGH SPEED ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To understand significance and the areas of application of high-speed electronics circuits.
- To understand the properties of various components used in high speed electronics
- To design High-speed electronic systems using appropriate components.

UNIT I SEMICONDUCTOR MATERIALS CHARACTERISTICS 9

Semiconducting Materials – (Si, GaAs, InP) – electrons in periodic lattices - energy band diagram – carrier concentration and carrier transport phenomenon – electrical – optical – thermal and high field properties of semiconductors.

UNIT II HOMOJUNCTION DEVICES 9

Homojunction Devices (BJT and FET): Structure - band diagram – operation – I-V and C-V characteristics (analytical expressions) - small signal switching models.

UNIT III MOS DEVICES 9

MOS Diode: Structure – band diagram – operation – C–V characteristics – effects of oxide charges – avalanche injection – high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation I–V and C–V characteristics (analytical expressions) – MOSFET breakdown and punch through – subthreshold current – scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET – buried channel MOSFET –charge coupled devices.

UNIT IV ADVANCED DEVICES 9

HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models - benefits of heterojunction transistor for high speed applications.

UNIT V FABRICATION AND CHARACTERIZATION 9

Crystal Growth and Wafer Preparation: Epitaxy – diffusion – ion implantation – dielectric film deposition and oxidization techniques – masking and lithography techniques (optical, e-beam and other advanced lithography techniques) – metallization – bipolar and MOS integration techniques – interface passivation techniques; Characterization Techniques: Four probe and hall effect measurement – I-V and C-V for dopant profile characterization and DLTS.

TOTAL:45 hours

TEXT BOOKS:

T1: Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: AHandbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press.

T2: Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits",Cambridge University Press, 2004, ISBN 0521835399.

T3: Nandita Das Gupta and Amitava Das Gupta, "Semiconductor Devices: Modeling and Technology", Prentice Hall of India, 2004.

T4: M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", John Wiley and Sons, 2008.

REFERENCE BOOKS:

R1: S. M. Sze, "Physics of Semiconductor Devices", 3rdedition, John Wiley and Sons, 2007

R2: J. Singh, "Semiconductor Devices: Basic Principles", John Wiley and Sons, 2007.

R3: BehzadeedajjRazavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.

R4: Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.

R5: Kai Chang, "RF and Microwave Wireless systems", John Wiley & Sons, Inc. New York, 2000.

R6: R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.

WEBLINKS:

W1: http://nptel.iitm.ac.in/courses/Webcoursecontents/IITDelhi/Semiconductor%20Devices/ in dex.html

W2: http://nptel.iitm.ac.in/video.php/subjectId/117106093

W3: http://nptel.iitk.ac.in/courses/Webcourse-contents/IITKANPUR/HighSpeed_Semiconductor Devices/ ui/Course_home

COURSE OUTCOMES:

CO1	Analyze the characteristics of semiconductor materials such as the energy band diagram, carrier concentration and carrier transport phenomenon	**K4**
CO2	Compare the working of BJT and FET suing small signal switching models	**K4**
CO3	Distinguish the working and characteristics of various MOS devices.	**K4**
CO4	Explain the operation of heterojunction transistors for high speed applications	**K3**
CO5	Recommend various components and methods for fabrication and characterization	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	1	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	3	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	3	3
CO4	2	1	2	2	2	-	-	-	-	-	-	2	1	3
CO5	2	2	2	2	2	-	-	-	-	-	-	2	3	2
Avg	**2**	**1.8**	**2**	**2**	**1.8**	-	-	-	-	-	-	**2.2**	**2.2**	**2.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		

PEC – 12	NANO ELECTRONICS	3	0	0	3

PREREQUISITE: ELECTRONIC DEVICES

COURSE OBJECTIVES:

- To understand various aspects of nano-technology and the processes involved in making nano components and material.
- To leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Introduction to nanotechnology, Types of nanotechnology and nano machines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space, Meso structures.

UNIT II BASICS OF QUANTUM MECHANICS 9

Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids.Kronig– Penny Model.Brillouin Zones.

UNIT III SHRINK-DOWN APPROACHES 9

Shrink-down approaches: Introduction, CMOS Scaling, The nano scale MOSFET, Finfets-Fin-FET Structure, Double Gate Structure Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.).

UNIT IV CARBON NANOTUBES 9

Carbon Nanotubes: Fullerenes – types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotubes FETs – Nanotubes for memory applications.

UNIT V SEMICONDUCTORS AND ELECTRONIC DEVICES 9

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.

TOTAL: 45 hours

TEXT BOOKS:

T1: G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

T2: W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.

T3: K.E. Drexler, Nanosystems, Wiley, 1992.

REFERENCE BOOKS:

R1: C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

R2: J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

WEBLINKS: :

W1: https://www.sciencedirect.com/topics/materials-science/nanoelectronics

W2: https://www.nanowerk.com/nanoelectronics.php

COURSE OUTCOMES:

CO1	Summarize the atomic and molecular structure and size of nano particles.	**K2**
CO2	Understand Basics of Quantum Mechanics, Band Theory of Solids and apply knowledge to model the electronic devices.	**K4**
CO3	Compare the performance of Fin-FET Structure and double Gate Structure Vertical MOSFETs	**K2**
CO4	Analyze the electronic properties and synthesis of carbon nanotubes , carbon nanotubes FETs	**K5**
CO5	Analyze the input and output characteristics of Resonant Tunneling Diode, Coulomb dots, Quantum blockade,2D semiconductors	**K5**

MAPPING OF COURSE OUTCOMES: WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	1	1	2	2	-	-	-	-	3	2	2
CO2	2	2	2	2	1	-		-	-	-	-	2	2	1
CO3	2	3	2	2	1	-	1	-	-	-	-	1	2	1
CO4	2	1	1	2	2	-	1	-	-	-	-	1	2	2
CO5	2	2	3	3	2	3	1	2	-	-	-	1	3	3
Avg	**2**	**1.8**	**1.8**	**2**	**1.4**	**1**	**1**	**0.4**	**-**	**-**	**-**	**1.6**	**2.2**	**1.8**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 13	TRANSMISSION LINES AND WAVEGUIDES	3	0	0	3

PREREQUISITE: ELECTROMAGNETIC WAVES

COURSE OBJECTIVES:

- To acquire knowledge in design of symmetric network filters and to understand the basics of transmission line theory.
- To enhance knowledge in signal propagation at Radio frequencies
- To analyze the characteristics of EM waves & its propagation between parallel planes & through waveguides.

UNIT I NETWORK FILTERS 9

Classification of filters– Characteristic impedance of Symmetrical Networks – Current and voltage ratios – Propagation constant, – Properties of Symmetrical Networks – characteristic impedance in the pass and stop band, constant K filters –LPF,HPF, BPF and BEF- m–derived filters –LPF and HPF– Filter circuit design .

UNIT II TRANSMISSION LINE THEORY 9

General theory of Transmission lines – Characteristic impedance – Propagation Constant –The Two Standard Forms for Voltage and Current of a Line Terminated by an Impedance –The infinite line – 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 – reflection factor and reflection loss.

UNIT III HIGHFREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies – Line constants 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– $\lambda / 4$ line, Impedance matching – single and double–stub matching –smith chart and its applications – Problem solving using Smith chart.

UNIT IV GUIDED WAVES BETWEEN PARALLEL PLANES 9

Transmission of TM waves between Parallel planes – Transmission of TE waves between Parallel planes. Transmission of TEM waves between Parallel planes – Velocities of the waves – characteristic impedance – Attenuation of TE and TM Waves in Parallel Plane Guides – Wave Impedances.

UNIT V WAVEGUIDES 9

Application of Maxwell's equations to the rectangular waveguide. TM and TE waves in Rectangular guide –Bessel's differential equation, Bessel function and TE and TM waves in Cylindrical waveguides. Rectangular and Circular Resonant cavities.

TOTAL:45 hours

TEXT BOOKS:

T1: E.C.Jordan, K.G. Balmain: "E.M.Waves& Radiating Systems", Pearson Education, 2006.

T2: .John. D. Ryder, "Network Lines and Fields", PHI Learning, Second Edition, 2005.

REFERENCE BOOKS:

R1: Umesh Sinha, "Transmission lines and Networks", Sathya Prakasham Publishers, 1997.

R2: JosephEdminister, Schaum's Series, "Electromagnetics", TMH, 2007.

R3: G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, 2006.

WEBLINKS:

W1: https://nptel.ac.in/courses/117101057

W2: https://www.vidyarthiplus.com/vp/Thread-EC2305-Transmission-Lines-and-Wave-guides-Einstein-Lecture-Notes

W3: https://engineeringinterviewquestions.com/mcqs-on-types-of-waveguides-answers/

COURSE OUTCOMES:

CO1	Explain the concepts, design techniques and applications of constant K and m-derived filters	**K5**
CO2	Analyze voltage, current, power, impedance, efficiency and reflection coefficient on a transmission line.	**K4**
CO3	Estimate voltage, current and input impedance of radio frequency line and solve design problems using Smith chart	**K5**

CO4	Apply Maxwell's equations to find the field components of TE, TM and TEM and to analyze its characteristics.	**K3**
CO5	Evaluate the field components of TE and TM waves through rectangular and cylindrical wave guides.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	-	-	-	-	1	1	-	-	2	2
CO2	2	2	2	2	-	-	-	-	1	1	-	-	2	2
CO3	2	2	2	2	-	-	-	-	1	1	-	-	2	2
CO4	2	2	2	2	-	-	-	-	1	1	-	-	2	2
CO5	2	2	2	2	-	-	-	-	1	1	-	-	2	2
Avg	**2**	**2**	**2**	**2**	-	-	-	-	**1**	**1**	-	-	**2**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 14	**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I BASIC THEORY 8

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories,

UNIT II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III EMI MITIGATION TECHNIQUES 10

Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and its operation – LPF, HPF, BPF, Surge protection devices, Transient protection.

UNIT IV STANDARDS AND REGULATION 9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications. MIL461E Standards.

UNIT V EMI TEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Current probes, MIL -STD test methods.

TOTAL: 45 hours

REFERENCE BOOKS:

R1: Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2010

R2: V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.

R3: Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009

R4: Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005

R5: Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002

R6: W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.

WEBLINK:

W1: https://nptel.ac.in/courses/108106138

COURSE OUTCOMES:

CO1	Identify various sources of EMI	**K3**
CO2	Illustrate EMI, EMC and testing methods	**K2**
CO3	Summarize standards, regulations used for EMI/EMC testing	**K2**
CO4	Explain different coupling and mitigation Mechanism to reduce Electromagnetic Interference	**K5**
CO5	Recommend appropriate instrument for EMI testing	**K5**

MAPPING OF COURSE OUTCOMES: WITH PROGRAMME OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	1	-	2	2	-	-	-	-	-	2	1
CO2	2	-	2	2	-	2	1	-	-	-	-	-	2	2
CO3	2	2	2	2	-	2	2	-	-	-	-	-	3	2
CO4	3	2	2	3	-	3	2	-	-	-	-	-	3	3
CO5	2	2	2	3	-	3	3	-	-	-	-	-	3	3
Avg	**2.4**	**1.75**	**2**	**2.2**	**-**	**2.4**	**2**	**-**	**-**	**-**	**-**	**-**	**2.6**	**2.2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 15	**COMPUTER ARCHITECTUREAND ORGANIZATION**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make students understand the basic structure and operation of digital computer.
- To understand the hardware–software interface.
- To familiarize the students with hierarchical memory system including cache memories and virtual memory.
- To expose the students with different ways of communicating with I/O devices and standard I/O interfaces.

UNIT I BASIC STRUCTURE OF COMPUTERS 9

Basic Structure of Computers, Functional units, software, and performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Queues.

UNIT II ARITHMETIC OPERATIONS 9

Processor organization, Information representation, Addition and Subtraction – Multiplication – Division –, ALU design, Floating point arithmetic operations.

UNIT III BASIC PROCESSING AND CONTROL UNIT 9

Control Design, Pipelining, Instruction sequencing, Interpretation, Hard wired control – Design methods, and CPU control unit. Microprogrammed Control – Basic concepts, minimizing microinstruction size. Microprogrammed computers.

UNIT IV MEMORY SYSTEM 9

Memory organizations, Device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

UNIT V I/O ORGANIZATION 9

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces,Concept of parallel processing, Forms of parallel processing, interconnect network.

TOTAL: 45 hours

TEXT BOOKS:

T1: V.CarlHammacher, "Computer Organisation", Fifth Edition.

T2: A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition

T3: Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition

T4: M.M.Mano, "Computer System Architecture", Pearson; 3rd edition, 1992

REFERENCE BOOKS:

R1: C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition

R2: Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

WEBLINKS:

W1: https://nptel.ac.in/courses/106106134

W2: https://www.sciencedirect.com/topics/computer-science/computer-architecture.

W3: https://www.academia.edu/39534878/Computer_System_Architecture_Morris_Mano

COURSE OUTCOMES:

CO1	Analyse the different basic structure of computers and make use of different instructions in the instruction set architecture for programming.	**K4**
CO2	Explain the fundamental concepts of a processor and its bus configurations.	**K2**
CO3	Illustrate the concept of pipelined execution.	**K3**
CO4	Distinguish the different secondary storage devices available and to analyze its cache performance.	**K2**
CO5	List the different ways of communication with I/O devices	**K2**

MAPPING OF COURSE OUTCOMES: WITH PROGRAMME OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	1	-	-	-	-	-	-	3	1	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	1
CO3	2	2	2	2	1	-	-	-	-	-	-	1	2	1
CO4	2	2	2	2	3	-	-	-	-	-	-	1	2	3
CO5	2	2	3	2	3	-	-	-	-	-	-	2	2	2
Avg	**2.2**	**2**	**2.2**	**1.8**	**2**	-	-	-	-	-	-	**1.8**	**2**	**1.8**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 16	WIRELESS NETWORKS	3	0	0	3

PREREQUSITE: NIL

COURSE OBJECTIVES:

- To understand physical as wireless MAC layer alternatives techniques.
- To learn planning and operation of wireless networks.
- To study various wireless LAN and WAN concepts.
- To understand WPAN and geo–location systems

UNIT I MULTIPLE RADIO ACCESS 9

Medium Access Alternatives*:* Fixed– Assignment for Voice Oriented Networks, Random Access for Data Oriented Networks, Handoff and Roaming Support, Types of handoff. Security and Privacy in wireless network, Radio propagation mechanism.

UNIT II WIRELESS WANS 9

First Generation Analog, Second Generation TDMA – GSM, Short Messaging Service in GSM, Second Generation CDMA – IS–95,Comparison of TDMA,FDMA and CDMA.GPRS – Third Generation Systems (WCDMA/CDMA 2000)

UNIT III WIRELESS LANS 9

Introduction to wireless LANs – various IEEE Standards IEEE 802.11 WLAN – Architecture and Services, Physical Layer– MAC sub layer– MAC Management Sub layer, Other IEEE 802.11 standards, HIPERLAN, WiMAX standard.

UNIT IV ADHOC AND SENSOR NETWORKS 9

Characteristics of MANETs, Merits and demerits of MANET, Table–driven and Source–initiated, On Demand routing protocols, Hybrid protocols, Application of ADHOC network Wireless Sensor networks – Classification, MAC and Routing protocols.

UNIT V WIRELESS MANS AND PANS 9

Wireless MANs – Physical and MAC layer details and architecture, Wireless PANs – Architecture of Bluetooth Systems, Physical and MAC layer details, various Standards for MAN and PAN, Merits and Demerits of MAN and PAN.

TOTAL: 45 hours

TEXT BOOKS:

T1: William Stallings, "Wireless Communications and networks", Pearson / Prentice Hall of India, 2nd Ed., 2007.

T2: Dharma Prakash Agrawal &QingAnZeng, "Introduction to Wireless and Mobile Systems", Thomson India Edition, 2nd Ed., 2007.

REFERENCE BOOKS:

R1: Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2007.

R2: KavethPahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks", Pearson Education Asia, 2002.

WEBLINKS:

W1: https://ict.iitk.ac.in/courses/wireless-ad-hoc-and-sensor-networks/

W2: http://www.gecgh.cteguj.in/uploads/5882/SWAYAM_PGCSE.pdf

COURSE OUTCOMES:

CO1	Illustrate the various radio access and propagation mechanisms	**K3**
CO2	Compare the working and performance of TDMA, FDMA and CDMA techniques	**K4**
CO3	Summarize the various IEEE standards used in wireless LANs.	**K2**
CO4	Compare the architecture, layers and standards of wireless MANs and PANs	**K4**
CO5	Design and implement wireless network environment for any application using latest wireless protocols and standards.	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	1	3	-	1	-	-	-	2	2	2
CO2	3	2	2	2	2	3	-	2	-	-	-	3	3	0
CO3	2	2	2	2	2	-	-	1	-	-	-	2	3	1
CO4	2	1	2	3	2	-	-	2	-	-	-	2	3	3

CO5	2	2	3	2	3	2	-	2	-	-	-	2	3	2
Avg	**2.2**	**1.6**	**2.2**	**2.2**	**2**	**1.6**	**-**	**1.6**	**-**	**-**	**-**	**2.2**	**2.8**	**1.6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 17	MOBILE AD-HOC NETWORKS	3	0	0	3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

- To understand the design issues in ad hoc networks.
- To learn the different types of MAC protocols.
- To be familiar with different types of ad hoc routing protocols.
- To be exposing to the TCP issues in ad hoc networks.
- To learn the architecture of ad hoc networks.

UNIT I INTRODUCTION TO ADHOC NETWORKS 9

Evolution of Wireless Network- Wireless Communication Characteristics- Types of Wireless Networks- Forces Driving Wireless Technology Evolution, Mobile Adhoc Network-Characteristics-Advantages-Application-Design issues and Constraints, Technical Challenges-Media Access Control and Optimization- Ad Hoc Routing- Multicasting and Broadcasting - TCP Issues- Energy Conservation- Network Security

UNIT II WIRELESS LANS AND PANS 9

Wireless LAN Technologies-IEEE 802.11a- IEEE 802.11b- IEEE 802.11g, -HIPERLAN 1 & 2-Infrared WLANs-UWB, Wireless PAN Technologies-Bluetooth-HomeRF-RFID.

UNIT III WIRELESS WANS AND MANS 9

The Cellular Concept-Capacity Enhancement-Channel Allocation-Handoff, Cellular Architecture, WLL- Architecture of WLL- WLL Technologies, WATM-Generic Reference model-MAC layers in WATM- Handoff Issues in WATM, Location Management

UNIT IV ADHOC WIRELESS NETWORKS 9

Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks-Medium Access Scheme-Quality of Service Provisioning-Security-Address and Service Discovery-Energy Management-Scalability-Deployment Considerations, Ad Hoc Wireless Internet & its Issues

UNIT V MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS 9

Classification of MAC protocols, Issues in Designing a Mac Protocol for Ad Hoc Wireless Networks, Design Goals of a Mac Protocol for Ad Hoc Wireless Networks, MACAW: A Media Access Protocol for Wireless LANs, Floor Acquisition Multiple Access Protocol, Collision Avoidance Time Allocation Protocol, Five-Phase Reservation Protocol, Distributed Laxity-Based Priority Scheduling Scheme, MAC Protocol Using Directional Antennas

TOTAL: 45 hours

TEXT BOOKS:

T1: Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile Adhoc networking, Wiley– IEEE press, 2004.

T2: C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education, 2007.

REFERENCE BOOKS:

R1: Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

R2: Mohammad Ilyas, The handbook of Adhoc wireless networks, CRC press, 2002.

R3: T. Camp, J. Boleng, and V. Davies Wireless Commn. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, 2002

WEBLINKS:

W1: www.educba.com/mobile-ad-hoc-network/

W2: www.brainkart.com/article/HIPERLAN(high-performance-local-area-network)_9933/

COURSE OUTCOME

CO1	Analyze the applications and features of Mobile Adhoc networks.	**K4**
CO2	Organize the different MAC protocols in Mobile Adhoc Network.	**K3**
CO3	Interpret the design issues, goals and classification of routing protocols.	**K5**
CO4	Estimate suitable secure routing protocols for the various types of security attacks in Adhoc networks.	**K5**
CO5	Elaborate the concept of cross layer design	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	-	-	-	-	-	2	2	2	2	2
CO2	2	2	1	2	-	-	-	-	-	1	2	2	3	2
CO3	1	2	2	2	-	-	-	-	-	2	1	1	2	2
CO4	2	2	1	2	-	-	-	-	-	2	2	2	2	2
CO5	2	2	2	2	-	-	-	-	-	1	2	2	2	2
Avg	**1.8**	**2**	**1.6**	**2**	-	-	-	-	-	**1.6**	**1.8**	**1.8**	**2.2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 18	SATELLITE COMMUNICATION	3	0	0	3

PREREQUISITE: MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

- To visualize the architecture of satellite systems as a means of high speed, high range communication system.
- To state various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- To solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

UNIT I SATELLITE ORBITS 9

Introduction to satellite communication, 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 AND SATELLITE LINK DESIGN 9

Spacecraft Technology– Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation– performance impairments–system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations–System reliability and design lifetime.

UNIT III SATELLITE ACCESS 9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – Encryption

UNIT IV EARTH SEGMENT 9

Earth Station Technology— Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP, Antenna Gain,Transmission losses – Free–space transmission – Feeder losses – Antenna misalignment

losses – Fixed atmospheric and Ionospheric losses.

UNIT V SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)– Direct to home Broadcast (DTH), Digital audio broadcast (DAB)– World space services, Business TV(BTV), GRAMSAT, Specialized services – E–mail, Video conferencing, Internet

TOTAL:45 hours

TEXT BOOKS:

T1: Dennis Roddy, "Satellite Communication:", 4th Edition, McGraw Hill,2009.

T2: Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt, "Satellite Communications", Wiley India. 2ndedition 2002.

REFERENCE BOOKS:

R1: Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.

R2: N.Agarwal, Design of Geosynchronous Space Craft, Prentice Hall, 1986.

R3: Bruce R. Elbert, The Satellite Communication Applications, Hand Book, Artech House Bostan London, 1997.

.

WEBLINKS:

W1: https://nptel.ac.in/courses/117105131

W2: https://ocw.mit.edu/courses/16-851-satellite-engineering-fall-2003/pages/lecture-notes/

W3: https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/SATTELITE%20COMMUNICATIONS.pdf

COURSE OUTCOMES:

CO1	Understand the fundamentals of satellite communication	**K2**
CO2	Develop concepts in space segment and to Analyze satellite link design.	**K3**
CO3	Distinguish the various multiple access schemes such as TDMA, FDMA and CDMA	**K4**
CO4	Evaluate the various interferences and its effect on the performance of the system.	**K5**
CO5	Explain the various applications of satellite communication	**K2**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	-	2	-	-	-	2	-	1	2	2
CO2	2	2	1	2	-	2	-	-	-	2	-	1	2	2
CO3	2	2	1	2	-	2	-	-	-	2	-	1	-	-
CO4	2	2	1	2	-	2	-	-	-	2	-	1	2	2
CO5	2	2	1	2	-	2	-	-	-	2	-	1	-	-
Avg	**2.2**	**2**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**1**	**1.2**	**1.2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓				✓

PEC – 19	WIRELESS SENSOR NETWORKS	3	0	0	3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

- To understand the design issues in wireless sensor networks.
- To learn the different types of MAC protocols.
- To be familiar with different types of routing protocols.
- To learn the architecture and protocols of wireless sensor networks.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Introduction to Sensor Networks, Unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks, Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Challenges for WSN, Enabling Technologies for Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Hardware Components of sensor node- controller, memory, communication device, sensors and actuators, power supply, Energy consumption of Sensor Node- Operation states with different power consumption, Microcontroller energy consumption, Memory, Radio transceivers, Power consumption of sensor and actuators Gateway Concepts: Need for gateway, WSN to Internet Communication, Internet to WSN Communication.

UNIT III TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples.

UNIT IV MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – ContentionBased protocols – Schedule-Based protocols – IEEE 802.15.4 Zigbee – Topology Control – Routing Protocols.

UNIT V SECURITY IN WIRELESS SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols.

TOTAL: 45 hours

TEXT BOOKS:

T1: Holger Karl& Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

T2: C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2006.

T3: Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks -An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS:

R1: WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory and Practice", John Wiley & Sons Publication,2011.

R2: SabrieSoloman, "Sensors Handbook" by McGraw Hill publication. 2009.

R3: KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science.

R4: Philip Levis, And David Gay, "TinyOS Programming" Cambridge University Press 2009.

WEBLINKS:

W1: www.geeksforgeeks.org/wireless-sensor-network-wsn

W2: www.studocu.com/in/document/delhi-technological-university/wireless-ad-hoc-sensor-networks/mac-protocols-for-wireless-sensor-networks/27583362

COURSE OUTCOME

CO1	Distinguish Wireless Sensor Networks and ADHOC Networks.	**K4**
CO2	Experiment with Operating Systems for WSN	**K3**
CO3	Relate various architecture models in Wireless Sensor Network	**K2**
CO4	Analyze the various routing protocols in Wireless Sensor Networks.	**K4**
CO5	Estimate the importance of security in WSN.	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	2	2	2	2	2
CO2	1	2	1	2	-	-	-	-	-	1	1	2	2	2
CO3	2	3	2	2	-	-	-	-	-	2	1	2	1	2
CO4	2	2	1	2	-	-	-	-	-	1	2	1	2	2
CO5	2	2	2	2	-	-	-	-	-	2	2	2	2	2
Avg	**1.8**	**2.2**	**1.6**	**2**	**-**	**-**	**-**	**-**	**-**	**1.6**	**1.6**	**1.8**	**1.8**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 20	COGNITIVE RADIO NETWORKS	3	0	2	4

PREREQUISITE: INTRODUCTION TO MATLAB, WIRELESS NETWORKS, INTERNET OF THINGS

COURSE OBJECTIVES:

- To introduce the students to the basic concepts and principles of multiplexing techniques.
- To teach the concept of Digital switching and digital switching in an analog environment.
- To introduce the students to the basic concepts of network synchronization control and management.

UNIT I INTRODUCTION TO COGNITIVE RADIOS 9

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

UNIT II COGNITIVE RADIO ARCHITECTURE 9

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

UNIT III INTRODUCTION TO SOFTWARE DEFINED RADIO 9

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

UNIT IV SDR ARCHITECTURE 9

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

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

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

TOTAL: 45 hours

TEXT BOOKS:

T1: Joseph MitolaIII, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.

T2: ThomasW.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", Artech House .2009.

T3: Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.

REFERENCE BOOKS:

R1: Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, "Next generation dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.

R2: HasariCelebi, HuseyinArslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.

R3: Markus Dillinger, KambizMadani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.HuseyinArslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.

WEBLINKS:

W1: www.slideshare.net/vatsalasharma180/cognitive-radio-networks-48446892

W2: www.wirelessinnovation.org/assets/documents/tut-SDR_Architectures.pdf

COURSE OUTCOMES:

CO1	Understand the need of Cognitive radio and software defined radio in wireless networks.	**K2**
CO2	Identify the hardware and software architecture of software defined radio and Cognitive Radio	**K3**
CO3	Analyze the design principles of software defined radio and cognitive radio to develop algorithms for cognitive radio spectrum sensing and dynamic spectrum access.	**K4**
CO4	Choose algorithms and implement to meet the requirements of next generation wireless networks	**K5**
CO5	Build experiments and projects with real time wireless applications	**K3**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	1	2	1	2	1	-	-	-	-	2	1	2
CO2	3	2	2	2	2	2	-	-	-	-	-	2	3	-
CO3	2	2	2	2	1	-	1	-	-	-	-	1	2	1
CO4	2	1	1	2	2	-	-	-	-	-	-	1	2	3
CO5	2	2	3	2	2	2	-	2	-	-	-	1	2	2
Avg	**2**	**1.6**	**1.8**	**2**	**1.6**	**1.2**	**0.4**	**0.4**	**-**	**-**	**-**	**1.4**	**2**	**1.6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC – 21	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

PREREQUISITE: Nil
COURSE OBJECTIVES:

- To understand OSI security architecture and classical encryption techniques.
- To acquire fundamental knowledge on the concepts of finite fields and number theory.
- To understand various block cipher and stream cipher models.
- To describe the principles of public key cryptosystems, hash functions and digital signature.
- To understand the concepts of public key encryption and number theory.
- To understand authentication and Hash functions & to know the network security tools and applications.

UNIT I INTRODUCTION 9

Services, Mechanisms, and attacks–the OSI security architecture–Network security model–Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography)

UNIT II PUBLIC KEY CRYPTOGRAPHY 9

Data Encryption Standard–Block cipher principles–block cipher modes of operation–Advanced Encryption Standard (AES). Public key cryptography: Principles of public key cryptosystems–The RSA algorithm–Key management – Diffie Hellman Key exchange.

UNIT III AUTHENTICATION AND HASH FUNCTIO 9

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm – Secure Hash Algorithm – HMAC Digital Signatures – Authentication Protocols – Digital Signature Standard.

UNIT IV NETWORK SECURITY 9

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security — S/MIME– Functionality, Messages and Certificate Processing – IP Security-. IP Security architecture.

UNIT V SYSTEM LEVEL SECURITY 9

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures –Firewall Design Principles – Characteristics, Types and Configuration – Trusted Systems – Data Access Control, Concept and Trojan Horse Defense.

TOTAL: 45 hours

TEXT BOOKS:

T1: William Stallings, "Cryptography and Network Security – Principles and Practices",Pearson Education, Third Edition, 2003.

T2: Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw–Hill, 2007.

T3: Thomas Calabrese, "Information Security Intelligence: Cryptographic Principles and Applications", Thomson Delmar Learning, 2006.

REFERENCES BOOKS:

R1: Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.

R2: Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition,Pearson Education, 2003.

R3: Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with codingtheory",Pearson Education, 2007.

R4: WenboMao, "Modern Cryptography Theory and Practice", Pearson Education, 2007.

R5: C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd

WEBLINKS:

W1: https://nptel.ac.in/courses/106105162

W2: http://williamstallings.com/Crypto/Crypto5e.html

W3: https://www.engppt.com/2012/10/cryptography-and-network-security.html

W4: http://williamstallings.com/Crypto4e.html.

W5: http://williamstallings.com/Crypto3e.html.

W6: http://torrentz.ws/search/Cryptograp

W7: http://www.quadibloc.com/crypto/co040401.htm

W8: http://csrc.nist.gov/publications/fips/fips197/fips-197.pdf

COURSE OUTCOMES:

CO1	Analyze various classical encryption like substitution and transposition techniques	**K4**
CO2	Evaluate the various public key cryptography methods	**K5**
CO3	Evaluate the various authentication algorithm.	**K5**
CO4	Illustrate the IP security architecture in network security	**K2**
CO5	Develop principles of firewall anddiscuss the various system threats and protection using virus counter measures, firewall, Trojan etc.,	**K3,K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1	1	1	-	-	-	-	-	-	1	1	2
CO2	2	3	1	1	2	-	-	-	-	-	-	3	2	1
CO3	2	2	1	2	0	-	-	-	-	-	-	2	1	1
CO4	3	1	1	1	1	-	-	-	-	-	-	1	2	2
CO5	1	1	1	1	1	-	-	-	-	-	-	1	2	1
Avg	**1.6**	**1.6**	**1**	**1.2**	**1**	-	-	-	-	-	-	**1.6**	**1.6**	**1.4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		

PEC – 22	**MEDICAL SIGNAL AND IMAGE PROCESSING**	**3**	**0**	**2**	**4**

PREREQUISITE: SIGNALS AND SYSTEMS, DIGITAL SIGNAL PROCESSING, DIGITAL IMAGE AND VIDEO PROCESSING

COURSE OBJECTIVES:

- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to analyze and quantify biomedical data

UNIT I BIOMEDICAL SIGNALS AND IMAGES 9

Origin of Bio-potential electrodes, Bio signals – Electro Cardiogram (ECG), Electroencephalogram(EEG), Electromyogram (EMG), PCG, EOG, lead systems and recording methods, typical waveforms and signal Characteristics clinical applications-

Imaging-ultrasound, X-ray, CT, MRI, PET

UNIT II FUNDAMENTALS OF DETERMINISTIC SIGNAL 9

Data Acquisition: Sampling in time, aliasing, interpolation, and quantization. Digital Filtering: Difference equations, FIR and IIR filters, basic properties of. DTFT & DFT, FFT, the overlap-save algorithm,Sampling and aliasing.

UNITIII BIO MEDICAL IMAGE PROCESSING 9

Review of Image processing - Medical image enhancement. Filtering - Extension of filtering and Fourier methods to 2-D signals and systems. Interpolation, noise reduction methods, edge detection, homomorphic filtering

UNITIV PROBABILITY AND RANDOM SIGNALS 9

PDFs: Introduction to random variables and probability density functions (PDFs). Classification: Bayes' rule, detection, statistical classification.

Random signals: Time averages, ensemble averages, autocorrelation functions, cross correlation functions. Linear systems, Wiener filters. Blind source separation: Use of principal component analysis (PCA) and independent component analysis (ICA) for filtering.

UNIT V IMAGE SEGMENTATION AND REGISTRATION 9

Image Segmentation: statistical classification, morphological operators, connected components. Image Registration: Rigid and non-rigid transformations, objective functions - Joint entropy, optimization methods. Nuclear Imaging: PET and SPECT Ultrasound Imaging

TOTAL: 45 hours

TEXT BOOKS:

T1: Amit Kumar, Fahimuddin Shaik, B Abdul Rahim,D.Sravan Kumar, "Signal and Image Processing in Medical Applications (Springer Briefs in Applied Sciences and Technology, 2016.

T2: WolfgangBirkfellner "Applied Medical Image Processing: A Basic Course, Second Edition, 2014.

T3: KayvanNajarian& Robert Splinter, "Biomedical Signal and Image Processing", 2nd Edition Biomedical Signal and Image Processing, 2012.

T4: FJ Theis, A Meyer-Bäse,"Biomedical Signal Analysis: Contemporary Methods and Applications, Prentice Hall India Learning Private Limited, 2011.

T5: Rangaraj. M Rangayyan. "Biomedical Image Analysis",CRC 2015

REFERENCE BOOKS:

R1: ErvinSejdic, Tiago H. Falk , 'Signal Processing and Machine Learning for Biomedical Big Data" 1st Edition, 2018.

R2: Scott T. Acton, Nilanjan Ray, "Biomedical Image Analysis: Segmentation", Morgan Claypool Publishers, United States (2009),

R3: Karen M. Mudry, Robert Plonsey, Joseph D. Bronzino, "Biomedical Imaging,

1st Edition.

R4: Rafael C. Gonzalez & Richard E. Woods, "Digital Image Processing",Third Edition. Pearson Education Inc, 2012.

WEBLINKS:

W1: https://nptel.ac.in/courses/108105101
W2: https://dl.icdst.org/pdfs/files3/61016eb30fb229b3de86f6e8b65ddf85.pdf
W3: https://ocw.mit.edu/courses/health-sciences-and-technology/hst-582j-biomedical-signal-and-image-processing-spring-2007/lecture-notes/
W4: https://biomedikal.in/2010/04/university-lecture-notes-on-biomedical-image-processing-biomedical-signal-processing/
W5: https://drive.google.com/open?id=1hsqXSlxCr5DE5IlJsrOmX39bQbL0Wpx-
W6: https://drive.google.com/open?id=190nyxVk1GKpdCfvM9nA-8WVMGuUpfgM6
W7: https://drive.google.com/open?id=1syoD8auYAYHNGfiWYo-YHD1r7kNAZaV2
W8: https://libgen.lc/ads.php?md5=3B50D6235FD5CC3723009397F5333F7E
W9: https://libgen.lc/ads.php?md5=76CC619D8043977966C6D19C44B4D320

COURSE OUTCOMES:

CO1	Apply the concepts for acquiring bio signals and images using different modalities.	**K3**
CO2	Analyze the process of sampling, quantization of bio signals, digital filter design using windows and spectral analysis.	**K4**
CO3	Compare the different techniques for image enhancement, filtering, restoration and edge detection in medical imaging.	**K4**
CO4	Select and discuss the methodologies to analyze probabilistic and random signals.	**K6**
CO5	Discuss the image segmentation and registration techniques and compare different Imaging applications.	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	1	2	2	2	-	-	-	-	-	0	2	3	2
CO2	3	2	2	2	2	-	-	-	-	-	0		3	1
CO3	3	2	3	2	3	-	-	-	-	-	0		3	1
CO4	3	1	2	2	2	-	-	-	-	-	0	1	3	2
CO5	-	2	2	1	2	-	-	-	-	-	0	1	3	1
Avg	**3.00**	**1.6**	**2.2**	**1.8**	**2.2**	-	-	-	-	-		**1.33**	**3**	**1.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC – 23	EMBEDDED SYSTEMS	3	0	0	3

PREREQUISITE: MICROPROCESSOR AND MICROCONTROLLER

COURSE OBJECTIVES:

- To explore about embedded systems, buses, tools, operating systems and software used for embedded system
- To study ARM architecture and its applications
- To study about PSoC family and programming using PSoC

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction - Microprocessor, Microcontroller –definition, comparison Classification of MCU. Embedded system-definition-Applications-Features-Characteristics – Model and example of embedded system. Embedded systems hardware- Microcontroller unit- Memory – Low power design- pullup pulldown resistors-Sensors-ADC-Actuators

UNIT II BUSES AND SOFTWARE TOOLS 9

Define Buses and Protocols- Onboard buses- external buses-Automotive buses- wireless communication Protocols. Software development tools- Program development-Hex file download- Hardware simulator. Applications-Mobile phone-RFID-Robotics-Brain Machine Interface

UNIT III OPERATING SYSTEM CONCEPTS 9

Embedded Operating Systems- History-Network Operating systems (NOS)-Layers of OS-Functions-Terminology- Kernel-Tasks-Processes-Scheduling Algorithms- Threads – Interrupt Handling- Inter Process Communication (IPC) – Real time Tasks-Types, Real Time Systems-RTOS

UNIT IV ADVANCED RISC MACHINES (ARM) 9

ARM- History, Architecture, ARM family - Interrupt Vector Table. Instruction set- Arithmetic, logical, compare, Condition, Branch. Thumb instruction - Load-store. Assembly language programming- addition, subtraction, multiplication, division. Application program – Motor control using ARM

UNIT V PSOC FAMILY FOR EMBEDDED APPLICATIONS 9

Introduction- PSoC, PSoC family. PSoC1- Internal Architecture, Digital Sub System, GPIO. PSoC Applications - Digital Applications-LED blink, CapSense, Analog applications- Inverter and non inverter. System Resources.

TOTAL: 45 hours

TEXT BOOKS:

T1: Lyla B Das "Embedded Systems An Integrated Approach", Pearson Publications 2017.

T2: David E-Simon, "An Embedded Software Prime", Pearson Education, 2010.

REFERENCES BOOKS:

R1: Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-GrawHill, 2004

R2: PSoC-Programmable System-on-Chip, Technical Reference Manual.

R3: Jane W.S.Liu, "Real Time System", Pearson Education, Third Indian Reprint, 2003.

R4: Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers andProgrammers", Elsevier(Singapore) Pvt. Ltd. Publications, 2005.

R5: Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.

WEBLINK:

W1: https://archive.nptel.ac.in/courses/108/102/108102045/

COURSE OUTCOMES:

CO1	Illustrate importance of microcontrollers in embedded systems	**K2**
CO2	Apply the concepts of buses, tools and operating systems	**K3**
CO3	Summarize microcontroller and its role in application development	**K2**
CO4	Design and develop ARM andPSoC processors based systems.	**K6**
CO5	Develop real time applications using ARM and PSoC	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	2	-	-	-	-	-	-	-	-	-	2	1
CO2	2	2	3	2	2	-	-	-	-	-	-	2	3	3
CO3	2	-	2	-	-	-	-	-	-	-	-	-	2	2
CO4	3	2	3	2	3	-	-	-	-	-	-	3	3	3
CO5	3	2	3	2	3	-	-	-	-	-	-	3	3	3
Avg	**2.40**	**2**	**2.6**	**2**	**2.67**	**-**	**-**	**-**	**-**	**-**	**-**	**2.67**	**2.6**	**2.4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 24	ELECTRONIC SYSTEM DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To study RF component such as resonator, filter, transmission lines, etc…
- To learn design of RF amplifiers using transistors.
- To study modern Power Supplies using SCR and SMPS technology.
- To learn about signal shielding & grounding techniques and study of A/D and D/A Converters.
- To learn knowledge about fabrication of PCBs using CAD

UNIT I INTRODUCTION TO RF DESIGN 9

RF behavior of passive components, Chip components and circuit board considerations, Review of transmission lines, Impedance and admittance transformation, Parallel and series connection of networks, ABCD and scattering parameters, Analysis of amplifier using scattering parameter. RF filter – Basic resonator and filter configurations – Butterworth and Chebyshev filters. Implementation of microstrip filters design. Band pass filter and cascading of band pass filter elements.

UNIT II RF TRANSISTOR AMPLIFIER DESIGN 9

Impedance matching using discrete components. Microstrip line matching networks. Amplifier classes of operation and biasing networks – Amplifier power gain, Unilateral design(S12 =0) – Simple input and output matching networks – Bilateral design – Stability circle and conditional stability, Simultaneous conjugate matching for unconditionally stable transistors. Broadband amplifiers, High power amplifiers and multistage amplifiers.

UNIT III DESIGN OF POWER SUPPLIES 9

DC power supply design using transistors and SCRs, Design of crowbar and foldback protection circuits, Switched mode power supplies, Forward, flyback, buck and boost converters, Design of transformers and control circuits for SMPS.

UNIT IV DESIGN OF DATA ACQUISITION SYSTEMS 9

Amplification of Low level signals, Grounding, Shielding and Guarding techniques, Dual slope, quad slope and high speed A/D converters, Microprocessors Compatible A/D converters, Multiplying A/D converters and Logarithmic A/D converters, Sample and Hold, Design of two and four wire transmitters.

UNIT V DESIGN OF PRINTED CIRCUIT BOARDS 9

Introduction to technology of printed circuit boards (PCB), General lay out and rules and parameters, PCB design rules for Digital, High Frequency, Analog, Power Electronics and Microwave circuits, Computer Aided design of PCBs.

TOTAL: 45 hours

TEXT BOOKS:

T1: Sydney Soclof, "Design and Applications of Analog Integrated Circuits," Pearson 1st Edition, 2015

T2: WalterC.Bosshart, Printed Circuit Boards – Design and Technology, Mcgraw Hill Education, 2013.

T3: ReinholdLuduig and Gene Bogdanov, "RF Circuit Design – Theory and Applications, Pearson Education, 2011.

REFERENCES BOOKS:

R1: KeithH.Billings& Taylor Morey, Switched Mode Power Supply Handbook, 3rd Edition McGraw–Hill Publishing Co., 2011.

R2: MichaelJaacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 2nd edition 1996.

R3: OtmarKigenstein, Switched Mode Power Supplies in Practice, John Wiley and Sons, 1989.

R4: Muhammad H. Rashid, Power Electronics – Circuits, Devices and Applications, Prentice Hall of India, 2004.

R5: ReinholdLuduig and Pavel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education, 2000

WEBLINKS

W1: https://caxapa.ru/thumbs/348441/Switchmode_Power_Supply_Handbook_3rd_edi.pdf

W2: https://archive.org/details/Docfoc.comIndustrialControlElectronicsByMichaelJacob/page/n3/mode/2up

W3: http://powerunit-ju.com/wp-content/uploads/2018/02/RF-Circuit-Design.pdf

COURSE OUTCOMES:

CO1	Analyse the behaviour of RF components and filters and derive ABCD parameters and scattering parameters of the various RF components.	**K4**
CO2	Be familiar with the amplifier classes, perform impedance matching using discrete components and design of RF Transistor amplifier.	**K6**
CO3	Understand the functioning and stability of broadband, high power and multistage amplifiers and design RF power supply using transistors and SCRs.	**K6**
CO4	Be familiar with the amplification, grounding, shielding and guarding of low level signals and analyse the design of transformers and control circuits for SMPS.	**K6**
CO5	Understand the design rules for PCB & implement the Design for Digital, High Frequency, Power Electronics, Microwave circuits, Computer Aided design	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3	-	-	-	-	-	-	-	-	3	2
CO2	3	3	1	3	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	3	1	2	-	-	-	-	-	-	-	-	3	2
Avg	3	3	1.4	2.4	-	-	-	-	-	-	-	-	3	2

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC – 25	ROBOTICS	3	0	0	3

PREREQUISITE: MICROPROCESSOR AND MICROCONTROLLER / EMBEDDED SYSTEMS

COURSE OBJECTIVES:

- To understand the fundamental concepts and embedded system required for Robot design
- To explore the use of various sensors, actuators and control mechanism for Robotic design
- To understand the types of algorithm used for Mobile Robot Design

UNIT I EMBEDDED SYSTEM FOR ROBOTICS 9

Robots and Controllers-Mobile Robots - Embedded Controllers-Robot Design -Operating System. Central Processing Unit- Logic Gates-Function Units - Registers and Memory-Retro-Arithmetic Logic Unit-Control Unit - Central Processing Unit - Structured Design. Arduino - Hardware - Programming- Interfacing-Communication. Raspberry Pi -Raspberry Pi Operating System and Setup - Tools and Programming - Raspberry Pi Input/Output Lines-Raspberry Pi Communication- Integration Development Environments .

UNIT II SENSORS ACTUATORS AND CONTROL 9

Sensors and Interfaces -Sensor Categories-Synchronous Serial and I2C Interfaces - Binary Sensors - Shaft Encoders - A/D Converters - Position Sensitive Devices—Sonar, Infrared, Laser - Lidar Sensors -Orientation Sensors - Inertial Measurement Units -Global Navigation Satellite - Digital Image Sensors. Actuators - DC Motors - H-Bridge - Pulse Width Modulation - Stepper Motors -Servos motors- Grippers. End Effectors. Control -On-Off Control - PID Control - Derivative Controller - Velocity Control and Position Control - Multiple Motors—

Driving Straight - Omega Interface.

UNIT III MULTITASKING AND COMMUNICATION 9

Multitasking - Preemptive Multithreading - Synchronization - Scheduling - Interrupts and Timer-Activated Tasks. Communication - Communication Channels - File Transfer and Remote Access - Radio Library - Robot to Robot Communication - Robot to PC Communication. Robot Manipulators- Homogeneous Coordinates - Manipulator Kinematics - Manipulator Simulation - Teaching and Programming - Industrial Manipulators

UNIT IV ALGORITHM FOR ROBOT DESIGN 9

Localization and Navigation -Localization - Environment Representation - Quadtree - Visibility Graph - Voronoi Diagram and Brushfire Algorithm - Potential Field Method - Wandering Standpoint Algorithm - Bug Algorithm Family -Dijkstra's Algorithm -A* Algorithm - Probabilistic Localization –SLAM. Maze Navigation - Micro Mouse Contest - Maze Exploration

UNIT V MOBILE ROBOT DESIGN 9

Driving Robots-Single Wheel Drive, Differential Drive, Tracked Robots, Synchro-Drive, Ackermann Steering, Drive Kinematics. Omni-Direction Robots - Mecannum Wheels, Drive, Kinematics, Omni-Directional Robot Design, Driving Program. Walking Robots- Balancing Robots- Six-Legged Robot Design, Biped Robot Design, Sensors for Walking Robots. Autonomous Boats and Planes -Autonomous Boats, Autonomous Underwater Vehicles, Unmanned Aerial Vehicles (UAVs)

TOTAL: 45 hours

TEXT BOOKS:

T1: Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino, 4th EditionThomas Braunl,Springer, 2022

T2: M. P.Groover, "Industrial Robotics–Technology, Programming and Applications", McGraw–Hill, 2001.

T3: Yoram Koren, "Robotics for Engineers", McGraw–Hill Book Co., 1992.

T4: Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control", Pearson Education, 2006.

T5: Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.

REFERENCES BOOKS:

R1: Fu.K.S. Gonzalz.R.C,and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw–Hill Book Co., 1987

R2: Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw–Hill, 1995

WEBLINKS:

W1: https://nptel.ac.in/courses/112105249

W2: https://blog.miguelgrinberg.com/post/building-an-arduino-robot-part-ii-programming-the-arduino

W3: https://spoken-tutorial.org/watch/Arduino/Robot+Control+using+Bluetooth/English/

COURSE OUTCOMES:

CO1	Illustrate the role of Embedded system in Robot development	K2
CO2	Identify and choose suitable Sensors, Actuators, communication and End-effectors for Robot design and development	K1,K3
CO3	Summarize different multitasking methods, Control Mechanism for Robot Design	K2
CO4	Distinguish various types of Mobile Robot and algorithm used for Robot design	K4
CO5	Design and Development of Mobile Robot for real time applications with appropriate sensors, actuators, control mechanism and algorithms	K6

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO2	2	2	3	2	2	-	-	-	-	-	-	2	2	2
CO3	2	3	1	2	-	-	-	-	-	-	-	2	2	3
CO4	2	3	3	3	3	2	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	3	3	3
Avg	**2.2**	**2.6**	**2.4**	**2.4**	**2.5**	**2.5**	**-**	**-**	**-**	**-**	**-**	**2.4**	**2.4**	**2.6**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 26	OPTICAL NETWORK	3	0	2	4

PREREQUISITE: PHYSICS (OSCILLATION, WAVES AND OPTICS), MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

- To facilitate the knowledge about optical fiber sources and transmission techniques.
- To enrich the idea of optical fiber networks algorithm such as SONET/SDH and optical CDMA.
- To explore the trends of optical fiber measurement systems.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers – Loss & bandwidth, System limitations, Non–Linear effects; Solutions; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH, Metropolitan – Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media – Access Control Protocols, Wavelength Routing Architecture, Single hop & Multi hop network.

UNIT III WAVELENGTH ROUTING NETWORKS 9

Optical Circuit Switching, Optical Packet Switching, Optical Burst Switching, Core Optical Networks. Metro Optical networks, Access Optical Networks,The optical layer, Node Designs, Routing and wavelength assignment,Traffic Grooming in Optical Networks, Architectural variations- Linear Light wave networks, Logically Routed Networks.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronizations, Broadcast OTDM networks, Switch–based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty – transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 hours

TEXT BOOKS:

T1: Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2004.

T2: Optical Switching Networks: Mayer & Martin, Cambridge University Press, 2008.

REFERENCE BOOKS:

R1: C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, IstEdition, 2002.

R2: P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

WEBLINKS:

W1: https://nptel.ac.in/courses/108106167

W2: https://news.mit.edu/topic/optical-networks

W3: http://www.hit.bme.hu/~jakab/edu/litr/wdm/opt_net.pdf

COURSE OUTCOMES:

CO1	Determine the various losses, signal distortion and other signal degradation factors in optical waveguides	**K3**
CO2	Explain the principle of broadcast and select networks.	**K4**
CO3	Determine the node design and cost tradeoff's in the optical layer and the various routing algorithms.	**K3**
CO4	Compare the various multiplexing, demultiplexing, synchronization and broadcast techniques of OTDM networks	**K5**
CO5	Analyze the issues in the management and control of optical networks	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	1	-	-	-	-	2	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	2	-	2	3	2
CO3	2	2	2	2	2	-	-	-	-	2	-	2	2	2
CO4	2	2	2	2	2	-	-	-	-	2	-	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	-	2	3	2
Avg	**2**	**2**	**2**	**2**	**1.8**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**2.6**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC – 27	UNDERWATER COMMUNICATION SYSTEMS	3	0	2	4

COURSE OBJECTIVES:

- To acquire knowledge on basics of Underwater Acoustics.
- To acquire knowledge on Characteristics of Sonar systems.
- To know the basic concepts of oceanographic instrumentation, underwater sensors and noises.
- To be able to analyze the performance of underwater signal processing systems

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTIC 9

The Ocean acoustic environment, measuring sound level, Sources and receivers, relevant units, sound velocity in sea water, typical vertical profiles of sound velocity, Sound propagation in the Ocean- characteristic sound propagation paths-deep water and shallow water, Range dependent environment. Sound attenuation in sea water, Bottom Loss, Surface bottom loss and volume scattering, Snell's law for range dependent Ocean.

UNIT-II UNDERWATER &AMBIENT NOISES IN THE SEA 9

Basic Concept of noises in underwater- Types of noises- Natural, man-made-Sources of ambient noise- different frequency bands of ambient noise, process of surface noise generation, shallow water, variability of ambient noise, Correlation Properties of Ambient Noise - Use of the Spatial Correlation Function, directional characteristics of ambient noise, intermittent sources of noise- biological & non biological (rain, earthquakes, explosions and volcanos').

UNIT III CHARACTERISTICS OF SONAR SYSTEM 9

Basic of Sonars – Active & passive sonars, hydrophones, DAS, ROV, AUV, Side Scan sonar, Echo sounder, MBEC, Sub bottom profiler, magnetometer, dredger, sensors application in shallow water and deep water

UNITIV UNDERWATER SENSORS 9

Sensors Types Sensor array characteristics-array gain, receiving directivity index, beam patterns, shading and super directivity, adaptive beamforming

UNIT V OCEANOGRAPHIC INSTRUMENTATION 9

Descriptions of research vessels, cruise, position fixing in the sea; sampling devices - Grab samplers, bottom samplers, dredges, sediment traps, boomerang samplers, water samplers, Winches, temperature measurement instruments, tools for studying ocean floor topography - Underwater Applications.

TOTAL:45 hours

TEXT BOOKS:

T1: William S. Burdic, "Underwater Acoustic Analysis", Prentice Hall Int. London/", Peninsula, Pub. 2nd Edition 2003.

T2: Robert J Urick, "Principles of Underwater Sound", 3rd Edition Peninsula

Publications,McGraw-Hill 2007

T3: Yi Lou, Niaz Ahmed, "Underwater Acoustic Communications and Networks",Springer Cham, https://doi.org/10.1007/978-3-030-86649-5.

T4: Clay &Medwin, "Acoustical Oceanography: Principles and Applications",A Wiley Series, 1998.

T5: L.M.Brekhovskikh and Yu.P.Lysanov, "Fundamental of Ocean Acoustics".Springer, 2002.

REFERENCE BOOKS:

R1: Digital Underwater Acoustic Communications, Lufen Xu, TianzengXu, Academic Press, September 13, 2016

R2: J.J. Bhatt. Oceanography — Exploring the Planet Ocean. D. Van. Nostrand Company, New York, 1994.

R3: Gross, M.G. Principles of Oceanography, 7thEdition, Prentice-Hall, 1995.

R4: Ask, T., Handbook of Marine Surveying, Sheridan House, 2007.

R5: Richard O.Nielsen, "Sonar signal processing"Artech House Acoustic Library.

WEBLINKS:

W1: https://www.academia.edu/27544279/underwater_wireless_communication_network

W2: http://web.mit.edu/millitsa/www/resources/pdfs/ency.pdf

W3: https://en.wikipedia.org/wiki/Underwater_acoustic_communication

W4: https://www.academia.edu/1355648/Acoustical_oceanography_principles_and_applications.

W5: https://www.science.gov/topicpages/u/underwater+communication+systems

W6: https://apps.dtic.mil/sti/pdfs/ADA168350.pdf

COURSE OUTCOMES:

CO1	Understand the acoustic environment and analyse sound propagation systems in oceanography	**K3**
CO2	Discussand analyse on various underwater noises, sources and characteristics of ambient noises.	**K4**
CO3	Analyse the various acoustic sensors characteristics in underwater communication	**K4**
CO4	Discuss the various imaging sonar systems and sensors& interpret on sampling process	**K6**
CO5	Analyse the different sampler, dredges &temperature measurement in oceanographic Instrumentation in underwater Applications	**K5**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2	2	2	-	-	-	-	-	-	-	3	3
CO2	2	2	2	1	2	-	-	-	-	-	-	-	3	3
CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	3
CO4	3	1	2	1	2	-	-	-	-	-	-	-	3	3
CO5	2	2	2	1	2	-	-	-	-	-	-	-	3	3
Avg	**2**	**1.60**	**2.20**	**1.40**	**2**	-	-	-	-	-	-	-	**3**	**3**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

PEC-28	SOFTWARE DEFINED NETWORKS	3	0	2	4

COURSE OBJECTIVES:

- To recognize the fundamentals and characteristics of Software Defined Networks
- To understand the basics of Software Defined Networks Operations and Data flow
- To discriminate different Software Defined Network Operations and Data Flow
- To analyze alternative definitions of Software Defined Networks
- To apply different Software Defined Network Operations in real world problem

UNITI INTRODUCTION TO SDR 9

Definition of SDR, History of SDR, Hardware Architecture of SDR, Software Architecture of SDR, Networking and SDR, RF architectures of SDR, Processing Architectures for SDR, Software Environments of SDR.

UNIT II TIMING SYNCHRONIZATION 9

Matched Filtering, Timing Error, Symbol Timing Compensation-Phase-Locked Loops-Feedback Timing Correction, Alternative Error Detectors and System Requirements-Gardner

UNIT III PROBABILITY IN COMMUNICATIONS 9

Modeling Discrete Random Events in Communication Systems, Binary Communication Channels and Conditional Probability, Modeling Continuous Random Events in Communication Systems- Cumulative Distribution Functions, Time-Varying Randomness in Communication Systems- Stationarity, Gaussian Noise Channels- Gaussian Processes, Power Spectral Densities and LTI Systems

UNIT IV FRAME SYNCHRONIZATION AND CHANNEL CODING 9

Frame Synchronization-Signal Detection-Alternative Sequences, Channel Coding-Repetition Coding-Interleaving-Block Interleaving-Convolutional InterleavingEncoding-BER Calculator

UNIT V ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING 9

OFDM Model- Cyclic Extensions, OFDM Waveform Structure, Packet Detection, CFO Estimation, Symbol Timing Estimation, Equalization, Bit and Power Allocation

TOTAL:45 hours

TEXT BOOKS:

T1: Travis F. Collins, Robin Getz, Di Pu, Alexander M. Wyglinski, "Software Defined Radio for Engineers", Prentice Hall,Mobile Communications Series,2018.

T2: Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, Inc. August 2013.

T3: Paul Goransson, Chuck Black, Timothy Culver, " Software Defined Networks -A Comprehensive Approach", 2nd Edition - Oct, 2016

REFERENCE BOOKS:

R1: John Bard, Vincent J. Kovarik Jr, "Software Defined Radio: The Software Communications Architecture", Wiley, 2007.

R2: Eugene Grayver, "Implementing Software Defined Radio", Springer-Verlag New York, 2013.

R3: Wolfram Donat, "Explore Software Defined Radio", Pragmatic Bookshelf, 2021.

WEBLINKS:

W1: www.tutorialspoint.com/orthogonal-frequency-division-multiplexing-ofdm

W2: www.digikey.com/en/articles/learn-the-fundamentals-of-software-defined-radio

COURSE OUTCOMES:

CO1	Examine the hardware and software architectures and estimate the required timing synchronization	**K4**
CO2	Analyze the probability models in communication, and synchronize frames	**K4**
CO3	Distinguish the different architectures of SDR	**K4**
CO4	Criticize the relationship between OFDM and SDR.	**K5**
CO5	Elaborate the applications of SDR in Wireless Networks	**K6**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	-	-	-	-	-	2	2	2	2	2
CO2	2	2	1	2	-	-	-	-	-	1	2	2	3	2
CO3	1	1	2	2	-	-	-	-	-	2	1	1	2	2
CO4	2	2	1	2	-	-	-	-	-	2	2	2	2	2
CO5	2	2	2	2	-	-	-	-	-	1	2	2	2	2
Avg	**1.8**	**1.8**	**1.6**	**2**	-	-	-	-	-	**1.6**	**1.8**	**1.8**	**2.2**	**2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

PEC-29	HIGH SPEED NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- Students will get an introduction about ATM and Frame relay.
- Students will be provided with an up–to–date survey of developments in High Speed Networks.
- Enable the students to know techniques involved to support real–time traffic and congestion control.
- Students will be provided with different levels of quality of service (Q.S) to different applications.

UNIT I INTRODUCTION TO HIGH-SPEED NETWORKS 9

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

UNIT II CONGESTION AND TRAFFIC MANAGEMENT 9

Queuing Analysis– Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

UNIT III TCP AND ATM CONGESTION CONTRO 9

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.

UNIT IV INTEGRATED AND DIFFERENTIATED SERVICES 9

Integrated Services Architecture – Approach, Components, Services– Queuing Discipline, Bit – Round Fair queuing (BFRQ), Generalized processor Sharing (GPS), Weighted Fair Queuing (WFQ) ,Random Early Detection, Differentiated Services

UNIT V PROTOCOLS FOR QOS SUPPORT 9

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

TOTAL: 45 hours

TEXT BOOK:

T1: William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002.

T2: William Stalling, "High-Speed Networks and Internets: Performance and Quality of Service" Pearson; 2ndedition, 2001.

T3: KavenPahlavan "Principles of Wireless Network", Prentice Hall Of India, 2010

REFERENCES BOOKS:

R1: Warland, Pravin Varaiya, "High Performance Communication Networks", Second Edition , Jean Harcourt Asia Pvt. Ltd., 2001.

R2: IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.

R3: Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.

WEBLINKS

W1: https://www.academia.edu/33831793/A_Course_Material_on_HIGH_SPEED_NETWORKS

W2: https://www.kiv.zcu.cz/~ledvina/vyuka/PDS/PDS-tut/HighSpeedNetworks/hsn0101.pdf

W3: https://sites.google.com/site/cs1128highsppednw/documents/%5BKaveh_Pahlavan%2C_Prashant_Krishnamurthy%5D_Principle.pdf?attredirects=0&d=1

COURSE OUTCOMES:

CO1	Develop an in-depth understanding, in terms of architecture, protocols and applications of major highspeed networking technologies	**K3**
CO2	Apply the Queuing Models, frame relay to manage the traffic and congestion control in High-Speed Network.	**K3**
CO3	Importance of algorithm and technologies involved in internet and associated networks	**K5**
CO4	Explain the Architecture of Integrated and Differentiated services.	**K5**
CO5	Analyze the protocols for Quality-of-Service Support	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	2	-	-	-	-	3	3	3	3	2	3
CO2	3	2	2	2	-	-	-	-	2	2	2	2	2	1
CO3	1	1	2	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	2	3	-	-	-	-	3	2	2	3	3	2
CO5	2	3	3	2	-	-	-	-	3	2	3	2	3	3
Avg	**2.2**	**2**	**2.2**	**2.2**	**-**	**-**	**-**	**-**	**2.6**	**2.2**	**2.4**	**2.4**	**2.6**	**2.2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

PEC-30	QUANTUM MECHANICS	3	0	0	3

COURSE OBJECTIVES:

- To study the basic principles of quantum mechanics.
- Explain the operator formulation of quantum dynamics.
- To understand the concept of quantum dynamics and quantum theory of scattering.
- An understanding of concepts of quantum computation.

UNIT I THE SCHRODINGER'S EQUATION AND ITS MATHEMATICALIMPLICATION 9

Introduction to quantum mechanics-Development of Time Dependent Schrodinger's equation - Statistical interpretation of wave function - Normalization of wave function – Conservation of total probability, Dynamical variables and Hermitian operators - position, linear and angular momentum operators – Commutation relations- Ehrenfest theorem - Heisenberg uncertainty principle, Time Independent Schrodinger equation– Properties of energy eigen functions, Expansion postulate.

UNIT II BOUND STATES & QUANTUM TUNNELING 9

Free particle - Momentum eigen functions, Energy levels of a particle – Infinite square well in one, two, and three dimensions - Density of states – Confined carriers - Electron wave propagation in devices - Quantum confinement - Penetration of a barrier – Tunnel effect - Basic principles of a few effective devices – Resonant tunnel diode, Superlattice , Quantum wire and Dot.

UNIT III QUANTUM DYNAMICS 9

Time development of the wave function - Time evolution operator - Schrodinger, Heisenberg, and Interaction pictures of quantum dynamics -Time evolution - Free particle wave packet, One-dimensional harmonic oscillator , Two-state quantum systems.

UNIT IV IDENTICAL PARTICLES AND SCATTERING THEORY 9

System of Identical particles – Symmetrization of wave functions - Exchange interactions - Free electrons in a metal – Fermi gas - Mutual scattering of two particles – Separation of Schrodinger equation in laboratory and center of mass frames - Quantum theory of Scattering – Differential and total cross sections, Scattering amplitude – Derivation using Green's functions - Born approximation -Scattering by spherically symmetric potentials.

UNIT V QUANTUM COMPUTATION 9

Quantum Bits - Single qubit gates - Multiple qubits – Controlled Not gate, Swap gate, Toffoli gate, Bell states - no-cloning theorem - Quantum Teleportation - Deutsch's Algorithm - Deutsch-Jozsa Algorithm - Quantum Fourier transform.

TOTAL: 45 hours

TEXT BOOKS:

T1: Bransden. B.H, and Joachain. C.J "Quantum Mechanics", Pearson, 2007.

T2: David. J, Griffiths, "Introduction to Quantum Mechanics", Pearson, 2009.

T3: Richard. L, Liboff, "*Introductory Quantum Mechanics"*, Pearson, 2003.

REFERENCE BOOKS:

R1: Mark Lundstrom, "Fundamentals of Carrier Transport", Cambridge University Press, 2000.

R2: Yoav Peleg, Reuven Pnini, ElyahuZaarur, and Eugene Hecht, "Schaum's Outline of Quantum Mechanics", Tata McGraw Hill, 2010.

R3: Eugen Merzbacher, "Quantum Mechanics", John Wiley & Sons, 1999.

R4: Mathews. P.M and Venkatesan. K, "*Quantum Mechanics"*, Tata McGraw Hill, 2010.

WEBLINKS:

W1: https://nptel.ac.in/courses/115106066

W2: https://nptel.ac.in/courses/122106034

COURSE OUTCOMES:

CO1	Understand the basics of quantum mechanics and apply it to study physical systems by solving the Schroedinger's equation	**K3**
CO2	Analyze bound states, quantum tunnelling effect and understand the electron wave propagation in devices	**K4**
CO3	Develop the time function of quantum dynamics and two-state quantum systems	**K6**
CO4	Describe the principles of quantum theory of Scattering.	**K4**
CO5	Explain single qubit gates and multiple qubits of quantum computation	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	2	-	-	-	-	-	2	-	2	2	2
CO2	3	2	2	2	-	-	-	-	-	2	-	2	3	3
CO3	2	2	2	2	-	-	-	-	-	2	-	2	2	2
CO4	2	2	2	2	-	-	-	-	-	2	-	2	2	2
CO5	2	2	2	1	-	-	-	-	-	2	-	2	2	1
	2.2	**1.8**	**2**	**1.8**	-	-	-	-	-	**2**	-	**2**	**2.2**	**2**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓		✓

PEC – 31	5G AND BEYOND 5G	3	0	0	3

COURSE OBJECTIVES:

- To be familiar with basics of 5G
- To understand 5G channel access methods & 5G architecture
- To analyze Radio access Networks & different channel models for 5G

UNIT-I INTRODUCTION TO 5G 9

3G and 4G(LTE) overview- Introduction to 5G – Use Cases - Evolving LTE to 5G Capability- 5G NR and 5G core network (5GCN) - 5G Standardization - 3GPP and IMT2020 - Spectrum for 5G – 5G deployment –E-Node and G-Node - Options, Challenges and Applications

UNIT-II 5G CHANNEL ACCESS METHODS 9

OFDM and OFDMA – MIMO OFDM – Generalized Frequency Division Multiplexing (GFDM) – Non-Orthogonal Multiple Access (NOMA) - Universal Filtered OFDM -Filter bank multicarrier (FBMC)- Sparse Code Multiple Access (SCMA) –Comparison of multiple access methods

UNIT III THE 5G ARCHITECTURE 9

Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfill 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.

UNIT-IV RADIO ACCESS NETWORK FOR 5G NR 9

5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols-Radio Link Control - Medium-Access Control – Physical Layer functions -Control Plane Protocols - Network Slicing- RAN virtualization- Spectrum Management in 5G

UNIT-V CHANNEL MODELS FOR 5G NR& 5G APPLICATIONS 9

Channel Hierarchy in 5G NR – Logical Channels and Transport Channels in 5G NR - Physical Layer Data Channels in 5G NR - Downlink Physical Channel and Uplink Physical Channels - Propagation Channel models for 5G, Applications-Enhanced Mobile Broadband, Massive Machine Type Communication and Ultra-Reliable Low Latency Communication.

TOTAL: 45 hours

TEXT BOOKS:

T1: Afif Osseiran, Jose F. Monserrat, Patrick Marsch,"5G Mobile and Wireless Communications Technology",Cambridge University Press ,Second Edition ,2011.

T2: Erik Dahlman, Stefan Parkvall, Johan Sko ̈ld ,"5G NR: The Next Generation Wireless Access Technology",Elsevier ,First Edition ,2016.

REFERENCE BOOKS:

R1: Jonathan Rodriguez," Fundamentals of 5G Mobile Networks", Wiley,First Edition,2010.

R2: Devaki Chandramouli, Rainer Liebhart, and Juho Pirskanen, "5G for the connected World",Wiley, 2019.

WEBLINKS:

W1: https://nptel.ac.in/courses/108/105/108105134/

W2: https://www.udemy.com/course/5g-mobile-networksmodern-wireless-communication-technology/

COURSE OUTCOMES:

CO1	Understand basics of 5G	**K2**
CO2	Analyze use of MIMO in 5G and its techniques.	**K4**
CO3	Draw and explain 5G architecture, its components and functional criteria.	**K5**
CO4	Develop the in-depth functioning of 5G radio access technologies.	**K3**
CO5	Understand various channel models for 5G	**K2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓		

PEC – 32	**ADVANCED MOBILE COMMUNICATION**	**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

- To be familiar with the concepts of 5G
- To understand the configuration of smart antenna

UNIT I INTRODUCTION TO 5G 9

5G Objectives and Usage Scenarios, 5G Activities, Channel Access Method/Air Interface, 5G Policy, 5G Timelines, 4G/5G Radio Access Network, 5G system concept, LTE-Advanced, LTE-Advanced Pro, 5G NR, The 5G architecture, Spectrum Analysis and Regulations for 5G.

UNIT II INFORMATION THEORETIC ASPECTS OF MIMO 9

Review of SISO fading communication channels, MIMO Channel models, Classical. and extended channels, Frequency selective and correlated channels models, Capacity of MIMO channels, Erogodic and outage capacity, capacity bounds and influence of channel properties on the capacity.

UNIT III SMART ANTENNA CONFIGURATION 9

Fixed Sidelobe Canceling, Retrodirective Arrays, Beamforming, Adaptive Arrays, Butler Matrix, Spatial Filtering with Beamformers, Switched Beam Systems, Multiple Fixed Beam System. Uplink Processing, Diversity Techniques, Angle Diversity, Maximum Ratio Combining, Adaptive Beamforming, Fixed Multiple Beams versus Adaptive Beamforming, Downlink Processing.

UNIT IV MASSIVE MIMO SYSTEM 9

Introduction - MIMO for LTE, capacity of massive MIMO, Pilot Design for massive MIMO, Resource allocation and transceivers design, Base band and RF implementation, Channel Models.

UNIT V MILLIMETER WAVE COMMUNICATION 9

Spectrum regulation, Channel propagation, Hardware technology for mmW systems, architecture and mobility, Beam forming techniques, Beam finding, Physical layer techniques - Duplex scheme and Transmission Schemes.

TOTAL: 45 hours

TEXT BOOKS:

T1: David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press 2005.

T2: . Hamid Jafarkhani, "Space - Time Coding: Theory and Practices", Cambridge University Press 2005.

REFERENCE BOOKS:

R1: Mischa Dohler, Jose F. Monserrat AfifOsseiran " 5G Mobile and Wireless Communication Technology", Cambridge University Press 2016Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall, 1997.

R2: Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai mmWave Massive MIMO: A Paradigm for 5G

WEBLINKS:

W1: https://onlinecourses.nptel.ac.in/noc22_ee56/preview

Course Outcomes:

CO1:	Demonstrate knowledge on cellular 5G concepts and its architecture.	**K5**
CO2:	Analyze the MIMO channel capacity models	**K4**
CO3:	Evaluate the configuration of smart antenna.	**K5**
CO4:	Analyze he Resource allocation for Massive MIMO	**K4**
CO5:	Analyze Beam forming techniques for millimeter wave communication	**K4**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	-
CO2	3	2	1	2	-	-	-	-	-	-	-	-	2	-
CO3	2	2	2	1	-	-	-	-	-	-	-	-	3	-
CO4	2	2	1	1	-	-	-	-	-	-	-	-	3	-
CO5	2	2	1	2	-	-	-	-	-	-	-	-	2	-
Avg	**2.4**	**2.2**	**1.4**	**1.6**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**-**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓			✓	✓

OPEN ELECTIVE COURSES

OPEN ELECTIVE COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
OEC– 01	High speed networks	3	0	0	3
OEC– 02	Mobile Ad-hoc Networks	3	0	0	3
OEC– 03	Remote Sensing	3	0	0	3
OEC–04	Robotics	3	0	0	3
OEC– 05	Satellite Communication	3	0	0	3
OEC– 06	Wireless Sensor Networks	3	0	0	3
OEC– 07	Introduction to MATLAB	3	0	0	3
OEC– 08	Radar and Navigational Aids	3	0	0	3
OEC– 09	Cognitive Radio Networks	3	0	0	3
OEC– 10	Cryptography and Network Security	3	0	0	3
OEC– 11	Medical Signal and Image Processing	3	0	0	3
OEC– 12	VHDL and Verilog HDL Programming	3	0	0	3
OEC– 13	Electronic Devices and circuits	3	0	0	3
OEC– 14	Analog and Digital Communication	3	0	0	3
OEC– 15	Embedded Systems	3	0	0	3
OEC– 16	VLSI Circuits	3	0	0	3
OEC– 17	Advanced Digital Signal Processing	3	0	0	3
OEC-18	5G based Internet of Things	3	0	0	3
OEC-19	Digital Image processing	3	0	0	3
OEC-20	Wavelet Transforms	3	0	0	3
OEC-21	Microcontroller based System Design	3	0	0	3
OEC-22	Digital System Design	3	0	0	3
OEC-23	Digital Signal Processing	3	0	0	3

OEC – 01	HIGH SPEED NETWORKS	3	0	0	3

COURSE OBJECTIVES:

- Students will get an introduction about ATM and Frame relay.
- Students will be provided with an up–to–date survey of developments in High Speed Networks.
- Enable the students to know techniques involved to support real–time traffic and congestion control.
- Students will be provided with different levels of quality of service (Q.S) to different applications.

UNIT I INTRODUCTION TO HIGH-SPEED NETWORKS 9

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL, High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

UNIT II CONGESTION AND TRAFFIC MANAGEMENT 9

Queuing Analysis– Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

UNIT III TCP AND ATM CONGESTION CONTROL 9

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.

UNIT IV INTEGRATED AND DIFFERENTIATED SERVICES 9

Integrated Services Architecture – Approach, Components, Services– Queuing Discipline, Bit – Round Fair queuing (BFRQ), Generalized processor Sharing (GPS), Weighted Fair Queuing (WFQ) ,Random Early Detection, Differentiated Services

UNIT V PROTOCOLS FOR QOS SUPPORT 9

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

TOTAL: 45 hours

TEXT BOOK:

T1: William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002.

T2: William Stalling, "High-Speed Networks and Internets: Performance and Quality of Service" Pearson; 2nd edition, 2001.

REFERENCES BOOKS:

R1: Warland, Pravin Varaiya, "High performance communication networks",2nd Edition, Jean Harcourt Asia Pvt. Ltd.,2001.

R2: IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.

R3: Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.

WEBLINKS:

W1: https://www.academia.edu/33831793/A_Course_Material_on_HIGH_SPEED_NETWORKS

W2: https://www.kiv.zcu.cz/~ledvina/vyuka/PDS/PDS-tut/HighSpeedNetworks/hsn0101.pdf

COURSE OUTCOMES:

CO1	Develop an in-depth understanding, in terms of architecture, protocols and applications of major highspeed networking technologies	**K3**
CO2	Apply the Queuing Models, frame relay to manage the traffic and congestion control in High-Speed Network..	**K3**
CO3	Importance of algorithm and technologies involved in internet and associated networks	**K5**
CO4	Explain the Architecture of Integrated and Differentiated services.	**K5**
CO5	Analyze the protocols for Quality-of-Service Support	**K4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
			✓	✓	

OEC – 02	MOBILE AD-HOC NETWORKS	3	0	0	3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

- To understand the design issues in ad hoc networks.
- To learn the different types of MAC protocols.
- To be familiar with different types of ad hoc routing protocols.
- To be exposing to the TCP issues in ad hoc networks.
- To learn the architecture of ad hoc networks.

UNIT I INTRODUCTION TO ADHOC NETWORKS 9

Evolution of Wireless Network- Wireless Communication Characteristics- Types of Wireless Networks- Forces Driving Wireless Technology Evolution, Mobile Adhoc Network-Characteristics-Advantages-Application-Design issues and Constraints, Technical Challenges-Media Access Control and Optimization- Ad Hoc Routing- Multicasting and Broadcasting -TCP Issues- Energy Conservation- Network Security

UNIT II WIRELESS LANS AND PANS 9

Wireless LAN Technologies-IEEE 802.11a- IEEE 802.11b- IEEE 802.11g, -HIPERLAN 1 & 2-Infrared WLANs-UWB, Wireless PAN Technologies-Bluetooth-HomeRF-RFID.

UNIT III WIRELESS WANS AND MANS 9

The Cellular Concept-Capacity Enhancement-Channel Allocation-Handoff, Cellular Architecture, WLL- Architecture of WLL- WLL Technologies, WATM-Generic Reference model-MAC layers in WATM- Handoff Issues in WATM, Location Management.

UNIT IV ADHOC WIRELESS NETWORKS 9

Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks-Medium Access Scheme-Quality of Service Provisioning-Security-Address and Service Discovery-Energy Management-Scalability-Deployment Considerations, Ad Hoc Wireless Internet & its Issues

UNIT V MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS 9

Classification of MAC protocols, Issues in Designing a Mac Protocol for Ad Hoc Wireless Networks, Design Goals of a Mac Protocol for Ad Hoc Wireless Networks, MACAW: A Media Access Protocol for Wireless LANs, Floor Acquisition Multiple Access Protocol, Collision Avoidance Time Allocation Protocol, Five-Phase Reservation Protocol, Distributed Laxity-Based Priority Scheduling Scheme, MAC Protocol Using Directional Antennas

TOTAL: 45 hours

COURSE OUTCOMES:

CO1	Analyze the applications and features of Mobile Adhoc networks.	**K4**
CO2	Organize the different MAC protocols in Mobile Adhoc Network.	**K3**
CO3	Interpret the design issues, goals and classification of routing protocols.	**K5**
CO4	Estimate suitable secure routing protocols for the various types of security attacks in Adhoc networks.	**K5**
CO5	Elaborate the concept of cross layer design	**K6**

TEXT BOOKS:

T1: Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile Adhoc networking, Wiley– IEEE press, 2004.

T2: C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education, 2007.

REFERENCE BOOKS:

R1: Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

R2: Mohammad Ilyas, The handbook of Adhoc wireless networks, CRC press, 2002.

R3: T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research," Wireless Commn. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.

WEBLINKS:

W1: www.educba.com/mobile-ad-hoc-network/

W2: www.brainkart.com/article/HIPERLAN(high-performance-local-area-network)_9933/

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC- 03	REMOTE SENSING	3	0	0	3

COURSE OBJECTIVES:

- To introduce the students to the basic concepts and principles of various components of remote sensing.
- To teach the concept of EMR interaction with atmosphere and earth materials.
- To introduce the students to the basic concepts of optical and microwave remote sensing.
- To teach the concept of geographic information system and application.

UNIT I REMOTE SENSING 9

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body – Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra Red (IR), Near IR, Middle IR, Thermal IR and Microwave – Black Body Radiation – Planck's law – Stefan–Boltzman law.

UNIT II EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIALS 9

Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non–selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows – Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces– Spectral Signature – Spectral Signature curves.

UNIT III OPTICAL AND MICROWAVE REMOTE SENSING 9

Introduction, Sensor parameters,Resolution – Earth resource satellites – Current Satellites – Radar principle – Side Looking Airborne Radar (SLAR)– Synthetic Aperture Radar (SAR) – Interpreting SAR images – Geometrical characteristics: slope foreshortening, layover, aspect, RADAR shadow.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 9

GIS architecture – Spatial Data modelling: Raster GIS models, Vector GIS models-comparison of raster and vector model– Data Input and Editing: Digitizer, Scanner – Data Editing – Data analysis and modelling: Reclassification, Overlaying, Buffering – GIS Output – Maps.

UNIT V APPLICATIONS 9

Visual Interpretation of Satellite Images – Image enhancement – Filtering – Classification – Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS: Urban Analysis, Water resources.

TOTAL: 45 hours

TEXT BOOKS:

T1: M.G. Srinivas (Edited by), Remote Sensing Applications, Narosa Publishing House, 2001.

T2: Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001.

REFERENCE BOOKS:

R1: Jensen, J.R., Remote sensing of the environment, Prentice Hall, 2000.

R2: Kang Tsung Chang, "Introduction to Geographic Information Systems", TMH, 2002

WEBLINKS:

W1: https://www.usgs.gov/science/science-explorer/ocean/mapping-the-seafloor

W2: https://en.wikipedia.org/wiki/Remote_sensing

COURSE OUTCOMES:

CO1	Examine the components of Remote Sensing, Electromagnetic Spectrum and its influence in Remote Sensing.	**K2**
CO2	Differentiate the Electromagnetic Radiation interaction with atmosphere and earth materials.	**K4**
CO3	Compare various types of Satellites and Sensors used in Optical and Microwave Remote Sensing.	**K6**
CO4	Elaborate and interpret various types of data in Geographic Information System (GIS).	**K4**
CO5	Analyse various applications of Remote Sensing using Geographic Information System (GIS).	**K4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC 04	ROBOTICS	3	0	0	3

COURSE OBJECTIVES:

- To Understand the fundamental concept and embedded system require for Robot design
- To explore uses of various sensors, actuators and control mechanism for Embedded robotic design
- To understand types of algorithm used for design of mobile robot

UNIT I EMBEDDED SYSTEM FOR ROBOTICS 9

Robots and Controllers-Mobile Robots - Embedded Controllers-Robot Design -Operating System. Central Processing Unit- Logic Gates-Function Units - Registers and Memory-Retro-Arithmetic Logic Unit-Control Unit - Central Processing Unit - Structured Design. Arduino - Hardware - Programming- Interfacing-Communication. Raspberry Pi -Raspberry Pi Operating System and Setup - Tools and Programming - Raspberry Pi Input/Output Lines-Raspberry Pi Communication

UNIT II SENSORS ACTUATORS AND CONTROL 9

Sensors and Interfaces Synchronous Serial and I2C Interfaces - Binary Sensors - A/D Converters - Position Sensitive Devices—Sonar, Infrared - Lidar Sensors -Orientation Sensors -Global Navigation Satellite - Digital Image Sensors. Actuators - DC Motors - Pulse Width Modulation - Stepper Motors -Servo motors- Grippers. End Effectors.

UNIT III MULTITASKING AND COMMUNICATION 9

Multitasking - Preemptive Multithreading - Synchronization - Scheduling. Communication - Communication Channels - File Transfer and Remote Access - Radio Library - Robot to Robot Communication - Robot to PC Communication. Robot Manipulators- Homogeneous Coordinates - Manipulator Kinematics - Manipulator Simulation - Teaching and Programming

UNIT IV ALGORITHM FO/R ROBOT DESIGN 9

Localization and Navigation -Localization - Environment Representation - Quadtree - Visibility Graph - Voronoi Diagram - Potential Field Method - Wandering Standpoint Algorithm - Bug Algorithm Family -Dijkstra's Algorithm -A* Algorithm - Probabilistic Localization –SLAM.

UNIT V MOBILE ROBOT DESIGN 9

Driving Robots-Single Wheel Drive, Differential Drive, Tracked Robots, Synchro-Drive, Ackermann Steering, Drive Kinematics. Walking Robots- Balancing Robots- Six-Legged Robot Design, Biped Robot Design, Sensors for Walking Robots. Autonomous Boats and Planes -Autonomous Boasts, Unmanned Aerial Vehicles (UAVs)

TOTAL: 45 hours

TEXT BOOK:

T1: Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino, 4thEdition Thomas Braunl, Springer,2022

T2: P.Groover, "Industrial Robotics–Technology, Programming and Applications", McGraw–Hill, 2001.

T3: Yoram Koren, "Robotics for Engineers", McGraw–Hill Book Co., 1992.

T4: Robert J. Schilling, "Fundamentals of Robotics- Analysis and Control," Pearson Education, 2006.

T5: Barry Leatham - Jones, "Elements of industrial Robotics", Pitman Publishing, 1987.

REFERENCE BOOKS:

R1. Fu.K.S. Gonzalz.R.C,and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw–Hill Book Co., 1987

R2. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw–Hill, 1995

WEBLINKS:

W1: https://nptel.ac.in/courses/112105249

W2: https://blog.miguelgrinberg.com/post/building-an-arduino-robot-part-ii-programming-the-arduino

W3: https://spoken-tutorial.org/watch/Arduino/Robot+Control+using+Bluetooth/English/

COURSE OUTCOMES:

CO1	Illustrate the role of Embedded system in Robot development	**K2**
CO2	Identify and choose suitable sensors, Actuators, communication and end effectors for Robot design and development	**K1,K3**
CO3	Summarize different multitasking methods, Control Mechanism for Robot Design	**K2**
CO4	Distinguish various types of Mobile Robot and algorithm used for Robot design.	**K4**
CO5	Develop Mobile Robot for real time applications with appropriate sensors, actuators, control mechanism and algorithms	**K3,K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC – 05	SATELLITE COMMUNICATION	3	0	0	3

PREREQUISITE: MICROWAVE THEORY AND TECHNIQUES

COURSE OBJECTIVES:

- To visualize the architecture of satellite systems as a means of high speed, high range communication system.
- To state various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- To solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

UNIT I SATELLITE ORBITS 9

Introduction to satellite communication, 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

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.

UNIT III SATELLITE LINK DESIGN 9

Satellite uplink and downlink Analysis and Design, link budget, E/N calculation– performance impairments–system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations–System reliability and design lifetime.

UNIT IV SATELLITE ACCESS 9

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access based on Time , Frequency and Code sharing - FDMA, TDMA, CDMA.

UNIT V EARTH SEGMENT 9

Earth Station Technology— Terrestrial Interface, Transmitter and Receiver, Antenna Systems TVRO, MATV, CATV, Antenna Gain, Transmission losses – Free–space transmission – Feeder losses – Antenna misalignment losses – Fixed atmospheric and Ionospheric losses .

TEXT BOOK:

T1: Dennis Roddy, "Satellite Communication:", 4th Edition, McGraw Hill,2009.

T2: Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt, "Satellite Communications", Wiley India. 2nd edition 2002.

REFERENCE BOOKS:

R1: Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.

R2: N.Agarwal, Design of Geosynchronous Space Craft, Prentice Hall, 1986.

R3: Bruce R. Elbert, The Satellite Communication Applications, Hand Book, Artech House Bostan London, 1997.

WEBLINKS:

W1: https://mrcet.com/downloads/digital_notes/ECE/IV%20Year/SATTELITE%20COMMUNICATIONS.pdf

W2: https://kanchiuniv.ac.in/coursematerials/SATELLITE_COMMUNICATION.pdf

W3: https://www.tutorialspoint.com/satellite_communication/satellite_communication_tutorial.pdf

COURSE OUTCOMES:

CO1	Understand the fundamentals of satellite communication	**K2**
CO2	Develop concepts in space segment using various sub systems	**K3**
CO3	Evaluate uplink and downlink design of satellite system.	**K5**
CO4	Distinguish the various multiple access schemes such as TDMA, FDMA and CDMA	**K4**
CO5	Analyze the components of earth segment and discuss the various interferences .	**K4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC -06	WIRELESS SENSOR NETWORKS	3	0	0	3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

- To understand the design issues in wireless sensor networks.
- To learn the architecture of wireless sensor networks.
- To learn the different types of MAC protocols, routing protocols.
- To learn the sensor network platform and tools.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Introduction to Wireless Sensor Networks, Issues - Applications of Sensor Networks-Types of wireless sensor networks: Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks-comparison between Manet and WSN-Challenges for WSN: characteristics requirement, required mechanisms, design challenges-Enabling Technologies for Wireless Sensor Networks.

UNIT II ARCHITECTURES 9

Single-Node Architecture - Hardware Components-Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios- Optimization Goals and Figures of Merit-Gateway Concepts: Need for gateway, WSN to Internet Communication, Internet to WSN Communication.

UNIT III NETWORKING SENSORS 9

MAC Protocols for Wireless Sensor Networks-Classification of MAC Protocols-Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Routing Protocols- Energy-Efficient Routing-Geographic Routing.

UNIT IV INFRASTRUCTURE ESTABLISHMENT 9

Introduction-Topology Control- Clustering: LEACH protocol-Time Synchronization in wireless sensor network-Localization and Positioning-Sensor Tasking and Control:Task driven sensing, Role of sensor nodes and utilities.

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9

Berkeley Motes, Programming Challenges, Node-level software platforms: TinyOS and nesC, Operating systems and execution environments, Node-level Simulators, State-centric programming.

TOTAL: 45 hours

TEXT BOOKS:

T1: Holger Karl& Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

T2: Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks -An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS:

R1: WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks Theory And Practice", By John Wiley & Sons Publications ,2011.

R2: KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter Science.

R3: Philip Levis, And David Gay, "TinyOS Programming" Cambridge University Press 2009.

R4: Jose Anand, Wireless Sensor Networks, Vijay Nicole Imprints Private Limited, 2014.

WEBLINKS:

W1: https://en.wikipedia.org/wiki/Wireless_sensor_network

W2: https://www.geeksforgeeks.org/wireless-sensor-network-wsn

COURSE OUTCOMES:

CO1	Distinguish Wireless Sensor Networks and ADHOC Networks.	**K4**
CO2	Relate various architecture models in Wireless Sensor Network.	**K4**
CO3	Analyze the various routing protocols in Wireless Sensor Networks.	**K4**
CO4	Explain the infrastructure establishment for wireless sensor networks applications.	**K2**
CO5	Experiment with sensor network platforms and tools for WSN applications.	**K3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
					✓

OEC – 07	INTRODUCTION TO MATLAB	3	0	0	3

COURSE OBJECTIVES:

- To help student be familiar with the environment and tools in MATLAB.
- To make student write programs to solve scientific and mathematical problems in MATLAB.

UNIT I MATLAB BASICS 9

The MATLAB environment - MATLAB Interactive Sessions- Menus and the Toolbar - Arrays, Files, and Plots, Script Files and the Editor/Debugger- The MATLAB Help System- Problem-Solving Methodologies.

UNIT II SPECIAL ARRAYS AND NUMBER 9

One- and Two-Dimensional Numeric Arrays, Multidimensional Numeric Arrays, Element-by-Element Operations, Matrix Operations, Cell Arrays, Structure Arrays.

UNIT III FUNCTIONS AND FILES 9

Elementary Mathematical Functions, User-Defined Functions, Working with Data Files, Additional Function Topics.

UNIT IV INTERACTIVE PLOTTING IN MATLAB 9

Toolbox structure -MATLAB graphic function, xy Plotting Functions, Additional Commands and Plot Types, Interactive Plotting in MATLAB, Three-Dimensional Plots

UNIT V PROGRAMMING WITH MATLAB 9

Program Design and Development, Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, Debugging MATLAB Programs, Applications to Simulation.

TOTAL: 45 hours

TEXT BOOKS:

T1: William J.Palm “Introduction to Matlab for Engineers” third edition, University of Rhode Island.

T2: David Houcque “Introduction to Matlab for Engineering Students” Northwestern University.

WEBLINK:

W1: https://mypustak.com/product/get.

COURSE OUTCOMES:

CO1	Explain the various aspects of the MATLAB development environment	**K4**
CO2	Perform and analyze numerical computations on vectors and matrices in MATLAB.	**K5**
CO3	Experiment array functions and multidimensional arrays using MATLAB	**K5**
CO4	Evaluate the various control structures in MATLAB	**K5**
CO5	Write programs in MATLAB using toolboxes and graphic functions	**K2**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC-08	**RADAR AND NAVIGATIONAL AIDS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be familiar with the fundamental concepts of Radars and Navigational Aids.
- To understand the various Radar signal detection and signal navigation techniques.

UNIT I INTRODUCTION TO RADAR 9

Introduction - Basic Radar – The simple form of the Radar Equation– Radar Block Diagram and Operation– Radar Frequencies – Development and Applications of Radar

The Radar Equation–Detection of Signals in Noise– Receiver Noise and the Signal to Noise Ratio–Probability Density Functions– Probabilities of Detection and False Alarm–Integration of Radar Pulses– Radar Cross Section of Targets– Radar cross Section Fluctuations– Transmitter Power–Pulse Repetition Frequency – Antenna Parameters–System losses – Other Radar Equation Considerations

UNIT II MOVING TARGET INDICATION (MTI) AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar– Delay Line Cancelers– 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 – Other Doppler Radars. Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy – Low–Angle Tracking – Tracking in Range – Other Tracking Radar Topics –Comparison of Trackers – Automatic Tracking with Surveillance Radars (ADT).

UNIT III PROPAGATION OF RADAR WAVES 9

Propagation Radar Waves – Atmospheric Refraction – Standard propagation – Nonstandard Propagation – The Radar Antenna – Reflector Antennas – Electronically Steered Phased Array Antennas – Phase Shifters – Frequency–Scan Arrays.Radar Transmitters – Power Tubes – Solid State RF Power Sources – Magnetron – Crossed Field Amplifiers – RF Power Sources – Radar Receivers –The Radar Receiver – Receiver noise Figure – Super–heterodyne Receiver – Duplexers and Receiver Protectors – Radar Displays.

UNIT IV SOUND NAVIGATION AND RANGING 9

Introduction – Characteristics of Sound in Sea Water – Transducers – Depth Sounding Principles – A generic echo sounding system – A digitized echo sounding system – A microcomputer echo sounding system. Speed Measurement using water pressure, electromagnetic induction, acoustic correlation technique and Doppler effect – Doppler Speed Logging system.

UNIT V SATELLITE NAVIGATION 9

Satellite theory – Global Positioning System (GPS) – The position fix – Dilution of Precision (DOP) – Satellite pass predictions – System errors – Differential GPS – GPS Antenna Systems – GPS receiver designation – Generic GPS receiver architecture – GPS User agreement – GPS on the web.

TOTAL: 45 hours

TEXT BOOKS:

T1: Merrill I. Skolnik, “Introduction to Radar Systems”. Tata McGraw–Hill (3rdEdition) 2003.

T2: Laurie Tetley and David Calcutt “Electronic Navigation Systems” Butterworth-Heinemann (A member of the Reed Elsevier plc group), 3rd Edition, 2001

REFERENCES BOOKS:

R1: Peyton Z. Peebles:, "Radar Principles", Johnwiley, 2004

R2: J.C Toomay, “Principles of Radar", 2nd Edition, PHI, 2004.

R3: N. S. Nagaraja, Elements of Electronic Navigation Systems, 2nd Edition, TMH, 2000.

WEBLINKS:

W1: https://www.ll.mit.edu/outreach/radar-introduction-radar-systems-online-course

W2: https://onlinecourses.nptel.ac.in/noc19_ee58/preview

COURSE OUTCOMES:

CO1	Interpret the basic terminologies used in the different navigational systems.	**K2**
CO2	Explain the mechanisms and working of RADAR systems	**K4**
CO3	Discuss the propagation and challenges in reception of RADAR signals	**K6**
CO4	Determine the depth of underwater using various methods	**K4**
CO5	Analyze the various factors and types of satellite navigation system	**K4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC-09	**COGNITIVE RADIO NETWORKS**	**3**	**0**	**0**	**3**

PREREQUISITE: INTRODUCTION TO MATLAB, WIRELESS NETWORKS, INTERNET OF THINGS

COURSE OBJECTIVES:

- To introduce the students to the basic concepts and principles of multiplexing techniques.
- To teach the concept of Digital switching and digital switching in analog environment.
- To introduce the students to the basic concepts of network synchronization control and management.

UNIT I INTRODUCTION TO COGNITIVE RADIOS 9

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

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps.

UNIT III INTRODUCTION TO SOFTWARE DEFINED RADIO 9

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

UNIT IV SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces.

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

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

TOTAL: 45 hours

TEXT BOOKS:

T1: Joseph MitolaIII, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000.

T2: Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication",ARTECH HOUSE .2009.

T3: Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.

REFERENCE BOOKS:

R1: Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, "Next generation

R2: dynamic spectrum access / cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.

R3: HasariCelebi, HuseyinArslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.

R4: Markus Dillinger, KambizMadani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.HuseyinArslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.

WEBLINKS:

W1: www.slideshare.net/vatsalasharma180/cognitive-radio-networks-48446892

W2: www.wirelessinnovation.org/assets/documents/tut-SDR_Architectures.pdf

COURSE OUTCOMES:

CO1	Understand the need of Cognitive radio and software defined radio in wireless networks.	**K2**
CO2	Identify the hardware and software architecture of software defined radio and Cognitive Radio	**K5**
CO3	Analyse the design principles of software defined radio and cognitive radio to develop algorithms for cognitive radio spectrum sensing and dynamic spectrum access.	**K5**
CO4	Choose algorithms and implement to meet the requirements of next generation wireless networks	**K3**
CO5	Build experiments and projects with real time wireless applications	**K5**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**	**Open book test**
✓	✓		✓		✓

OEC-10	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

PREREQUISITE:Nil
COURSE OBJECTIVES:

- To understand OSI security architecture and classical encryption techniques.
- To acquire fundamental knowledge on the concepts of finite fields and number theory.
- To understand various block cipher and stream cipher models.
- To describe the principles of public key cryptosystems, hash functions and digital signature.
- To understand the system level security used

UNIT I INTRODUCTION 9

Services, Mechanisms and attacks–the OSI security architecture–Network security model–Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography)

UNIT II PUBLIC KEY CRYPTOGRAPHY 9

Data Encryption Standard–Block cipher principles–block cipher modes of operation–Advanced Encryption Standard (AES). Public key cryptography: Principles of public key cryptosystems–The RSA algorithm–Key management – Diffie Hellman Key exchange.

UNIT III AUTHENTICATION AND HASH FUNCTION 9

Authentication requirements – Authentication functions – Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs – MD5 message Digest algorithm – Secure Hash Algorithm – Digital Signature Standard.

UNIT IV NETWORK SECURITY 9

Authentication Applications: Kerberos – X.509 Authentication Service – Electronic Mail Security — S/MIME–Functionality, – IP Security-. IP Security architecture.

UNIT V SYSTEM LEVEL SECURITY 9

Intrusion detection – password management – Viruses and related Threats – Virus Counter measures –Firewall Design Principles – Characteristics, Types and Configuration – Trusted Systems – Data Access Control, Concept and Trojan Horse Defense.

TOTAL: 45 hours

At the end of this course the students will be able to ,Understand OSI security architecture and connect with various security models

TEXT BOOKS:

T1: William Stallings, "Cryptography and Network Security – Principles and Practices", Pearson Education, Third Edition, 2003.

T2: Behrouz A. Foruzan, "Cryptography and Network Security", Tata McGraw–Hill, 2007.

REFERENCES BOOKS:

R1. Bruce Schneier, "Applied Cryptography", John Wiley & Sons Inc, 2001.

R2. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Third Edition, Pearson Education, 2003.

R3. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with coding theory", Pearson Education, 2007.

R4. WenboMao, "Modern Cryptography Theory and Practice" , Pearson Education, 2007.

R5. Thomas Calabrese, "Information Security Intelligence: Cryptographic Principles and Applications", Thomson Delmar Learning, 2006.

WEBLINKS:

W1: .https://nptel.ac.in/courses/106105162.

W2: http://csrc.nist.gov/publications/fips/fips46-3/fips46-3.pdf

W3: http://homes.esat.kuleuven.be/~abiryuko/Enc/e31.pdf

W4: http://cobweb.ecn.purdue.edu/~kak/compsec/NewLectures/Lecture2.pdf

W5: http://buchholz.hs-bremen.de/aes/AES.pdf

COURSE OUTCOMES:

CO1	Analyze various classical encryption like substitution and transposition techniques	**K4**
CO2	Evaluate the various public key cryptography methods	**K5**
CO3	Evaluate the various authentication algorithm.	**K5**
CO4	Illustrate the IP security architecture in network security	**K2**
CO5	Develop principles of firewall anddiscuss the various system threats andprotection using virus counter measures, firewall, Trojan etc.,	**K3,K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC – 11	MEDICAL SIGNAL & IMAGE PROCESSING	3	0	0	3

PREREQUISITE: SIGNALS AND SYSTEMS, DIGITAL SIGNAL PROCESSING, DIGITAL IMAGE AND VIDEO PROCESSING

COURSE OBJECTIVES:

- To understand the fundamentals of medical image processing techniques.
- To develop computational methods and algorithms to analyze and quantify biomedical data

UNITI BIOMEDICAL SIGNALS AND IMAGES 9

Origin of Bio-potential electrodes, Bio signals – Electro Cardiogram (ECG), Electroencephalogram(EEG), Electromyogram (EMG), PCG, EOG, lead systems and recording methods, typical waveforms and signal Characteristics clinical applications.Imaging Modalities**:** Survey of major modalities for medical imaging: ultrasound, X-ray, CT, MRI, PET, and SPECT. MRI: Physics and signal processing for magnetic resonance imaging. Surgical Applications: A survey of surgical applications of medical image processing.

UNIT II FUNDAMENTALS OF DETERMINISTIC SIGNAL 9

Data Acquisition: Sampling in time, aliasing, interpolation, and quantization. Digital Filtering: Difference equations, FIR and IIR filters, basic properties of discrete-time systems, convolution. DTFT: The discrete-time Fourier transform and its properties. FIR filter design using windows.DFT: The discrete Fourier transform and its properties, the fast Fourier transform (FFT), the overlap-save algorithm, digital filtering of continuous-time signals. Sampling Revisited: Sampling and aliasing in time and frequency, spectral analysis

UNIT III BIO MEDICAL IMAGE PROCESSING 9

Review of Image processing - Medical image enhancement. Filtering - Extension of filtering and Fourier methods to 2-D signals and systems. Interpolation, noise reduction methods, edge detection, homomorphic filtering

UNITIV PROBABILITY AND RANDOM SIGNALS 9

PDFs: Introduction to random variables and probability density functions (PDFs). Classification: Bayes' rule, detection, statistical classification. Estimating PDFs - Practical techniques for estimating PDFs from real data.

Random signals: Time averages, ensemble averages, autocorrelation functions, cross correlation functions. Linear systems, power spectra, cross spectra, Wiener filters. Blind source separation: Use of principal component analysis (PCA) and independent component analysis (ICA) for filtering.

UNIT V IMAGE SEGMENTATION AND REGISTRATION 9

Image Segmentation: statistical classification, morphological operators, connected components. Image Registration: Rigid and non-rigid transformations, objective functions - Joint entropy, optimization methods. Nuclear Imaging: PET and SPECT Ultrasound Imaging

TOTAL: 45 hours

TEXT BOOKS:

T1. Amit Kumar, Fahimuddin Shaik, B Abdul Rahim,D.Sravan Kumar , "Signal and Image Processing in Medical Applications (Springer Briefs in Applied Sciences and Technology, 2016.

T2. Wolfgang Birkfellner "Applied Medical Image Processing: A Basic Course, Second Edition, 2014.

T3. Kayvan Najarian& Robert Splinter, "Biomedical Signal and Image Processing", 2nd Edition Biomedical Signal and Image Processing, 2012.

T4. Theis. "Biomedical Signal Analysis: Contemporary Methods and Applications, Prentice Hall India Learning Private Limited, 2011.

REFERENCE BOOKS:

R1. Ervin Sejdic, Tiago H. Falk, 'Signal Processing and Machine Learning for Biomedical Big Data" 1st Edition, 2018.

R2. Karen M. Mudry, Robert Plonsey, Joseph D. Bronzino, "Biomedical Imaging", 1st Edition.

WEBLINKS:

W1: https://dl.icdst.org/pdfs/files3/61016eb30fb229b3de86f6e8b65ddf85.pdf

W2: https://ocw.mit.edu/courses/health-sciences-and-technology/hst-582j-biomedical-signal-and-image-processing-spring-2007/lecture-notes/

W3: https://biomedikal.in/2010/04/university-lecture-notes-on-biomedical-image-processing-biomedical-signal-processing/

COURSE OUTCOMES:

CO1	Apply the concepts for acquiring bio signals and images using different modalities.	**K3**
CO2	Analyze the process of sampling, quantization of bio signals, digital filter design using windows and spectral analysis.	**K4**
CO3	Compare the different techniques for image enhancement, filtering, restoration and edge detection in medical imaging.	**K4**
CO4	Select and discuss the methodologies to analyze probabilistic and random signals.	**K6**
CO5	Discuss the image segmentation and registration techniques and compare different Imaging applications.	**K5**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**	**Open book test**
✓	✓	✓	✓	✓	✓

OEC – 12	**VHDL AND VERILOG HDL PROGRAMMING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the VHDL language feature to realize the complex digital systems.
- To design and simulate sequential and concurrent techniques in VHDL.
- To explain modeling of digital systems using VHDL and design methodology.
- To explain predefined attributes and configurations of VHDL

UNIT I INTRODUCTION 9

Synchronous and Asynchronous circuit design, Programming logic device families, Realization of combinational and sequential circuits using Verilog – Registers – counters

UNIT II VHDL 9

VHDL operators – Arrays – concurrent and sequential statements – packages- Data flow– Behavioral – structural modeling – compilation and simulation of VHDL code –Test bench.

UNIT III HARDWARE MODELLING WITH VHDL 9

Realization of combinational and sequential circuits using VHDL – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.

UNIT IV VERILOG HDL 9

Logic System, Data Types and Operators For Modelling inVerilog HDL - Behavioral Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines– structural modeling – compilation and simulation of Verilog code –Test bench.

UNIT V HARDWARE MODELLING WITH VERILOG HDL 9

Design of simple Microprocessor Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA – Xilinx4000

TOTAL:45 hours

TEXT BOOKS:

T1: Charles H Roth Jr."Digital System Design using VHDL" Thomson learning, 2012.

T2: ParagK.Lala "Digital system Design using PLD" B S Publications,2003.

T3: Douglas L. Perry, "VHDL programming by Example" Tata McGraw Hill, 4th edition.

T4: Samir Palnitkar, "Verilog HDL", Pearson Education, 2ndEdition, 2004.

T5: J.Bhasker, "A Verilog HDL Primer", B.S.Publications, 2ndEdition, 2001.

REFERENCE BOOKS:

R1: Charles H.RothJr , "Fundamentals of Logic Design" Thomson Learning, 7th edition 2013

R2: Nripendra N Biswas,"Logic Design Theory" Prentice Hall of India,2001.

WEBLINK:

https://nptel.ac.in/courses/106105165

COURSE OUTCOMES:

CO1	To understand the basic language features of Verilog using combinational and sequential circuits.	**K2**
CO2	To understand the behavioral and structural modelling of combinational and sequential circuits in VHDL	**K2**
CO3	To design hardware, create entities and to verify hardware behavior.	**K6**
CO4	To describe and design digital and electronics system hardware at register – transistor level using VHDL	**K5**
CO5	To analyze an FPGAs by interconnecting logic blocks using VHDL	**K4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓			✓		✓

OEC – 13	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3

The student should be made to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance – Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diodecharacteristics- Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS AND THYRISTOS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors – Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback –Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 hours

TEXT BOOKS:

T1: G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition,Pearson,2014.

T2: D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education

T3: S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley&Sons, 2006.

REFERENCE BOOKS:

R1: C.T. Sah, "Fundamentals of solid-state electronics," World Scientific Publishing Co. Inc,1991.

R2: Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," OxfordUniv.Press, 2011.

WEBLINKS:

W1: https://www.mheducation.co.in/electronic-devices-and-circuits-9789339219505-india

W2: http://www.rtna.ac.th/departments/elect/Data/EE306/Electronic%20Devices%20and%20Circuit%20Theory.pdf

COURSE OUTCOMES:

CO1	Explain the structure and working operation of basic electronic devices.	**K2**
CO2	Identify and differentiate both active and passive elements	**K3**
CO3	Analyze the characteristics of different electronic devices such as diodes and Transistors	**K4**
CO4	Choose and adapt the required components to construct an amplifier circuit	**K3**
CO5	Evaluate the acquired knowledge in design and analysis of oscillators	**K5**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC – 14	ANALOG AND DIGITAL COMMUNICATION	3	0	0	3

COURSE OBJECTIVES:

- To analyze various Amplitude, Angle and Pulse modulation systems.
- To provide some depth analysis in noise performance of various receiver.
- To study some basic information theory with some channel coding theorem.
- To study signal space representation of signals and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To understand baseband and band pass signal transmission and reception techniques.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

UNIT I ANALOG COMMUNICATION 9

Introduction to Communication Systems – Modulation – Types – Need for Modulation. Theory of Amplitude Modulation –DSB and SSB Techniques – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT II PULSE AND DATA COMMUNICATION 9

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAMPTM –PCM). Data Communication: History of Data Communication – Standards Organizations for Data Communication– Data Communication Circuits – Data Communication Codes – Data communication Hardware – serial and parallel interfaces.

UNIT III DIGITAL COMMUNICATION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes – ARQ Techniques.

UNIT V MULTI-USER RADIO COMMUNICATION 9

Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Handover Techniques – Overview of Multiple Access Schemes – Satellite Communication – Bluetooth.

TOTAL: 45 hours

TEXT BOOKS:

T1: Haykin S., "Communications Systems", John Wiley and Sons, 2001.

T2: Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.

T3: Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication", Kluwer Academic Publishers, 2004.

T4: Proakis J.G., "Digital Communications", 4thEdition, McGraw Hill, 2000.

REFERENCE BOOKS:

W1: Taub H. and Schilling D.L., "Principles of Communication System", Tata McGraw Hill, 2001.

W2: Wozencraft J. M. and Jacobs I. M. "Principles of Communication Engineering", John Wiley, 1965.

WEBSITE:

1. https://www.wiley.com/en-us/An+Introduction+to+Analog+and+Digital+Communications%2C+2nd+Edition-p-9780470460870
2. https://www.skylineuniversity.ac.ae/pdf/computer/An%20Introduction%20to%20Digital%20Multimedia.pdf

COURSE OUTCOMES:

CO1	Analyze and compare different Analog modulation schemes for their efficiency and bandwidth.	**K4**
CO2	Analyze the behavior of a communication system in presence of noise.	**K4**
CO3	Choose pulsed modulation system and analyze their system performance.	**K3**
CO4	Comparedifferent digital modulation schemes and can compute the bit error performance.	**K4**
CO5	Explain the concepts and methods of equalization and synchronization to eliminate the influence of noise in communication systems.	**K5**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC–15	EMBEDDED SYSTEMS	3	0	0	3

PREREQUISITE: Microprocessor and Microcontroller

COURSE OBJECTIVES:

- To explore about embedded systems, buses, tools, operating systems and software used for embedded system
- To study ARM architecture and its applications
- To study about PSoC family and programming using PSoC

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction - Microprocessor, Microcontroller –definition, comparison Classification of MCU. Embedded system-definition-Applications-Features-Characteristics – Model and example of embedded system. Embedded systems hardware- Microcontroller unit- Memory –Sensors-ADC-Actuators

UNIT II BUSES AND SOFTWARE TOOL 9

Defining Buses and Protocols- Onboard buses- external buses-Automotive buses- wireless communication Protocols. Software development tools- Program development-Hex file download- Hardware simulator. Applications-Mobile phone-RFID

UNIT III OPERATING SYSTEM CONCEPTS 9

Embedded Operating Systems- History-Network Operating systems (NOS)-Layers of OS-Functions-Terminology- Kernel-Tasks-Processes-Scheduling Algorithms- Threads – Interrupt Handling- Inter Process Communication (IPC)

UNIT IV ADVANCED RISC MACHINES (ARM) 9

ARM- History, Architecture, ARM family - interrupt Vector Table. Instruction set- Arithmetic, logical, compare, Condition, Branch. Thumb instruction - Load-store. Assembly language programming- addition, subtraction, multiplication, division.

UNIT V PSOC FAMILY FOR EMBEDDED APPLICATIONS 9

Introduction- PSoC,PSoC family. PSoC1- Internal Architecture, Digital Sub System, GPIO. PSoC Applications - Digital Applications-LED Blink, CapSense

TOTAL: 45 hours

Text Books:

T1: Lyla B Das “Embedded Systems An Integrated Approach”, Pearson Publications 2017

T2: David E-Simon, “An Embedded Software Prime”, Pearson Education, 2010

References Books:

R1. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-GrawHill, 2004

R2. PSoC-Programmable System-on-Chip, Technical Reference Manual.

WEBLINK:

W1: https://archive.nptel.ac.in/courses/108/102/108102045/

COURSE OUTCOMES

CO1	Illustrate importance of microcontrollers in embedded systems.	**K2**
CO2	Apply the concepts of buses, tools and operating systems.	**K3**
CO3	Summarize microcontroller and its role in application development.	**K2**
CO4	Design and develop ARM andPSoC processors based systems.	**K6**
CO5	Develop real time applications using ARM and PSoC.	**K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC – 16	**VLSI CIRCUITS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the basic CMOS circuits
- To learn the CMOS process technology.
- To Analyze techniques of chip design using programmable devices.
- To explain the concepts of designing VLSI subsystems.
- To evaluate the concepts of modeling a digital system using Hardware Description Language.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

UNIT IV DESIGN OF ARTHIMETIC BUILDING BLOCK AND SUBSYSTEM 9

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

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL: 45 hours

TEXT BOOKS:

T1: Jan Rabaey, AnanthaChandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.

T2: M.J. Smith, "Application Specific Integrated Circuits",Addisson Wesley, 1997

REFERENCE BOOKS:

R1: Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 1993

R2: R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005

R3: A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.

COURSE OUTCOMES:

CO1	To understand the functionality of a device based on MOS capacitor	**K2**
CO2	To perform the Boolean operations and to determine the output of a combinational circuits as the Boolean function	**K4**
CO3	To enable the storing data and to create registers, counters and processors and also to construct a finite state machine	**K3**
CO4	To interface and designs a subsystem with other elements of a device	**K5**

CO5	To fabricate transistors in FPGA and will be able to understand the testing methods used in post-production.	**K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**	**Open book test**
✓	✓		✓		✓

OEC –17	**ADVANCED DIGITAL SIGNAL PROCESSING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be familiar with the random process
- To estimate the spectrum using various methods

UNIT I INTRODUCTION 9

Introduction to finite signals, systems and processing of finite signals, Random Variables and Random Process. Filtering Random process, Spectral Factorization, Special types of random process

UNIT II SIGNAL MODELING 9

The Least Squares Method, The Pade Approximation, Pole-Zero Modeling, Shank's Method, All-Pole Modeling, Linear Prediction, Finite Data Records, Stochastic Models.

UNIT III LINEAR PREDICTION AND OPTIMUM LINEAR FILTERS 9

Forward and backward linear prediction, Optimum Reflection Coefficients for the Lattice Forward and Backward Predictors, Relationship of an AR Process to Linear Prediction. AR Lattice Filters, ARMA Lattice Ladder Filters, FIR Wiener Filters, IIR Wiener Filters, Noncausal Wiener Filters.

UNIT IV SPECTRUM ESTIMATION 9

Estimation of Spectra from finite duration signals, Minimum Variance Spectrum Estimation, The Maximum Entropy Method, Frequency Estimation – Eigen Decomposition of the Autocorrelation Matrix, Pisarenko Harmonic Decomposition, MUSIC; Principal Components Spectrum Estimation – Bartlett Frequency Estimation, Minimum Variance Frequency Estimation, Autoregressive Frequency Estimation

UNIT V NONPARAMETRIC AND PARAMETRIC MODELS SPECTRUM ESTIMATION 9

Nonparametric Methods for Power Spectrum Estimation – Bartlett, Welch, Blackman and Turkey methods, Performance Characteristics of nonparametric methods, Computational Requirements Yule-Walker, Burg, Least Squares Methods, Sequential estimation methods, AR, MA and ARMA Methods.

TOTAL: 45 hours

TEXT BOOKS:

T1: Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.

T2: John G. Proakis& Dimitris G.Manolakis, ―Digital Signal Processing – Principles, Algorithms & Applications‖, Fourth Edition, Pearson Education / Prentice Hall, 2007

REFEENCE BOOKS:

R1: Sophoncles J. Orfanidis, "Optimum Signal Processing", McGraw Hill, 2000

R2: Alan V Oppenheim, Ronald W. Schafer, "Discrete Time Signal Processing", Pearson, 2010.

WEBLINK:

W1: https://onlinecourses.nptel.ac.in/noc22_ee60/preview

COURSE OUTCOMES:

CO1	Explain the various random variables and random processes	**K2**
CO2	Compare the various methods of Signal Modelling and prediction	**K4**
CO3	Identify the appropriate Optimum linear filter for the given random process	**K3**
CO4	Estimate the power spectrum using various methods	**K5**
CO5	Analyze the nonparametric and parametric models of power spectrum estimation	**K4**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC –18	5G BASED INTERNET OF THINGS	3	0	0	3

COURSE OBJECTIVES:

- To understandIoT Architectures, protocols and Smart Objects
- To build simple IoT Systems using Embedded system boards.
- To understand different enabling wireless technologies and networks for IoT
- To develop IoT infrastructure for smart real time applications

UNIT I FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT system building blocks - IoT Architectures: one M2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT II IoT PROTOCOLS 9

IoT Protocols: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, IEEE 802.11 and LoRaWAN- Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo – Application Layer Protocols: CoAP and MQTT.

UNIT III WIRELESS TECHNOLOGY FOR IOT 9

Wireless Technologies: NFC, RFID, Zigbee, LoRa, Z wave, SPI- Wired vs. Wireless communication, GSM, CDMA, LTE, GPRS, WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart.

UNIT-IV ENABLING WIRELESS NETWORKS FOR IOT 9

Wireless Networks for IOT-overview; Introduction to 5G for IOT–features, Characteristics, Architecture, Impact of 5G on IOT,Applications,5G IoT ecosystem,Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication; Software Defined Networks– features, Characteristics, Architecture and applications.

UNIT V IOT APPLICATIONS- DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic, Arduino - Board details, IDE programming –Temperature monitoring using Cloud Platform. Raspberry Pi - Interfaces and Raspberry Pi with Python Programming: Temperature monitoring using Cloud.5G based IOT applications- Smart Traffic system, Smart Agriculture

TOTAL: 45 hours

TEXT BOOKS:

T1: Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things-Architectures, Protocols, and Standards", Wiley 2018.

T2: David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.

T3: Viswanatha Reddy Allugunti, "Introduction to 5G Networks and Applications",2021

REFERENCE BOOKS:

R1: ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

R2: Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols‖", Wiley, 2012.

R3: Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

R4: Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

R5: Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

WEBLINKS:

W1: https://archive.nptel.ac.in/courses/106/105/106105166/

W2: https://www.arduino.cc/ https://www.ibm.com/ smarterplanet/us/en /?ca =v_ smarterplanet

W3: https://www.ee.iitb.ac.in/~karandi/assets/attachment/5GMobileEdgeKarandikar.pdf

COURSE OUTCOMES:

CO1	Identify appropriate IoT Architecture and protocol, sensor and actuator for application development	**K3**
CO2	Explain role of cloud and smart objectsin IoT	**K2**
CO3	Recommend appropriate hardware and IOT technology for smart system development	**K5**
CO4	Illustrate different protocols and wireless technologies for various layers of Architecture	**K2**
CO5	Design and develop5G based IOT applications with suitable cloud platform	**K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies

✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓		

OEC-19	DIGITAL IMAGE PROCESSING	3	0	0	3

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

- To be familiar with the fundamentals of digital images.
- To perform simple image processing techniques such as image enhancement, compression and segmentation.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS 9

Fundamental steps in digital image processing – Basic relationship between pixels-Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms.

UNITII IMAGE PROCESSING TECHNIQUES 9

Image Enhancement Techniques: Spatial Domain method: Histogram Processing-Fundamentals of Spatial Filtering:Smoothing Spatial filters, Sharpening Spatial filters-Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering.

UNIT III IMAGE COMPRESSION 9

Image compression fundamentals – coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, transform coding, JPEG standards.

UNIT IV IMAGE SEGMENTATION AND REPRESENTATION 9

Fundamentals-point, line, Edge Detection - Thresholding-Region Based Segmentation - Image Representation: Representation schemes – Boundary Descriptors – Regional Descriptors.

UNIT V APPLICATIONS OF IMAGE PROCESSING 9

Case study: Biometric Authentication (Face, Finger Print, Signature Recognition), Vehicle Number Plate Detection and Recognition, underwater Object Detection, biomedical application.

TOTAL: 45 hours

TEXT BOOKS:

T1: Gonzalez and Woods, "Digital Image Processing", 4th edition, Pearson, 2018.

T2: Al Bovic, "Handbook of Image and Video Processing",Elsevier, 2005.

T3: Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson 2002.

REFERENCE BOOKS:

R1: Relf, Christopher G, "Image Acquisition and processing with LabVIEW", CRC press

R2: Chris Solomon, Toby Breckon "Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab", John Wiley & Sons.

WEBLINK:

W1: Professor Bernd Girod's course page on Image Communication about video compression: http://www.stanford.edu/class/ee398b/.

COURSE OUTCOMES:

CO1	Apply 2D transforms and analyze the digital image.	**K3**
CO2	Analyze images using image enhancement and filtering techniques.	**K4**
CO3	Analyze various techniques for compression and coding of digital images.	**K4**
CO4	Analyze images using segmentation and representation techniques.	**K4**
CO5	Apply the digital image processing concepts in various applications.	**K3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
					✓

OEC-20	**WAVELET TRANSFORMS AND TECHNIQUES**	**3**	**0**	**0**	**3**

PREREQUISITE: SIGNALS AND SYSTEMS

COURSE OBJECTIVES:

- To study the basics of Fourier transforms and short time Fourier transforms.
- To study the wavelet transform in both continuous and discrete domain.
- To understand the applications of Wavelet transform.

UNIT I SHORT TIME FOURIER TRANSFORM (STFT) 9

Signal representation with continuous and discrete STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling, significance of wavelet transform.

UNIT II INTRODUCTION TO WAVELET TRANSFORM 9

The origins of wavelets - Wavelets and other wavelet like transforms-Different families of wavelets:Haar, Daubechies,Coiflets, Symlets - comparative analysis of wavelet transforms.

UNIT III CONTINUOUS WAVELET TRANSFORM 9

Continuous Wavelet Transform: Wavelet transform-A first level introduction, Continuous time-frequency representation of signals, Properties of wavelets used in continuous wavelet transform, Continuous versus discrete wavelet transform.

UNIT IV DISCRETE WAVELET TRANSFORM AND FILTER BANKS 9

Discrete Wavelet Transform: Haar scaling functions and function spaces, Translation and scaling of $\phi(t)$, Haar wavelet function, properties, Filter Bank and sub band coding principle – Wavelet Filters - Inverse DWT computation by Filter bank.

UNIT V APPLICATIONS 9

Wavelet based Signal compression, Image processing and Compression techniques, Image denoising techniques, Biomedical Application, Underwater Application.

TOTAL: 45 hours

TEXT BOOKS:

T1: Mallat S., "Wavelet tour of Signal Processing", Academic Press, 1996.

T2: Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.

T3: C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.

T4: Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.

T5: Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.

T6: P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

REFERENCE BOOKS:

R1: B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

R2: A.N. Akansu and R.A. Haddad, Multiresolutionsignal Decomposition: Transforms,Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.

R3: Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.

R4: Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, JeanMichel Poggi, John Wiley & Sons, 2010 .

WEB LINK

W1: https://towardsdatascience.com/the-wavelet-transform-e9cfa85d7b34

COURSE OUTCOMES:

CO1	Explain the significance and issues in Time frequency analysis.	**K2**
CO2	Explain the short time Fourier transforms.	**K2**
CO3	Evaluate Continuous Wavelet Transform using the different wavelet functions.	**K5**
CO4	Compute DWT and IDWT using filter banks and sub-band coding principles.	**K4**
CO5	Apply DWT and CWT for diverse applications and understand time-frequency analysis.	**K3**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
✓	✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
					✓

OEC -21	**MICROCONTROLLER BASED SYSTEM DESIGN**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To implement the assembly language programming of 8085,8086 and 8051.
- To experiment the interface concepts of various peripheral device with the processor.

UNIT I MICROPROCESSORS HARDWARE ARCHITECTURE 9

Introduction to 8085 & 8086 Microprocessor system and their building blocks – Addressing modes, Instruction set and assembler directives of microprocessors, (with examples of 8085 and 8086).

UNIT II MICROPROCESSOR PERIPHERAL INTERFACING AND MEMORY 9

Interfacing with peripherals – timer, serial I/O, Parallel I/O, A/D and D/A converters, Arithmetic Coprocessors, System level interfacing design,Advanced coprocessor Architectures- 286, 486, Pentium.

UNIT III MICROCONTROLLER 9

Microcontrollers vs Microprocessors– 8051 Micro Controller Hardware – I/O Pins, Instruction Set , Ports and Circuits – External Memory – Addressing modes - Counters and Timers – Serial Data I/O – Interrupts

UNIT IV INTERFACING MICROCONTROLLER 9

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

UNIT V INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems and Fundamental – Software for Embedded Systems – Stepper motor and waveform generation - Intel 8051 / Atmel 89c51 / Arduino, PIC Microcontroller, Introduction to RISC processors

TOTAL: 45 hours

TEXT BOOKS:

T1: R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, 1996

T2: D A Patterson and J H Hennessy, "Computer Organization and Design The hardware andsoftware interface", Morgan Kaufman Publishers.

T3: Douglas Hall, "Microprocessors Interfacing", Tata McGraw Hill, 1991.

T4: Kenneth J. Ayala, "The 8051 Microcontroller", Penram International Publishing, 1996.

REFERENCE BOOKS:

R1: David. E.Simon, "An Embedded Software Primer", Pearson Education, 2001

R2: Muhammad Mazidi "8051 Microcontroller and Embedded systems" Pearson education, 2007

R3: N Senthil Kumar, M Saravanan "Microprocessors & Microcontrollers" OxfordPublications, 2011

WEBLINK:

W1: https://nptel.ac.in/courses/106108100

COURSE OUTCOMES:

CO1	To understand the architecture of microprocessors.	**K2**
CO2	To learn and analyze the design aspects of I/O and Memory Interfacing circuits	**K4**
CO3	To understand and distinguish a microprocessor and a microcontroller.	**K2,K3**
CO4	To interface microprocessors with supporting chips.	**K6**
CO5	Testing the program of PIC microcontrollers, ARM processors, Arduino, PIC Microcontroller.	**K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC-22	DIGITAL ELECTRONICS	3	0	0	3

COURSE OBJECTIVES:

- To introduce basic postulates of Boolean algebra and show the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.

UNITI LOGIC GATES, BOOLEAN ALGEBRA AND MINIMIZATION TECHNIQUES 9

Review of Boolean Algebra and De-Morgan's Theorem, Minimum of Boolean Expressions, Minterm, Maxterm, Sum Of Products (SOP) & Product Of Sums (POS) forms, Canonical forms, Karnaugh maps, Quin McCluskey method of minimization.

UNIT II COMBINATIONAL LOGIC DESIGN 9

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Bit Adder/ Subtractor, Look Ahead Carry Generator, BCD Adder, Code Converters- Encoder -Decoder, Multiplexer, De-Multiplexer.

UNIT III SEQUENTIAL LOGIC DESIGN 9

Design of S-R, JK, D and T Flip Flops, Modulo N Counters, Shift registers- SISO, SIPO, PIPO, PISO, Universal Shift Register, Races, Hazards.

UNIT IV MEMORIES, PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES 9

Memories: ROM, PROM, EPROM, EEPROM, RAM, Static RAM cell, Bipolar RAM cell, MOSFET RAM cell, Dynamic RAM CELL. Programmable logic devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Array (FPGA).

UNIT V VHDL CONCEPTS IN DIGITAL DESIGN 9

Design entry: Different Modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, VHDL constructs and codes for combinational and sequential circuits.

TOTAL: 45 hours

TEXT BOOKS:

T1: R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.

T2: Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.

T3: M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd. / Pearson Education, 2003.

T4: S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006.

REFERENCE BOOKS:

R1: W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.

R2: D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.

R3: Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition2012.

R4: Donald D. Givone, Digital Principles and Design, Tata McGraw–Hill Education, 2002.

WEBLINKS:

W1: www.tutorialspoint.com/digital_electronics/index.asp

W2: www.coertvonk.com/hw/logic/synchronous-sequential-logic-30712

COURSE OUTCOME:

CO1	Examine the laws of Boolean algebra and Simplifyminterms and maxterms using K map and tabulation methods	**K4**
CO2	Analyze combinational logic circuits like adders, subtractors, multiplexers and Demultiplexers.	**K4**
CO3	Distinguish the operations of SR,JK,T and D flip-flops.	**K4**
CO4	Criticize the different types of memories and their designs	**K5**
CO5	Compile VHDL codes to design combinational and sequential circuits.	**K6**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓

OEC – 23	DIGITAL SIGNAL PROCESSING	3	0	0	3

COURSE OBJECTIVES:

- To be familiar with sampling and the various types of analysis performed on digital signals
- To design filters in accordance to the application.

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS 9

Discrete time signals: Sequences; Representation of signals on orthogonal basis; Sampling quantization, quantization error, Nyquist rate, aliasing effect, Z-Transform and its properties, Analysis of LTI systems, frequency Analysis, Inverse Systems

UNITII ANALYSIS OF SIGNALS USING DFT – FFT ALGORITHMS 9

Discrete Fourier Transform (DFT)- DFT – properties – Frequency analysis of signals using DFT – FFT algorithms –Advantages over discrete computation of DFT – Radix 2 algorithms – DIT and DIF algorithms – Computation of IDFT using FFT– overlap add and save methods.

UNITIII INFINITE IMPULSE RESPONSE FILTER DESIGN 9

Design of Infinite Impulse Response Filter from Analog Butterworth and Chebyshev filters – Impulse invariance and bilinear methods of IIR digital filter design – realization using direct, cascade, and parallel and ladder forms.

UNIT IV FINITE IMPULSE RESPONSE FILTER DESIGN 9

Design of FIR filters using windowing technique–Rectangular – Hamming– Blackman windows. Realization of FIR filters – Transversal, linear phase and polyphase realization structures.

UNIT V MULTIRATE SIGNAL PROCESSING 9

Introduction to multirate signal processing – Decimation and Interpolation by integer factors – sub band coding of speech signals – QMF filters, Application of DSP.

TOTAL: 45 hours

TEXT BOOKS:

T1: Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata McGraw Hill, 2007.
T2: A.V.Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8thIndian Reprint, Pearson, 2004.
T3: John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
T4: L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.

REFERENCE BOOKS:

R1: J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
R2: D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.
R3: Emmanuel C Ifeachor, Barrie W Jervis, "Digital Signal Processing A Practical Approach", Pearson Education / Prentice Hall, 2014.
R4: Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2006

WEBLINKS:

W1: https://nptel.ac.in/courses/117102060
W2: https://onlinecourses.iitk.ac.in/course/ee301a
W3: https://freevideolectures.com/course/2317/digital-signal-processing-iit-delhi

COURSE OUTCOMES:

CO1	Represent signals mathematically in time and frequency domain, analyze the performance of LTI systems.	**K4**
CO2	Analyze the response of signals using DFT and FFT algorithms	**K4**
CO3	Design IIR filters for various applications using Butterworth and Chebyshev approximations	**K6**
CO4	Estimate the performance of FIR filters using various windowing techniques.	**K5**
CO5	Compare the spectral estimation methods and analyzemultirate signal processing techniques	**K4**

ASSESSMENT METHODS

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments	Case Studies
✓	✓	✓	✓	✓	
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
✓	✓		✓		✓