VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM - CHENNAI
NAAC ACCREDITED WITH 'A' GRADE
Marching Beyond 25 Years Successfully

B.TECH.

Electronics and Computer Engineering

Curriculum and Syllabus

Effective from the Academic year 2022 - 2023

Department of Electronics and Communication Engineering

School of Engineering

VISTAS

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Implement the acquired sound technical knowledge in core and specialized subjects of Electronics & Computer 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 in Electronics and Computer Engineering 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 Electronics, Cognitive Networks, Data Structure, Computer Architecture, 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, and Statistics to solve problems.
		1.1.2	Apply advanced mathematical techniques to model and solve Electronics and Computer engineering problems.
1.2	Demonstrate competence in basic sciences	1.2.1	Apply laws of natural science to a computing engineering problem.
1.3	Demonstrate competence in engineering fundamentals	1.3.1	Apply fundamental computing concepts to solve engineering problems
1.4	Demonstrate competence in specialized engineering knowledge to the program	1.4.1	Apply Electronics and Computer 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 computer 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 Electronics and Computer 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 Computer 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) modelling 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, conflict resolution and leadership skills	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
		9.2.4	Maintain composure in difficult situations
9.3	Demonstrate success in a 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 impact technologies.			
14.1	Demonstrate an ability to develop solutions using engineering principles and practices	14.1.1	Describe the rationale for choosing 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 of the Board Member	Designation	Role
1	Dr.V. Rajendran	Professor & Director, Dept of ECE, VISTAS	Convenor
2	Dr. P. Vijayakumar	Professor, Department of Electronics Engineering, Vellore Institute of Technology, Chennai	Academic Expert
3	Dr. R. Srinivasan	Scientist – F, Ocean Electronics Group, National Institute of Ocean Technology, Chennai.	Industrial Expert
4	Mr. Mahesh S	NFVi - Cloud Infrastructure Engineer, Nokia Solution Network Pvt Ltd, Chennai	Alumni
5	Dr. S. Jerritta	Professor & HoD, Dept of ECE, VISTAS	Internal Expert
6	Dr. G.R. Jothilakshmi	Associate Professor, Dept of ECE, VISTAS	Internal Expert
7	Dr. T. Jaya	Associate Professor, Dept of ECE, VISTAS	Internal Expert
8	Dr. P. Vijayalakshmi	Associate Professor, Dept of ECE, VISTAS	Internal Expert
9	Dr. M. Monisha	Assistant Professor, Dept of ECE, VISTAS	Internal Expert

B.Tech – ELECTRONICS AND COMPUTER 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	Engineering 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	Basics of 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	3	-	-	3	40	60	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	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 and 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	Introduction to IoT	3	-	-	3	40	60	100
PCC	Electronic Devices	3	1	-	4	40	60	100
PCC	Digital Electronics	3	-	2	4	40	60	100
PCC	Data Structures and Algorithms	3	1	-	4	40	60	100
PCC	Electronic Devices Laboratory	-	-	2	1	40	60	100
PCC	Data Structures and algorithms Laboratory	-	-	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	Mathematics-IV Probability and Random Processes	3	1	-	4	40	60	100
PCC	Operating Systems	3	-	-	3	40	60	100
PCC	Signals and Systems	3	-	-	3	40	60	100
PCC	Database Management Systems	3	-	-	3	40	60	100
PCC	Design and Analysis of Algorithms	3	-	2	4	40	60	100
PCC	Signals and Systems - Laboratory	-	-	2	1	40	60	100
PCC	Database Management Systems 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	Data Communication Networks	3	1	-	4	40	60	100
PCC	Introduction to AI & ML	3	-	2	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	1	-	4	40	60	100
PCC	Data Communication Networks Laboratory	-	-	2	1	40	60	100
PCC	Microprocessors and Microcontrollers Laboratory	-	-	2	1	40	60	100
HSC	Personality Development III	2	-	-	2	40	60	100
PCC	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/ Coursera/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	.Net Programming	3	-	-	3	40	60	100
PCC	Embedded Systems Design	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	.Net Programming Laboratory	-	-	2	1	40	60	100
PCC	Embedded Systems Design Laboratory	-	-	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	Industrial Electronics and Automation	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	Automation and Robotics 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 COURSES (HSC)

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 (Effective Technical Communication)	2	-	-	2
HSC – 04	Personality Development II	2	-	-	2
HSC – 05	Personality Development III	2	-	-	2
HSC – 06	Personality Development IV	2	-	-	2

BASIC SCIENCE COURSES (BSC)

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

ENGINEERING SCIENCE COURSES (ESC)

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
ESC - 01	Programming for Problem Solving	3	-	-	3
ESC- 02	Basics of 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 and Design	1	-	4	3
ESC - 07	Basic Electrical and Electronics Engineering Laboratory	-	-	2	1

PROFESSIONAL CORE COURSES (PCC)

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PCC-01	Introduction to IoT	3	-	-	3
PCC-02	Electronic Devices	3	1	-	4
PCC-03	Digital Electronics	3	1	-	4
PCC-04	Data Structures	3	-	2	4
PCC-05	Electronic Devices Laboratory	-	-	2	1
PCC-06	Data Structures and algorithms Laboratory	-	-	2	1
PCC-07	Operating Systems	3	-	-	3
PCC-08	Signals and Systems	3	-	-	3
PCC-09	Database Management Systems	3	-	-	3
PCC-10	Design and Analysis of Algorithms	3	-	2	4
PCC-11	Signals and Systems - Laboratory	-	-	2	1
PCC-12	Database Management Systems Laboratory	-	-	2	1
PCC-13	Data Communication Networks	3	1	-	4
PCC-14	Introduction to AI & ML	3	1	-	4
PCC-15	Microprocessors & Microcontrollers	3	-	2	4
PCC-16	Data Communication Networks Laboratory	-	-	2	1
PCC-17	Microprocessors & Microcontrollers Laboratory	-	-	2	1
PCC-18	Industrial Training/ Mini Project/ MOOC Course (NPTEL/SWAYAM/CourseEra/ Mathworks) - Minimum 4 weeks	-	-	4	2
PCC-19	.Net Programming	3	-	-	3
PCC-20	Embedded System Design	3	-	-	3
PCC-21	Embedded System Design Laboratory	-	-	2	1
PCC-22	.Net Programming Laboratory	-	-	2	1
PCC-23	Summer Internship (4 weeks)	-	-	4	2
PCC-24	Industrial Electronics And Automation	3	-	-	3
PCC-25	Automation And Robotics Laboratory	-	-	2	1

PROFESSIONAL ELECTIVE COURSES

Code No.	Course Title	Hours / Week			Credits
		Lecture	Tutorial	Practical	
PEC–01	Information Theory and Coding	3	0	2	4
PEC–02	Digital Image and Video Processing	3	0	2	4
PEC–03	CMOS Design	3	-	-	3
PEC–04	High Speed Electronics	3	-	-	3
PEC–05	Wireless Networks	3	-	-	3
PEC–06	Mobile Ad-hoc Networks	3	-	-	3
PEC–07	Wireless Sensor Networks	3	-	-	3
PEC–08	Cognitive Radio Networks	3	0	2	4
PEC–09	Cryptography and Network Security	3	-	-	3
PEC–10	Electronic System Design	3	0	2	4
PEC–11	Robotics	3	-	-	3
PEC–12	Optical Network	3	-	-	3
PEC–13	Software Defined Network	3	-	-	3
PEC–14	High Speed Networks	3	-	-	3
PEC–15	Applied Cryptography	3	-	-	3
PEC–16	Big-Data Programming	3	-	-	3
PEC–17	Bioinformatics	3	-	-	3
PEC–18	Cyber Forensics	3	-	-	3
PEC–19	Data Warehousing And Data Mining	3	-	-	3
PEC–20	E- Commerce	3	-	-	3
PEC–21	Ethical Hacking	3	-	-	3
PEC–22	Game Programming	3	0	2	4
PEC–23	Information Retrieval Techniques	3	-	-	3
PEC–24	Object Oriented Analysis And Design	3	-	-	3
PEC–25	Software Engineering	3	-	-	3
PEC–26	Software Project Management	3	-	-	3
PEC–27	User Interface Design and Extension	3	-	-	3
PEC–28	Virtual Reality	3	0	2	4
PEC–29	Agile Methodologies	3	-	-	3
PEC–30	Information Security	3	0	2	4
PEC -31	Java Programming	3	-	-	3
PEC-32	Machine Learning Algorithms	3	0	2	4
PEC-33	Data Science	3	-	-	3
PEC -34	Natural Language Processing	3	-	-	3
PEC-35	Deep Learning	3	-	-	3

PEC -36	Cyber Security	3	-	-	3
PEC -37	Software Defined Radio	3	-	-	3
PEC-38	Cyber Physical Systems	3	-	-	3
PEC -39	Android and Web Development	3	-	-	3
PEC-40	Web of Things	3	-	-	3

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 Program	-	-	-	-
MC–02	Universal Human Values – 2	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	Internet Of Things	3	-	-	3
OEC–19	Digital Image processing	3	-	-	3
OEC–20	Wavelet Transform	3	-	-	3
OEC–21	Microcontroller based System Design	3	-	-	3
OEC–22	Digital Electronics	3	-	-	3
OEC–23	Digital Signal Processing	3	-	-	3
OEC-24	Mobile Communication and Networks	3	-	-	3
OEC-25	5G based Internet of Things	3	-	-	3
OEC-26	5G and Beyond 5G	3	-	-	3
OEC-27	Advanced Mobile Communication	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: M. J. Sienko and R. A. Plane., "Chemistry: Principles and Applications",McGraw Hill Higher Education; 5thedition.

T2: C. N. Banwell, "Fundamentals of Molecular Spectroscopy",McGraw Hill Education, 4th Edition, 2017.

T3: B. L. Tembe, Kamaluddin and M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)".

T4: C. N. Banwell, "Fundamentals of Molecular Spectroscopy" McGraw Hill Higher Education; 5th edition, 2010.

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.

T2: Ramamrutham S., “Basic Civil Engineering”,Dhanpat Rai Publishing Co. (P) Ltd.1999.

T3: Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers,2000.

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
Avg	**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
Avg	**-**	**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. 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
Avg	**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	2	0	0	0

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 6

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 6

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 6

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 6

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 6

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 identify the scope and characteristics of people-friendly and eco-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: 30 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 6

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 6

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 6

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 6

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 6

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: 30 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, CO2), 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 Singlephase 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
Avg	**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, 50thEdition, 2010.

T2: Parthasarathy N.S. and Vela Murali, "Engineering Drawing", Oxford University Press, New Delhi, 1stEdition,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
CO 1	2	1	2	-	2	-	-	-	-	3	-	2	2	1
CO 2	2	3	2	-	2	-	-	-	-	3	-	3	2	3
CO 3	2	2	2	-	2	-	-	-	-	3	-	2	2	2
CO 4	2	2	2	-	2	-	-	-	-	3	-	2	2	2
CO 5	2	2	2	-	2	-	-	-	-	3	-	3	2	2
Avg	**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 official contexts 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 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
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
Avg	**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, 4thEdition, 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, ……
2. ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors, and inductors.
3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
4. Loading of a transformer: measurement of primary and secondary voltages and currents, and power
5. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line- line voltage, phase-to-neutral voltage, line and phase currents).
6. Load Characteristics of a DC Motor
7. Torque - Slip Characteristic of an Induction motor
8. Three phase induction motors – Direction reversal by change of phase-sequence of connections.
9. Demonstration of DC-DC Converter.
10. Demonstration of DC-AC converter.
11. 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; 5th edition,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:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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.

UNITIV 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:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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's identity.

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 APPLICATIONSOF 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 Publishing Company, New Delhi, 6threprint,2008.

T3: Sivaramakrishna Das.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	INTRODUCTION TO IOT	3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of IoT and its application sectors
- To understand M2M and IoT
- To understand and become proficient in IoT platforms
- To understand and apply IoT protocols appropriately
- To design and develop IoT based applications

UNIT I INTRODUCTION AND CONCEPTS OF IOT 9

Introduction to IOT, definition and characteristics of IOT - Architecture of Internet of Things, Physical and logical design of IOT, IOT enabling technologies, IOT levels and deployment templates-Domain specific IOTs, home automation, cities, environment, Domain specific IOTs, Energy, retail, agriculture, industry, health and lifestyle

UNIT II IOT AND M2M COMMUNICATION 9

M2M, difference between IOT and M2M, ETSI M2M Architecture, system architecture -ETSI M2M SCL resource structure, Security in ETSI M2M framework, SDN and NFV for IOT, IOT system management, need for IOT system management -SNMP, Network operator requirements, NETCONF-YANG, IOT system management with NETCONF-YANG, IoT Design methodology-case study on IOT system for Weather Monitoring

UNIT III IOT PLATFORMS 9

Introduction to Hardware used for IoT: Microcontrollers, Microprocessors, SoC, Sensors - Introduction to Arduino, Pi, Spark, Intel Galileo

UNIT IV IOT TECHNICAL STANDARDS AND PROTOCOLS 9

RF Protocols: RFID, NFC;IEEE 802.15.4: ZigBee, Z-WAVE, THREAD; Bluetooth Low Energy (BLE), IPv6 for Low Power and Lossy Networks (6LoWPAN) and Routing Protocol for Low power and lossy networks (RPL) -CoAP,XMPP, Web Socket, AMQP, MQTT, WebRTC, PuSH - Architectural Considerations in Smart Object Networking

UNIT V DEVELOPING INTERNET OF THINGS 9

IoT platforms design methodology, IoT Physical devices and endpoints -IoT Systems: Logical design using Python, IoT physical servers and cloud offerings (Cloud computing for IoT)

TOTAL: 45 hours

TEXT BOOKS:

T1: ArshdeepBahga, Vijay Madisetti, “Internet of Things, A Hands -on Approach”, 1st Edition 2015, University Press, ISBN: 978-81-7371- 954-7

T2: Oliver Hersent, David Boswarthick, Omar Elloumy, “The Internet of Things”,1st Edition2015,ISBN: 978-81-265-5686-1

T3: Michael Miller, “The Internet of Things, How Smart TVs, Smart Cars, Smart Homes, and Smart Cities are changing the World”, First edition ,2015, Pearson, ISBN:978-93-325-5245-6

WEB LINKS:

W1. https://archive.nptel.ac.in/courses/106/105/106105166/

W2. https://nptel.ac.in/courses/108108098

W3. https://tools.ietf.org/html/rfc7452

W4. http://dret.net/lectures/iot-spring15/protocols

W5. http://iot.intersog.com/blog/overview-of-iot-development-standards-and-frameworks

COURSE OUTCOMES:

CO1:	Apply IOT architecture at various application domains	K3
CO2:	Examine M2M Communication and architecture	K4
CO3:	Experiment with various IoT platforms	K3
CO4:	Utilize different standards and protocols	K3
CO5:	Construct Cloud computing for IoT	K3

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**
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	2	2	3	2	3	-	-	-	-	-	-	-	2	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	2	1
Avg	**2.6**	**2**	**2.4**	**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**
✓	✓		✓		

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-V characteristics, 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-State electronics," World Scientific Publishing Co. Inc,1991.

R2: Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.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	Analyse the characteristics of PN junction diode, Zener diode and Schottky diode	**K3**
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 ELECTRONICS	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	DATA STRUCUTRES AND ALGORITHMS	3	0	2	4

Course Objectives:

- To understand the basic concepts of data structures and algorithms.
- To differentiate linear and non-linear data structures and the operations upon them.
- To perform sorting and searching in a given set of data items.
- To comprehend the necessity of time complexity in algorithms.

UNIT I Introduction to Algorithms and Analysis **12**

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithm

UNIT II Linear Data Structures **12**

Array- 1D and 2D array, Stack - Applications of stack: Expression Evaluation – Conversion of Infix to postfix and prefix expression, Tower of Hanoi. Queue - Types of Queues: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists

UNIT III Sorting and Search Techniques **12**

Searching - Linear Search and binary search, Applications - Finding square root of 'n'- Longest Common Prefix- Sorting – Insertion sort - Selection sort – Bubble sort – Quick sort- Merge sort, Analysis, Applications

UNIT IV Non-linear Data Structures **12**

Tree, Binary Tree – Terminology and Properties, Tree Traversals, Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Applications - Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's Algorithm.

UNIT V Hashing and Balanced Binary Search Trees **12**

Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications - AVL trees – Terminology - basic operations (rotation, insertion and deletion) - Recent trends in

algorithms and data structures.

TOTAL: 60 hours

TEXTBOOKS

T1.M.A.Weiss,"Data Structures and Algorithm Analysis in C",third Edition, Pearson Education, 2007

T2. A.V.Aho,J.E.Hopcroft and J.D.Ullman,"Data Structures and Algorithms", Pearson Education , First Edition Reprint 2003

REFERENCE BOOK:

R1. R.F.Gilberg, B.A.Forouzan, "Data Structures" ,Second Edition, Thomson India Edition, 2009

WEBLINKS:

W1: https://techdevguide.withgoogle.com/paths/data-structures-and-algorithms/
W2: https://www.thedshandbook.com/

Course Outcome	Description	Knowledge Level
CO1	Understand the fundamental analysis and compute time complexity for a given problem	K3
CO2	Articulate linear data structures and perform various operations permitted on them	K2
CO3	Design and apply a suitable algorithm for searching and sorting problems	K6
CO4	Develop an algorithm using non-linear data structures	K6
CO5	Understand and apply appropriate hashing techniques to find solutions for practical problems	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	P O4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO 11	PO1 2	PS O1	PS O2
CO1	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO2	3	3		2	-	-	-	-	-	-	2	2	2	2
CO3	3			2	-	-	-	-	-	-	2	2	2	2
CO4	2	2	2	2	-	-	-	-	-	-	2	2	2	2
CO5	3	2	2	2	-	-	-	-	-	-	3	2	2	2
Avg	**2.6**	**2.25**	**2**	**2**							**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**
✓	✓		✓		✓

PCC– 05	ELECTRONIC DEVICES LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To study and experiment the behavior 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," 7thedition, 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," 3rdedition, 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	**DATA STRUCTURES AND ALGORITHMS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

- Understand various data representation techniques in the real world.
- Implement linear and non-linear data structures.

- Analyze various algorithms based on their time and space complexity.
- Develop real-time applications using suitable data structure.
- Identify suitable data structure to solve various computing problems

LIST OF EXPERIMENTS

1. Implementation of Single Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) traversal
2. Implementation of polynomial expression in memory using single linked list.
3. Implementation of Circular Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) traversal
4. Implementation of Double Linked List operations: (i) Creation (ii) insertion (iii) deletion (iv) Traversal in both ways.
5. Design and implement Stack and its operations using List.
6. Implementation of stack operations:
    a. To convert infix expression into postfix expression.
    b. To evaluate the postfix expression.
7. Design and implement Queue and its operations using List.
8. Implementation of binary search tree operations: a. Creation of node. b. Traverse the above binary search tree recursively in pre-order, post-order and in-order. c. Count the number of nodes in the binary search tree.
9. Implementation of searching techniques:
    a. Linear search b. Binary search c. Fibonacci search
10. Implementation of sorting techniques to arrange a list of integers in ascending order. a. Bubble sort b. Insertion sort c. Selection sort
11. Implementation of sorting techniques to arrange a list of integers in ascending order. a. Quick sort b. Merge sort.
12. Implementation of graph traversal algorithms: a. Depth first search. b. Breadth first search.

TOTAL: 30 hours

TEXT BOOKS:

T1: M. A. Weiss, "Data Structures and Algorithm Analysis in C", third Edition, Pearson Education, 2007

T2: A. V. Aho, J. E. Hop croft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.

REFERENCE BOOKS:

R1: R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2009

WEB LINKS:

W1. https://nptel.ac.in/courses/106102064

W2. https://onlinecourses.nptel.ac.in/noc22_cs26/preview

COURSE OUTCOMES:

CO1	Gain skills to design and analyze simple linear and non linear data structures.	**K3**
CO2	Examine insertion, deletion and modification in singly and doubly linked list.	**K5**
CO3	Construct Stack, Queue in array for which all insertions and deletions are made at both end using various operations.	**K4**
CO4	Apply Insertion, find and deletion operations in Binary Search Tree and Hashing functions.	**K5**
CO5	Evaluate shortest path in an undirected graph using depth and breadth first algorithms.	**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**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	2	2	-	-	-	-	-	-	-	2	2	2
CO4	2	2	3	3	-	-	-	-	-	-	-	2	3	2
CO5	2	3	2	3	-	-	-	-	-	-	-	3	1	3
Average	**2.4**	**2.2**	**2.2**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2.4**

ASSESSMENT METHODS:

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

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://www.bib.irb.hr/1182399/download/1182399.978-1-68507-532-3.pdf
W4: http://www.wright.edu/~scott.williams/LeaderLetter/selfawareness.html
W5: 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:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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 of relaxation through meditation to keep up morality in life.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO**	**PO9**	**PO10**	**PO11**	**PO12**	**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 develop the mathematical theory of random variables and random processes for Telecom 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 with Applications 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 as Strict 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:

	PO1	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	OPERATING SYSTEM	3	0	0	3

COURSE OBJECTIVES

- To understand the features of operating system and its role in managing various system resources.
- To learn the Structure and functions of OS, Process scheduling, Deadlocks, Device management, Memory management and File systems

UNIT I PROCESSES AND THREADS 9

Introduction to operating systems – review of computer organization – operating system structures – system calls – system programs – system structure – virtual machines. Processes: Process concept – Process scheduling – Operations on processes – Cooperating processes – Inter process communication – Communication in client-server systems. Threads: Multi-threading models – Threading issues.

UNIT II PROCESS SCHEDULING AND SYNCHRONIZATION 9

CPU Scheduling: Scheduling criteria – Scheduling algorithms – Multiple-processor scheduling – Real time scheduling – Algorithm Evaluation. Process Synchronization: The critical-section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – critical regions – Monitors. Deadlock: System model – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance –Deadlock detection – Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Memory Management: Background – Swapping – Contiguous memory allocation –Paging – Segmentation – Segmentation with paging. Virtual Memory: Background –Demand paging – Process creation – Page replacement – Allocation of frames –Thrashing.

UNIT IV FILE SYSTEMS 9

File-System Interface: File concept – Access methods – Directory structure – File system mounting – Protection. File System Implementation: Directory implementation –Allocation methods – Free-space management – efficiency and performance – recovery– log-structured file systems.

UNIT V I/O SYSTEMS 9

I/O Systems – I/O Hardware – Application I/O interface – kernel I/O subsystem –streams – performance. Mass storage Structure: Disk scheduling – Disk management –Swap-space management – RAID – disk attachment – stable storage – tertiary storage.

TOTAL : 45 hours

TEXT BOOKS:

T1. Silberschatz, Galvin, and Gagne, "Operating System Concepts", Sixth Edition, Wiley India Pvt Ltd, 2003

T2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004

REFERENCE BOOKS:

R1.Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
R2. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.

WEB LINKS:

W1.https://www.tutorialspoint.com/operating_system/index.html
W2.https://onlinecourses.nptel.ac.in/noc21_cs44/preview

COURSE OUTCOMES

CO1:	Understand the concept of operating system structures, system calls, system programs and build user programs based on it	K2, K6
CO2:	Compare the performance of various CPU scheduling algorithms	K4
CO3:	Compare and contrast various memory management schemes	K4
CO4:	Use allocation methods to allocate disk space to the files	K3
CO5:	Evaluate the various file and disk management strategies	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**
CO1	2	2		2									2	3
CO2	3	2	3	3	3									3
CO3	3		3	2	3								3	
CO4	3	3	3	3	3								3	
CO5		3		3	3								3	3
AVG	**2.75**	**2.5**	**3**	**2.6**	**3**								**2.75**	**3**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC-08	SIGNALS AND SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

- To study the properties and representation of discrete and continuous signals.
- To study and analyze continuous time system using CTFT and Laplace transform
- To study and analyze 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 – Deterministic and random 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

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

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

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.	K4

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	K3
CO5:	Evaluate discrete time system using state variable equations and matrix representation	K5

TEXT BOOKS:

T1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.

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, c1998.

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, 1998.

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, 2013.

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
	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 - 09	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

COURSE OBJECTIVES

- To help the learner to understand the concepts, techniques, security features, how data is stored in the system, Query Languages used and different types of Statements used in the Query Processing in Database Management Systems.

UNIT I INTRODUCTION 9

Database system application-Purpose of database system-View of data-Database language-Relational database-Data storage and queuing-Transaction management-Database architecture-Database users and administrators-History of database system

UNIT II INTRODUTION TO SQL 9

SQL Data Definition and its types – Specifying Constraints in SQL – Basic Retrieval Queries in SQL –INSERT,UPDATE ,DELETE Statements in SQL – Aggregate Functions in SQL – GROUPING : The GROUP BY and HAVING Clause – JOIN Expressions - VIEWS - TRANSACTIONS – SUBQUERIES

UNIT III DATABASE DESIGN& PROGRAMMING TECHNIQUES 9

Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form–Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form– Entity relationship Model –Entity relationship Diagram and Examples

UNIT IV TRANSACTION MANAGEMENT AND DATABASE SECURITY 9

Transaction - Simple Transaction Model – Serialz ability- Lock based protocols-Time stamp based protocol-Deadlock handling- Two Phase Commit – Introduction to Database Security Issues – Access Control Based on Granting and Revoking Privileges – Challenges of Database Security

UNIT V DATA STORAGE AND QUERYING 9

Overview of Physical storage Media - Magnetic disks - RAID-Tertiary storage – File organization-Organization of records in files- B+ - tree index files - B-tree Index files- Static Hashing- Dynamic Hashing –Overview of query processing - CASE STUDY-ORACLE

TOTAL : 45 hours

TEXT BOOKS:

T1: Abraham Silberschatz, Henry F.korthS.Sudharshan, ”Database system concepts” sixth edition,tatamcgraw hill 2010.

T2: Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, FourthEdition ,Pearson / Addisionwesley, fifth edition, 2009.

REFERENCES:

R1: Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.

R2: S.K.Singh, "Database Systems Concepts, Design and Applications", Second Edition, Pearson Education, 2011.

WEB LINKS:

W1. https://onlinecourses.nptel.ac.in/noc22_cs51/preview.

W2.https://www.w3schools.com/mysql/mysql_rdbms.asp.

COURSE OUTCOMES

CO1:	Identify the purpose and need of database management system and compare it with conventional systems	**K3**
CO2:	Construct various SQL queries such as DDL & DML statements, Joins, Aggregate functions, Views and sub queries	**K5**
CO3:	Compare and distinguish all the five normal forms in Database management system	**K4**
CO4:	Apply and assess the transaction management and database security	**K5**
CO5:	Examine various data storage and querying techniques such as RAID, B tree and B+ tree index files, static and dynamic hashing and query processing	**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									3
CO2	3	2	2	3	3									3
CO3	3	2	3	3	3									3
CO4	2	2	2	3	3									3
CO5	0	2	3	3	3									3
Avg	**2.2**	**2**	**2.6**	**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**
✓	✓	✓	✓		✓

PCC-10	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	2	4

COURSE OBJECTIVES:

- To provide a mathematical foundation for analyzing and proving the efficiency of an algorithm.
- To understand and apply the algorithm analysis techniques.
- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To understand different algorithm design techniques

UNIT I INTRODUCTION 9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Algorithm Design Techniques- Fundamentals of the Analysis of Algorithmic Efficiency – Time Space Trade off –Asymptotic Notations and their properties. AnalysisFramework– Empiricalanalysis–RecurrenceEquations–SolvingRecurrenceEquations–Analysisoflinearsearch.

UNIT II DIVIDE-AND-CONQUER AND GREEDY TECHNIQUE 9

Divide and Conquer Methodology – Binary Search – Finding Maximum and Minimum – Closest-Pair and Convex Hull Problems – Matrix multiplication: Strassen's algorithm, Greedy Algorithms: General Method – Container Loading – Prim's algorithm and Kruskal's Algorithm – 0/1 Knapsack problem – Minimum Spanning Tree (Kruskals Algorithm) – Huffman Trees.

UNIT III DYNAMIC PROGRAMMING AND BACKTRACKING 9

Dynamic programming: General Method - Multi stage graphs - All Pair Shortest Paths-Optimal Binary Search- 0/1 Knapsack Problem, Travelling Salesman Problem – Floyd's algorithm. Backtracking- State Space Tree – General and Recursive Backtracking Algorithm – Estimating the Efficiency – 8- Queens problem– Sum of Subsets – Graph Colouring – Hamiltonian Circuit Problem – Knapsack Problem.

UNIT IV GRAPH AND COMPLEXITY CLASS 9

Graph Traversals – Breadth and Depth first search Traversal – Connected Components – Biconnected Components -Floyd-Warshall Algorithm. Network Flows - Flow Networks, Maximum Flows – Ford-Fulkerson Algorithm - Minimum Cost Flows – Cycle Cancelling Algorithm-The Class P, The Class NP, Reducibility and NP-completeness

UNIT V STRING MATCHNG, APPROXIMATION AND RANDOMIZED ALGORITHMS 9

Naïve String-matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering, Randomized Algorithms - The hiring problem, Finding the global Minimum Cut.

TOTAL: 45 hours

TEXT BOOKS:

T1: Anany Levitin, ―Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.
T2: Ellis Horowitz, Sartajsahni, Sanguthevar, Rajesekaran, "Fundamentals of Computer Algorithms",Galgotia Publication Pvt. Ltd., Reprint, 2010.
T3: Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, "Introduction to Algorithms" 3 rd Edition, The MIT Press Cambridge, Massachusetts London, England, 2014.
T4: S.Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2015.

REFERENCE BOOKS:

R1: Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, ―Data Structures and Algorithms, Pearson Education, Reprint 2006.
R2: Harsh Bhasin, ―Algorithms Design and Analysis, Oxford university press, 2016.
R3: Jon Kleinberg, ÉvaTardos ,Algorithm Design, Pearson education, 2014.
R4: Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, "Network Flows: Theory, Algorithms, and Applications", Pearson Education, 2014.

WEB LINKS:

W1: https://archive.nptel.ac.in/courses/106/101/106101060/
W2:https://archive.nptel.ac.in/courses/106/106/106106127/

COURSE OUTCOMES

CO1:	Determine asymptotic notation, its properties and measure algorithm's behaviour.	**K5**
CO2:	Apply mathematical principles to solve various problems using Divide and Conquer and Greedy approach.	**K3**
CO3:	Design an algorithm using Dynamic Programming and Backtracking for various complex problems.	**K6**
CO4:	Perform graph traversals and analyse the complexity of class problems.	**K5**
CO5:	Develop an approximation and randomized algorithms.	**K6**

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**	**PSO2**
CO 1	3	3	2	2	2	-	-	-	-	-	-	-	3	3

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

PCC-11	**SIGNALS AND SYSTEMS – LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To generate continuous and discrete time signals
- To perform basic operations on signals
- To design and analyze various filters

LIST OF EXPERIMENTS:

USING 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. Basic Operations on Signals**.**

USING MATLAB

1. Generation of Signals
2. Basic Operations on Signals
3. Linear and circular convolution of two sequences
4. Sampling and effect of aliasing

5. Transformation of signals into time and frequency domains.
6. Design and Analysis of Low Pass, High Pass, Band Pass and Band Stop 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.

WEB LINK:

W1. https://www.google.com/search?channel=trow5&client=firefox-bd&q=dsp+lab+matlab+experiments+-nptel
W2. https://onlinecourses.nptel.ac.in/noc21_ee28/preview

COURSE OUTCOME:

CO1:	Evaluate the concepts of signals and systems DSP kits.	**K5**
CO2:	Analyze the concept of sampling at various frequencies	**K4**
CO3:	Differentiate the various types of signals using MATLAB programs	**K4**
CO4:	Illustrate linear and circulation convolution of various signals	**K4**
CO5:	Evaluate the magnitude and phase characteristics of carious filters	**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**
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	Assignments	Case Studies
		✓	✓		
Observation	**Record**	**Experimental Procedure**	**Results**	**Demonstration/ Presentation**	**Open book test**
✓	✓	✓	✓	✓	

PCC-12	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	2	1

COURSE OBJECTIVE:

- To understand the various database management system concepts by working on databases.

LIST OF EXPERIMENTS:

1. DDL and DML Commands.
2. Join Queries.
3. Views and Set operations.
4. Built in functions.
5. Nested Queries
2. Triggers.
3. Aggregate Functions.
4. Roles and Privileges.
5. Cursors.
6. PL/SQL programs
7. PL/SQL cursor programs
8. Front end tools – Mini Project

COURSE OUTCOMES

CO1 :	Identify the need of DML and DDL commands and Nested queries	**K3**
CO2 :	Examine and compare various types of Joins and Set operators and write SQL queries	**K4**
CO3 :	Design and develop Views, Triggers and Cursors using SQL	**K6**
CO4 :	Test and solve various aggregate functions and built in functions using SQL	**K6**

CO5 :	Discuss Roles and Privileges and develop a mini project using front end tool using SQL	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	3	3	3						2	2	3	2
CO2	2	3	3	3	3						2	2	3	2
CO3	3	3	3	3	3						2	2	3	2
CO4	3	3	3	3	3						2	2	3	2
CO5	2	3	3	3	2						2	2	3	2
Average	**2.6**	**3**	**3**	**3**	**2.8**						**2**	**2**	**3**	**2**

ASSESSMENT METHODS:

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

HSC-04	PERSONALITY DEVELOPMENT-II	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; 3rdEdition 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 Agarwalpublishers, 2015.

REFERENCE BOOKS:

R1: Ishitha Chatterjee, "Gender Justice and feminist Jurisprudence",Central Law Publications, 1stEdition, 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	DATA COMMUNICATION NETWORKS	3	1	0	4

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 12

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 12

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 12

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 12

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 12

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: 60 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		2	2		-	-		-	-	-	-	2	2
CO2	2	2	2	2	2	-	-	2	-	-	-	-	3	-
CO3		2	2	2	2	-	-		-	-	-	-	3	
CO4	-		2	3	2	-	-	2	-	-	-	-	3	3
CO5			3	2	3	-	-	2	-	-	-	-	3	2
Avg	**2**	**2**	**2.2**	**2.2**	**2.25**			**2**					**2.8**	**2.333333**

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	INTRODUCTION TO AI AND ML	3	0	2	4

COURSE OBJECTIVES

- To understand the basics of Machine Learning (ML)
- Able to program in Python ML Packages
- To understand the methods of Machine Learning
- To visualize a dataset

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 12

Introduction – Foundations of AI – History of AI – Intelligent agent – Types of agents- Structure of agents -– Problem solving agents –Uninformed search strategies – Breadth first search – Uniform cost search – Depth first search – Depth limited search –Bidirectional search – Searching with partial Information.

UNIT II INTRODUCTION TO MACHINE LEARNING 12

Machine learning: Types of Machine Learning - Understanding data – Continuous variable, categorical variable, Independent variable, dependent variable -Regression and classification- linear regression introduction- Over fitting and Underfitting - Bias and Variance -Machine Learning Life cycle -- Data Preprocessing techniques – Feature selection

UNIT III MACHINE LEARNING ALGORITHMS 12

Classification and Regression- Naïve bayes- Decision trees- support vector machine (SVM) – Random forest- Linear Regression- Multiple Linear Regression-Logistic Regression. -K-nearest neighbor - Unsupervised learning - k-means clustering- Principal component analysis

UNIT IV MODEL EVALUATION 12

Model Evaluation and Selection methods, Precision-Recall and ROC Curves Confusion Matrices, Regression Evaluation, Optimizing Classifiers for Different Evaluation Metrics

UNIT V MACHINE LEARNING USING PYTHON 12

Scikit- learn Dataset - Understanding Data frame-slicing a data frame-managing data -Data Loading with NumPy and pandas- creating training and test sets - Implementation of Machine learning algorithms - predictions - implementation of metrics for validating machine learning algorithms - Scaling and normalization- Data visualization

TOTAL : -- 60 hours

TEXT BOOKS:

T1: Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012

T2: Sebastain Raschka, "Python Machine Learning", Packt publishing (open source).

REFERENCE BOOKS:

R1: Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009

R2: Hastie, Tibshirani, Friedman, "The Elements of Statistical Learning" (2nd ed)., Springer, 2008

WEB LINKS:

W1. https://machinelearningmastery.com/types-of-learning-in-machine-learning/Online
W2.https://www.coursera.org/learn/machine-learning
W3. https://nptel.ac.in/courses/106/106/106106139/
W4. https://www.timberlake.co.uk/machinelearning

COURSE OUTCOMES

CO1:	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.	K 3
CO2:	To apply the Basic Concepts of Machine Learning.	K4
CO3:	To build various machine learning algorithms using Linear models	K5
CO4:	To apply ML techniques to application and evaluate the models	K4
CO5:	Apply basic principles of AI and ML in solutions that require problem solving, inference, perception, knowledge representation, and learning.	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	3	3	3	3	2								2	3
CO 2	3	2	2	2	2								2	3
CO 3	3	3	3	2	2								2	3
CO 4	3	3	2	2	3								2	3
CO 5	2	2	3	2	3								2	3
Avg	**2.8**	**2.6**	**2.6**	**2.2**	**2.4**								**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 – 15	MICROPROCESSORS AND MICROCONTROLLERS	3	1	0	4

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 12

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 12

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 12

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 12

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 12

Introduction to Embedded Systems and Fundamental – Software for Embedded Systems – Stepper motor and waveform generation - Intel 8051 / Atmel 89c51 / Arduino, PIC Microcontroller, Architecture & Programming of ARM processor, Introduction to RISC processors; ARM microcontrollers interface designs.

TOTAL : 60 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 and software 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

COURSE OUTCOMES

CO1:	To understand the architecture of microprocessors	K 3
CO2:	To learn the design aspects of I/O and Memory Interfacing circuits	K4
CO3:	To understand and distinguish a microprocessor and a microcontroller	K5
CO4:	To interface microprocessors with supporting chips.	K4
CO5:	Testing the program of PIC microcontrollers, ARM processors, Arduino, PIC Microcontroller.	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**
CO1	2	1	1	1	-	2	-	-	-	1	-	3	2	1
CO2	2	1	1	1	-	2	-	-	-	1	-	3	2	1
CO3	1	1	1	1	1	2	-	-	-	1	-	3	2	1
CO4	2	1	1	1	-	2	-	-	-	1	-	3	2	2
CO5	2	1	1	1	1	2	-	-	-	1	-	3	2	2
	1.8	**1**	**1**	**1**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**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**
√	√		√		

PCC – 16	DATA COMMUNICATION 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.

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.

COURSE OUTCOME

CO1:	Analyse the concepts of various networking components and their uses.	K 3
CO2:	Construct topologies using networking devices.	K4
CO3:	Analyse and implement error detection and flow control techniques	K5
CO4:	Develop the various routing algorithms for finding of the shortest route.	K4
CO5:	Create an algorithm for encryption and decryption and implement the same with proper simulations.	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	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
	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**	**Assignments**	**Case Studies**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration/ Presentation**	**Open book test**
	✓	✓		✓	✓

PCC – 17	**MICROPROCESSORS & MICROCONTROLLERS LABORATORY**	**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

- To introduce ALP concepts and features
- To write ALP for arithmetic and logical operations in 8086 and 8051
- To differentiate Serial and Parallel Interface
- To interface different I/Os with Microprocessors

- To be familiar with MASM

LIST OF EXPERIMENTS:

1. Programs for 8– bit and 16 –bit Arithmetic operations (Using 8085 & 8086).
2. Programs for Sorting and Searching (Using 8085 & 8086).
3. Programs for Code conversions (Using 8085 & 8086).
4. Interfacing and Programming 8279, 8259, and 8253.
5. Serial and Parallel Communication between two MP Kits.
6. Interfacing and Programming of Stepper Motor and DC Motor Speed control/ Interfacing ADC and DAC.
7. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
8. Communication between 8051 Microcontroller kit and PC.
9. Design Entry and simulation of combinational logic circuits (8 bit adders, 4 bit multipliers, address decoders, multiplexers).
10. Design Entry and simulation of sequential logic circuits for counters

COURSE OUTCOME:

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

CO1:	To write ALP programs for arithmetic programs using 8085&8086	K 3
CO2:	To interface different I/Os with processor	K4
CO3:	To generate waveforms and interface Stepper motor & DC motor	K5
CO4:	To execute programs in 8051	K4
CO5:	To design VHDL programs for combinational and sequential circuits.	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	3	3	-	-	-	-	1	-	1	2	3
CO2	-	1	1	3	3	-	-	-	-	2	-	1	2	3
CO3	-	1	1	3	3	-	-	-	-	1	-	1	2	3
CO4	-	2	1	3	3	-	-	-	-	1	-	1	2	3
CO5	-	2	1	3	3	-	-	-	-	1	-	1	2	3
Avg	-	**1.4**	**1**	**3**	**3**	-	-	-	-	**1.2**	-	**1**	**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**

	✓	✓		✓	✓

HSC – 05	PERSONALITY DEVELOPMENT-III	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 TO PROGRAM OUTCOMES:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	-	-	-	-	-	3	3	2	3	3	3	3	-	3
CO 2	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO 3	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO 4	-	-	-	-	-	2	3	2	3	3	3	3	-	3
CO 5	-	-	-	-	-	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	.NET PROGRAMMING	3	0	0	3

Course Objectives

- To assist the learner to understand the .NET Architecture, Object oriented concepts
- To use ADO.NET for database connectivity and developing the ability to solve any type of problems by mapping with real world environment using ASP.NET and C#.
- Construct various applications using C# in .Net framework
- Demonstrate how to retrieve data from database using ADO.NET programming
- Create web based and windows based applications using ASP.NET
- Make the developer experience consistent across widely varying types of apps, such as Windows based apps and Web-based apps.

UNIT I INTRODUCTION TO C# 9

Introducing C# - Introduction to .Net framework and Architecture - Understanding .NET- Overview of C#- Literals Variables-Constant Variables – Scope of Variables – Boxing and Unboxing - Data Types- Operators- Expressions Branching- Looping- Methods- Arrays- Strings- Structures- Enumerations.

UNIT II OBJECT ORIENTED ASPECTS OF C# 9

Classes-Adding Variables – Adding Methods - Objects – Accessing class Members – Constructors – Abstract classes and Methods - Inheritance - Polymorphism – Interfaces - Operator Overloading - Delegates and Events - Errors and Exceptions.

UNIT III ADO.NET 9

ADO.NET Introduction - ADO.NET Architecture: Connected and Disconnected Architecture – Data Provider Connection Object, Command Object, Data Reader - Datasets : Data Table , Data Column , Data Row , Data Constraints , Data Relation , Data Adapters

UNIT IV WEB BASED APPLICATION DEVELOPMENT ON .NET 9

Building Windows Forms Applications -Programming Web Applications with Web Forms using ASP.NET - ASP.NET controls - Understand Data Binding and various Data Sources in ASP.NET - Understand the creation of Master Pages and themes - Configuration of web applications using IIS configurations - State management in ASP.NET Programming Web Services.

UNIT V MVC FRAMEWORK 9

MVC basics , MVC Architecture, Web forms vs MVC, Create a controller , Create models ,Create a view ,Add a service class ,Use dependency injection ,Finish the controller ,Update the layout

TOTAL: 45 h

TEXT BOOKS:

T1: Balagurusamy. E, "Programming in C#", Tata McGraw-Hill, 2004. (Unit I, II)
T2: Liberty.J, "Programming C#", 2nd Edition., O'Reilly, 2002. (Unit III, IV, V)
T3: Bill Hamilton, Matthew MacDonald , " ADO.NET in a Nutshell " ,O'Reilly Media (Unit III)
T4: Jesse Liberty, Dan Maharry, Dan Hurwitz . "Programming ASP.NET 3.5" 4th Edition , O'Reilly Media (Unit IV)

REFERENCES:

R1: Herbert Schildt, "The Complete Reference: C#", Tata McGraw-Hill, 2004.
R2: Robinson et al, "Professional C#", 2nd ed., Wrox Press, 2002.
R3: Andrew Troelsen, "C# and the .NET Platform", A! Press, 2003.
R4: ThamaraiSelvi, R. Murugesan, "A Textbook on C#", Pearson Education
R5: ADO.NET in a Nutshell By Bill Hamilton, Matthew MacDonald Publisher: O'Reilly Media.
R6: Programming ASP.NET 3.5, 4th Edition By Jesse Liberty, Dan Maharry, Dan HurwitzPublisher: O'Reilly Media

Web Links:

W1: https://ict.iitk.ac.in/courses/introduction-to-c-sharp/
W2: https://www.btechguru.com/training--dot-net--c-sharp-dot-net--framework--c-sharp-programming-tutorial-part-1-video-lecture--11285--27--139.html

COURSE OUTCOMES

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

CO1	Construct various applications using C# in .Net framework	**K3**
CO2	Familiar about Object Oriented concepts in C# language	**K3**
CO3	Demonstrate how to retrieve data from database using ADO.NET programming	**K4**
CO4	Develop ASP.NET based web application using C#	**K4**
CO5	Develop desktop based, modern web based applications using Model View Controller.	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO 3	P O4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	2	2	2	2	-	-	-	-	2	1	2
CO2	3	2	2	2	2	3	2	-	-	-	-	2	1	2
CO3	2	2	3	3	2	2	2	-	-	-	-	2	3	2
CO4	2	3	2	2	2	3	2	-	-	-	-	2	3	3
CO5	3	2	3	2	2	2	3	-	--	-	-	2	3	3
Average	**2.4**	**2.4**	**2.4**	**2.2**	**2**	**2.4**	**2.2**	**-**	**-**	**-**	**-**	**2**	**2.2**	**2.4**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC – 20	EMBEDDED SYSTEMS DESIGN	3	0	0	3

COURSE OBJECTIVES:

- To understand the Building Blocks of Embedded System and software Tools
- To explore the role of Input/output interfacing with Bus Communication protocol.
- To understand the scheduling, Real time operating system for multitask process.
- Example tutorials to discuss applications based on embedded design approaches

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock- IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, Target Hardware Debugging

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Device Drivers.

UNIT III RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, Multiprocessing and Multitasking, Pre-emptive and non-pre-emptive scheduling,– synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Vx Works, µC/OS-II.

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, Speed and Direction control of motor

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Introduction- PSoC, PSoC family. PSoC1- Internal Architecture, Digital Sub System, GPIO. Embedded Applications - Digital Applications-LED blink, CapSense. Analog Applications - Ambient temperature measurement.

TOTAL: 45 h

TEXT BOOKS:

T1: Rajkamal, ‘Embedded system-Architecture, Programming, Design’, McGrawHill Edu,2016
T2: Peckol, “Embedded system Design”,John Wiley&Sons,2010 .

REFERENCE BOOKS:

R1: Shibu.K.V, “Introduction to Embedded Systems”, TataMcgraw Hill, 2009
R2: Lya B.Das,”Embedded Systems”, Pearson Education, 2010.
R3:Parag H.Dave, Himanshu B.Dave, “Embedded Systems-Concepts, Design and Programming”, Pearson Education,2015.
R4: Elicia White, “Making Embedded systems”,O’Reilly Series, SPD, 2011

WEBLINKS:

W1: https://archive.nptel.ac.in/courses/108/102/108102169/

W2: https://nptel.ac.in/courses/106105159

COURSE OUTCOMES:

CO1	Choose hardware functional, software strategies and RTOS required to develop various Embedded systems	**K1**
CO2	Compare and differentiate various Buses and communication standards	**K2**
CO3	Apply the concept of process, multiprocessors and operating systems in embedded system design	**K3**
CO4	Develop various scheduling algorithms through Real time operating system	**K4**
CO5	Develop embedded system application with suitable processor, buses, task, interfaces and operating system	**K6**

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**
CO1	2	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2	2	-	-	-	-	-	-	-	-	-	-	2	2	3
CO3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
CO4	3	2	3	2	3	-	-	-	-	-	-	3	3	3
CO5	3	2	3	3	3	-	-	-	-	-	-	3	3	3
Avg	**2.60**	**2.00**	**2.67**	**2.50**	**3.00**	-	-	-	-	-	-	**2.60**	**2.40**	**2.80**

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	.NET PROGRAMMING LABORATORY	0	0	2	1

LIST OF EXPERIMENTS

1. Implement C# program
   a) Write a program in C# to count a total number of alphabets, digits and special characters in a string.
   b) Write a program in C# to count a total number of duplicate elements in an array.
   c) Design program to implement Stack in c#.
2. Basic C# program
   (a) Calculate Hypotenuse of triangle using dynamic initialization of variables
   (b) To get input from the user and perform calculations
   (c) Calculate the quadrant for the coordinates using if..else…ladder
   (d) Check whether the alphabet is a vowel or not using switch..case…
   (e) To understand about for..each loop and strings
3. Create a login page using controls.
4. Create a registration page with all controls.
5. Establish database connection using ado.net
6. Create a page with control values fetching from database
7. Create a master page for college application.
8. Apply themes and different CSS in a form.
9. Create a crud application
10. Create a web application with MVC framework

Text Books:

T1:Balagurusamy. E, “Programming in C#”, Tata McGraw-Hill, 2004.

T2:Liberty.J, “Programming C#”, 2nd Edition., O’Reilly, 2002.

References:

R1:Herbert Schildt, “The Complete Reference: C#”, Tata McGraw-Hill, 2004.

R2:Robinson et al, “Professional C#”, 2nd ed., Wrox Press, 2002.

Web Links:

1.https://www.tutorialspoint.com/dot net/index.html
2.https://ict.iitk.ac.in/courses/introduction-to-c-sharp

COURSE OUTCOME:

Course Outcome	Description	Knowledge Level
CO1	Understanding the basic concepts, and programs in C#	K5
CO2	Establish database connection using ADO.Net	K1
CO3	Create user interactive web pages using ASP.net	K1
CO4	Applying themes and different CSS in a form	K4
CO5	Performing database operations for windows and web applications using MVC	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO 2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	2	2	-	-	-	-	-	-	-	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	-	2	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	2	1	2
CO4	2	2	2	2	-	-	-	-	-	-	-	2	2	2
CO5	2	2	2	3	-	-	-	-	-	-	-	3	2	3
Average	**2.2**	**2.4**	**2**	**2.4**	-	-	-	-	-	-	-	**2.2**	**2**	**2.2**

ASSESSMENT METHODS:

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

PCC – 22	EMBEDDED SYSTEMS DESIGN LABORATORY	0	0	2	1

Course Objectives:

- Learn the working of ARM processor
- Understand the Building Blocks of Embedded Systems
- Write programs to interface I/O devices with processor
- Study the interrupt performance
- Develop simple application using Sensor and proc

Experiments

1. Study of ARM evaluation system
2. ALP to multiply two 16 bit binary numbers using ARM
3. ALP to find the sum of first 10 integer numbers using ARM
4. ALP to find the number of 0's and 1's in 32 bit data using ARM
5. ALP to determine whether the given 16 bit is even or odd using ARM
6. Display "Hello world" message using internal UART
7. Interface and Control speed and direction of DC Motor/ Stepper motor.
8. Interface a DAC and generate Triangular/Square waveform
9. Study of PSOC evaluation system
10. Interface a keyboard and display the key code on an LCD using PSOC
11. Interface Touch screen using PSOC
12. Develop an ambient temperature using PSOC and ARM

TEXT BOOKS:

T1: A.N. Sloss, D. Symes and C. Wright, "ARM System Developer's Guide: Design and Optimizing System Software", Morgan Kaufman Publishers, 2004

T2: W. Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008

T3: F. Vahid and T. Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", Wiley India Pvt. Ltd., 2002

REFERENCE BOOKS:

R1: Douglas V Hall, "Microprocessor and Interfacing", 3rd Edition, 2017

WEBLINKS:

W1: https://onlinecourses.nptel.ac.in/noc20_cs15/preview

COURSE OUTCOMES:

CO1	Solve simple operations using ARM	**K3**
CO2	Make use of ARM Interface memory, A/D and D/A convertors and verify the same	**K3**
CO3	Analyze the performance of ARM and PSOC using I/O interfaces	**K4**
CO4	Develop a program for motor and sensor and verify the same	**K4**
CO5	Formulate a simple application using embedded system	**K6**

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**	**PSO1**	**PSO2**
CO1	3	2	2	2	2	-	-	-	3	3	-	2	2	2
CO2	3	2	2	2	2	-	-	-	3	3	-	2	2	3
CO3	3	3	2	2	3	-	-	-	3	3	-	3	3	3
CO4	3	3	3	3	3	-	-	-	3	3	-	3	3	3
CO5	3	3	3	3	3	-	-	-	3	3	-	3	3	3
Avg	**3.00**	**2.60**	**2.40**	**2.40**	**2.60**	**-**	**-**	**-**	**3.00**	**3.00**	**-**	**2.60**	**2.60**	**2.80**

ASSESSMENT METHODS

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**	**Case Studies**
		✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**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 – Leaders approach – Effective Change management.

TOTAL: 30 h

COURSE OUTCOME

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

CO1	Develop and Communicate assertively by knowing the causes of misunderstanding	**K3**
CO2	Analyze and overcome the barriers in formal and informal communication	**K3**
CO3	Prepare and present messages with a specific intent.	**K4**
CO4	Select powerful presentations that deliver effective messages.	**K4**
CO5	Manage the various principles of change	**K6**

MAPPING OF COURSE OUTCOMES WITH THE PROGRAMME OUTCOMES

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

TEXTBOOKS

T1. Helping employees embrace change – LaClair, J. and Rao, R. Helping Employees Embrace Change, McKinsey Quarterly, 2002, Number 4.

T2. Who Moved My Cheese by Spencer Johnson published by vermilion first edition.

T3. Effective Communication. Adair, John. London: Pan Macmillan Ltd., 2003.

T4. Business Communication Today: Bovee, Courtland L, John V. Thill& Barbara E. Schatzman. Tenth Edition. New Jersey: Prentice Hall, 2010.

SEMESTER VII

PCC – 24	INDUSTRIAL ELECTRONICS AND AUTOMATION	3	0	0	3

UNIT I DC AMPLIFIERS **9**

Need for DC amplifiers, DC amplifiers – Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers – Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

UNIT II REGULATED POWER SUPPLIES **9**

Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques – Short Circuit, Over voltage and Thermal Protection. Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators – Current boosting .

UNIT III SCR AND THYRISTOR **9**

Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors – Classes A, B, C, D, E and F, Ratings of SCR.

UNIT-IV APPLICATIONS OF SCR **9**

Applications of SCR in power control Static circuit breaker, Protection of SCR, Inverters – Classification, Single phase inverters, Converters – Single phase half wave and full wave. DIAC, Triac and thyristor applications Chopper circuits – Principle, Methods and configurations, DIAC and TRIAC, TRIACS – Triggering modes, Firing circuits, Commutation.

UNIT-V INDUSTRIAL APPLICATIONS **9**

Industrial applications - Industrial timers – Classification, Types, Electronic timers – Classification, RC and digital timers, Time base generators. Electronic D.C motor control. Dielectric heating – Principle, Material properties. Electrodes and their coupling to RF generator, Thermal losses and applications. Ultrasonics – Generation and Applications.

Total : 45h

COURSE OUTCOME

CO1	Understand construction, characteristics, and working principle of different types of Power Amplifiers devices.	**K3**
CO2	Analyse different regulated power supplies.	**K3**
CO3	Evaluate various triggering and commutation techniques of SCR and Thyristors.	**K4**
CO4	Make use of various applications circuits of SCRs.	**K4**
CO5	Select electronic components for industrial/controlled applications.	**K6**

TEXTBOOKS:

T1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.

T2: Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

REFERENCE BOOKS:

R1.V.R. Moorthy, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press,2007.
R2. Salivahanan, Electronics Devices and Circuits, TMH, 2 nd Edition, 201.
R3. Thyristors and applications – M. Rammurthy, East-West Press, 1977.
R4. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2003.

WEBLINKS

W1.https://onlinecourses.nptel.ac.in/noc20_ee97/preview
W2. https://nptel.ac.in/courses/122106025

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
	2.8	**2**	**2.6**	**2**	**3**	-	-	-	-	-	-	-	**2**	**1.4**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PCC – 25	AUTOMATION AND ROBOTICS LABORATORY	0	0	2	1

COURSE OBJECTIVES:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations.

LIST OF EXPERIMENTS

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place
5. Robot programming and simulation for Colour identification
6. Robot programming and simulation for Shape identification
7. Robot programming and simulation for machining (cutting, welding)
8. Robot programming and simulation for writing practice
9. Robot programming and simulation for any industrial process (Packaging, Assembly)
10. Robot programming and simulation for multi process.

COURSE OUTCOMES:

CO1	Develop the robot programming for the given application	K3
CO2	Use of any robotic simulation software to model the different types of robots	K3
CO3	Determine the orientation and position of robot using simulation	K3
CO4	Develop pick and place application system	K6
CO5	Determine the simulation for machining and industrial process	K3

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	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3
Avg	**3**	**3**	**3**	**2.8**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.4**	**3**	**3**

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	INFORMATION THEORY AND CODING	3	0	2	4

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. K S Shivaprakasha Muralidhar Kulkarni, "Information Theory and Coding", Wiley Publication, January 2019

T2. R Bose, "Information Theory, Coding and Cryptography", TMH 2007

T3. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002; Chapters: 3,4,5, November 2002.

T4. Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.Simon Haykin, "Communication Systems", 4thEdition, John Wiley and Sons, 2001.

T5. M. Mansurpur, "Introduction to Information Theory", Mc-Graw Hill, 1987.

T6. R.B. Ash, Information Theory, Prentice Hall, 1970.

T7. N. Abramson, “Information and Coding”, McGraw Hill, 1963.

REFERENCE BOOKS:

R1. Mark Nelson, “Data Compression Book”, BPB Publication 1995.
R2. Watkinson J, “Compression in Video and Audio”, Focal Press, London, 1995.
R3. Ranjan Bose, “Information Theory, Coding and Cryptography, Tata McGraw-Hill Education, 2008.
R4. Shu Lin and D J Costello, “Error Control Coding” Pearson ,2nd edition, 2004

WEBSITE LINK:

W1. http://www.nitjsr.ac.in/course_assignment/EC23EC4211ITC_PPT.pdf
W2. https://www.wileyindia.com/information-theory-and-coding.html

COURSE OUTCOMES:

CO1:	Analyse 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:	Analyse different Image format and coding text Compression Techniques	K4
CO5:	Abstract 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**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
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
	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 – 02	DIGITAL IMAGE AND VIDEO PROCESSING	3	0	2	4

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.

UNIT II 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", 4th edition, Pearson.

T2. Al Bovic, "Handbook of Image and Video Processing", Elsevier, 2005.

T3. Yao wang, Joem Ostarmann and Yaquin Zhang, "Video processing and communication 1st edition, 2001.

T4. M. Tekalp, "Digital video Processing", Prentice Hall Signal Processing 2nd edition.

T5. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson 2015.

REFERENCES:

R1. Relf, Christopher G, "Image acquisition and processing with Lab VIEW", CRC press, 2003.

R2. Anerozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", John Wiley & Sons, 2nd edition, 2021.

R3. Chris Solomon, Toby Breckon "Fundamentals of Digital Image Processing and Practical Approach with Examples in MATLAB", John Wiley & Sons, 2001.

R4. K.R. Rao and J. J. Hwang, "Techniques and Standards for Image, Video and Audio Coding," Prentice Hall, Upper Saddle River, New Jersey, 1996.

WEBLINK:

W1. https://onlinecourses.nptel.ac.in/noc24_ee38/preview

W2. http://cobweb.ecn.purdue.edu/~ace/courses/ee695-vid/.

COURSE OUTCOMES:

CO1:	Apply 2D transforms and analyse a digital image in frequency domain.	**K3**
CO2:	Analyse images using histogram based and segmentation techniques.	**K4**
CO3:	Compare and contrast lossy and lossless compression techniques.	**K4**
CO4:	Analyse 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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PS O1	PS O2
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 – 03	CMOS DESIGN	3	0	0	3

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 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, timing controls, procedural assignments conditional statements, Data flow and RTL, structural gate level switch level modelling, Design hierarchies, Behavioural and RTL modelling, Test benches, Structural gate level description of decoder, equality detector, comparator, priority encoder, half adder, full adder, Ripple carry adder, D latch 72 and D flip flop. An overview of the features of advanced FPGAs, IP cores, Soft-core processors, Various factors determining the cost of a VLSI, Comparison of ASICs, FPGAs, PDSPs and CBICs.

TOTAL: 45 hours

TEXTBOOKS:

T1: Weste and Harris "CMOS VLSI DESIGN" (Third edition) Pearson Education, 2005.

T2: Uyemura J.P "Introduction to VLSI circuits and systems", Wiley 2002.

REFERENCES:

R1: D. A. Pucknell& K. Eshraghian, "Basic VLSI Design", Third edition, PHI, 2003.

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.

WEBLINK :

W1: https://onlinecourses.nptel.ac.in/noc21_ee09/preview

W2:https://www.cdeep.iitb.ac.in/vod/vodCloud/course_intra.php?ccode=296&referSrc=57dc9eb7be985a0e14aaa07846b0b9b4

COURSE OUTCOMES:

CO1	To use the mathematical methods of CMOS technology for the analysis and design of IC and other digital logic circuits	**K3**
CO2	To determine both the functionality and the performance of a design with low static power consumption, delay and size reduction in a CMOS device.	**K4**
CO3	To design combinational and sequential circuits at transistor level and to compare the both using flipflops and latches.	**K4**
CO4	To verify the basic design correctness, design specifications and test procedure in a test design.	**K4**
CO5	To be able to design structural and behavioural modelling in register-transfer level and to check the circuit functionality and the prototyping applications in Processors.	**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	1	1	-	-	-	-	1	-	-	2	1
CO2	2	1	1	1	-	-	-	-	-	1	-	-	1	1
CO3	1	1	1	1	-	-	-	-	-	1	-	-	1	1
CO4	2	2	1	1	-	-	-	-	-	1	-	1	2	2
CO5	2	1	1	1	1	-	-	-	-	1	-	-	2	2
Avg	**1.8**	**1.2**	**1**	**1**	**1**					**1**		**1**	**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 – 04	**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: A Handbook of Interconnect Theory and Design Practices", January 2014, 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", 3rd edition, John Wiley and Sons, 2008

R2. J. Singh, "Semiconductor Devices: Basic Principles", John Wiley and Sons, 2007.

R3. BehzadRazavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5 2013.

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/index.html

W2. http://nptel.iitm.ac.in/video.php/subjectId/117106093

W3. http://nptel.iitk.ac.in/courses/Webcoursecontents/IITKANPUR/HighSpeed_Semiconductor Devices/ ui/Course_home

COURSE OUTCOME:

CO1:	Analyse 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

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**
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
	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 – 05	WIRELESS NETWORKS	3	0	0	3

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 handoffs. Security and Privacy in wireless network, Radio propagation mechanism.

UNIT II 3G OVERVIEW 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 h

COURSE OUTCOME:

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

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**

TEXT BOOKS:

T1. William Stallings, "Wireless Communications and networks", Pearson / Prentice Hall of India, 2nd Ed., 2009.

T2. Dharma Prakash Agrawal &QingAnZeng, "Introduction to Wireless and Mobile Systems", Thomson India Edition, 2nd Ed., 2015.

REFERENCE BOOKS:

R1. Vijay. K. Garg, "Wireless Communication and Networking", Morgan Kaufmann Publishers, 2008.

R2. Kaveth Pahlavan, Prashant Krishnamurthy, "Principles of Wireless Networks", Pearson Education Asia, 2002.

R3. Gary. S. Rogers & John Edwards, "An Introduction to Wireless Technology", Pearson Education, 2007.

R4. Clint Smith, P.E. & Daniel Collins, "3G Wireless Networks", Tata McGraw Hill, 2nd Ed,. 2017.

WEBLINK :

W1 :https://nptel.ac.in/courses/117105132

W2 :https://nptel.ac.in/courses/117104099

W3 :https://nptel.ac.in/courses/106105160

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	-
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
	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 – 06	MOBILE ADHOC NETWORKS	3	0	0	3

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

Introduction – Cellular and AdHoc Networks - Mobile Ad hoc Networking with 4G - Application of Mobile Ad Hoc Networks - Issues in Mobile Ad Hoc networks-Ad Hoc wireless Internet- Mobile Quality of Service - QoS Parameters-Issues and Challenges in providing Mobile QoS. Mobility models – types.

UNIT II MEDIUM ACCESS PROTOCOLS 9

MAC Protocols: design issues, goals and classification. Contention based protocols– with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.

UNIT III NETWORK PROTOCOLS 9

Routing Protocols: Design issues, goals and classification, Proactive vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm, Hierarchical Routing, QoS aware routing.

UNIT IV END TO END DELIVERY AND SECURITY 9

Transport layer: Issues in designing – Transport layer classification, Adhoc transport protocols. Security issues in Adhoc networks: issues and challenges, types of network security attacks, various, Types of secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G 9

Introduction to Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective. Integration of Adhoc with Mobile IP networks.

TOTAL: 45 h

COURSE OUTCOME:

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

CO1	Analyse the applications and features of Mobile Adhoc networks.	**K4**
CO2	Identify the different MAC protocols in Mobile Adhoc Network	**K2**
CO3	Interpret the design issues, goals and classification of routing protocols.	**K2**
CO4	Estimate suitable secure routing protocols for the various types of security attacks in Adhoc networks	**K5**
CO5	Illustrate the concept of cross layer design	**K3**

TEXTBOOKS:

T1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architectures and protocols, 2nd edition, Pearson Education, 2007.

T2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCE BOOKS:

R1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile Adhoc networking, Wiley– IEEE press, 2013.

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.

WEBLINK :

W1 :https://nptel.ac.in/courses/106106147

W2 :https://nptel.ac.in/courses/117104099

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
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
	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 – 07	**WIRELESS SENSOR NETWORKS**	**3**	**0**	**0**	**3**

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-hoc Networks (MANETs) and Wireless Sensor Networks, Challenges for WSN, 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 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 – Contention Based 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 h

TEXT BOOKS:

T1. Holger Karl& Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2007.

T2. Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks",John Wiley & Sons, 10 Jun 2010.

T3. C.Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2006.

T4. 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. SabrieSoloman, "Sensors Handbook" by McGraw Hill publication. 2010.

R3. KazemSohrby, Daniel Minoli, "Wireless Sensor Networks": Technology, Protocols and Applications, Wiley-Inter science, 2010.

R4. Philip Levis, And David Gay, "TinyOS Programming" Cambridge University Press 2009.

WEBLINK:

W1 : https://nptel.ac.in/courses/106105160

W2 : https://nptel.ac.in/courses/117104099

COURSE OUTCOME:

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

CO1	Distinguish Wireless Sensor Networks and ADHOC Networks.	**K2**
CO2	Experiment with Operating Systems for WSN	**K2**
CO3	Relate various architecture models in Wireless Sensor Network	**K2**
CO4	Analyse the various routing protocols in Wireless Sensor Networks.	**K5**
CO5	Estimate the importance of security in WSN.	**K3**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**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
	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 –09	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

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 TO CRYPTOGRAPHY 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 – 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 h

TEXT BOOKS:

T1. William Stallings, "Cryptography And Network Security – Principles and Practices", Pearson Education, Third Edition, 2022.

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", Fifth Edition, Pearson Education, 2015.

R3. Wade Trappe and Lawrence C. Washington, "Introduction to Cryptography with coding theory", Pearson Education, 2005.

R4. WenboMao, "Modern Cryptography Theory and Practice" , Pearson Education, 2007.

R5. Thomas Calabrese, "Information Security Intelligence: Cryptographic Principles and Applications", Thomson Delmar Learning, 2006.

WEBLINK:

W1 :https://nptel.ac.in/courses/106105031

W2 :https://nptel.ac.in/courses/106105162

COURSE OUTCOME:

At the end of this course the students will be able to, Understand OSI security architecture and connect with various security models

CO1	Analyse 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	**K3**
CO5	Design principles of firewall and discuss the various system threats and protection using virus counter measures, firewall, Trojan etc.,	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1	1	1	1	1	-	-	-	-	-	-	-	1	2
CO2	2	3	1	1	2	-	-	-	-	-	-	-	2	1
CO3	2	2	1	2	-	-	-	-	-	-	-	-	1	1
CO4	3	1	1	1	1	-	-	-	-	-	-	-	2	2
CO5	1	1	1	1	1	-	-	-	-	-	-	-	2	1
	1.6	**1.6**	**1**	**1.2**	**1**	-	-	-	-	-	-	-	**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 – 10	**ELECTRONIC SYSTEM DESIGN**	**3**	**0**	**2**	**4**

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 amplifiers 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 BOARD 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 h

TEXT BOOKS:

T1. Reinhold Luduig and Pavel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education, 2000.

T2. Sydney Soclof, "Applications of Analog Integrated Circuits", Prentice Hall of India, 2004.

T3. Walter C.Bosshart, "Printed Circuit Boards – Design and Technology", TMH, 1983.

REFERENCES BOOKS:

R1. Keith H.Billings, Handbook of Switched Mode Supplies, McGraw–Hill Publishing Co., 1998.

R2. Michael Jaacob, Applications and Design with Analog Integrated Circuits, Prentice Hall of India, 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, 2017.

WEBLINK:

W1 :https://nptel.ac.in/courses/117105080

W2 :https://nptel.ac.in/courses/108105132

COURSE OUTCOMES:

CO1:	Analyse the behaviour of RF components and filters and derive ABCD parameters and scattering parameters of the various RF components.	**K4/K6**
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**
CO 1	3	3	1	3	-	-	-	-	-	-	-	-	3	2
CO 2	3	3	1	3	-	-	-	-	-	-	-	-	3	2
CO 3	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO 4	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO 5	3	3	1	2	-	-	-	-	-	-	-	-	3	2
	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- 11	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 algorithms 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- 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 h

TEXT BOOKS:

T1. Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino, 4th Edition Thomas 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:

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 OUTCOME

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

CO1:	Illustrate the role of Embedded system in Robot development	**K3**
CO2:	Identify and choose suitable sensors, Actuators, communication and end effectors for Robot design and development	**K2**
CO3:	Discuss 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	**K6**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
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
	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 – 12	OPTICAL NETWORK	3	0	0	3

PREREQUISITE: Physics (Oscillation, Waves and Optics), Microwave Theory and Techniques

COURSE OBJECTIVES:

- To facilitate the knowledge about optical fibre sources and transmission techniques.
- To enrich the idea of optical fibre networks algorithm such as SONET/SDH and optical CDMA.
- To explore the trends of optical fibre measurement systems.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibres – 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 trade-offs 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	Analyse 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-13	**SOFTWARE DEFINED NETWORKS**	**3**	**0**	**0**	**3**

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 analyse 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 Interleaving Encoding-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 h

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

REFERENCES:

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-14	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 back off – 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.

T3: Kaven Pahlavan "Principles of Wireless Network", Prentice Hall Of India, 2010

REFERENCES:

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 BroadBand 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/PDStut/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 high speed 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**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	3	2	2	2	-	-	-	-	3	3	3	3	2	3
CO 2	3	2	2	2	-	-	-	-	2	2	2	2	2	1
CO 3	1	1	2	2	-	-	-	-	2	2	2	2	3	2
CO 4	2	2	2	3	-	-	-	-	3	2	2	3	3	2
CO 5	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- 15	APPLIED CRYPTOGRAPHY	3	0	0	3

Course Objective:

- To understand the mathematical background for cryptography .
- To understand the taxonomy of cryptography primitives
- To understand the Symmetric key encryption system, public key encryption system
- To implement cryptographic algorithms

UNIT I - INTRODUCTION **9**

Cryptography goals – Taxonomy of cryptography primitives – Background on functions – Basic terminology – Definition and examples – Block ciphers, stream cipher, substitution ciphers, transposition ciphers – Composition of ciphers – Digital signature – Construction of digital signature – Public key cryptography – Hash functions – Protocol and mechanism – Key establishment and management – Pseudo random numbers – Classes of attack.

UNIT II - NUMBER THEORY **9**

Probability theory – Information theory – Complexity theory – Number theory – Abstract algebra – Finite fields – Primality test – Prime number generation – Irreducible polynomial.

UNIT III - RANDOM GENERATORS **9**

Pseudo random bits and sequences – Random bit generation – Pseudorandom bit generation – statistical tests – Stream Cipher.

UNIT IV - ENCRYPTION ALGORITHMS **9**

Block cipher – DES – FEAL – IDEA – SAFAR – Public key encryption – RSA – Rabin – Elgamal –Mc Eliece – Knapsack.

UNIT V - HASH ALGORITHMS **9**

Hash function and data integrity – Classification and framework – Basic constructions and general results – Unkeyed hash functions – Keyed hash functions – data integrity and message authentication – Advanced attacks and hash funct

TOTAL: 45 h

TEXT BOOK :

T1: A.Menezes, P.Van Oorschot and S. Vanstone, "Hand book of Applied Cryptography" CRC Press, Fifth Printing, 2001.

REFERENCES :

R1: Charlie Kaufman, Radia Perlman, Mike Speciner, " Network Security, Private communication in public world" PHI 2nd edition 2002.

R2: Bruce Schneier, Neils Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd, 2003

R3: Douglas R Simson "Cryptography – Theory and practice", CRC Press 1995. 3. Stallings, "Cryptography& Network Security", Pearson Education, 4th Edition 2006.

WEBLINKS:

W1: https://dl.icdst.org/pdfs/files3/f7ba35bf7149b541644785c9270cc6b8.pdf

Course Outcome	Description	Knowledge Level
CO1	Understand the basics of cryptographic algorithms and protocols	K3
CO2	Analyze the concept of public key cryptography, Hash functions, Key establishment and management	K4
CO3	Acquire knowledge on encryption algorithms such as Block cipher, DES, FEAL, IDEA and SAFAR	K3
CO4	Evaluate the performance of Hash function, data integrity and message authentication	K5
CO5	Assess existing applications of cryptography and develop new protocols and applications that employ cryptography.	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	1	1							1	2	-
CO2	2	3	2	2	2							2	2	2
CO3	2	3	2	2	1							2	2	2
CO4	2	3	2	3	3							2	3	3
CO5	2	3	3	2	3							3	3	3

Average	**2.2**	**2.8**	**2.4**	**2**	**2**							**2**	**2.4**	**2**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC - 16	**BIG DATA PROGRAMMING**	**3**	**0**	**0**	**3**

Course Objectives

- To explore the fundamental concepts of big data analytics, Hadoop, R programming and HiveQL
- To learn big data analytics using R Programming

UNIT I INTRODUCTION TO BIG DATA 9

Introduction to Big Data Platform – Challenges of Conventional Systems - Nature of Data- Evolution Of Analytic Scalability - Intelligent data analysis- Analytic Processes and Tools - Analysis vs. Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error

UNIT II HADOOP 9

History of Hadoop- The Hadoop Distributed File System – Components of Hadoop-Analyzing the Data with Hadoop Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce Features

UNIT III HIVEQL 9

Introduction to HiveQL- Databases in Hive-HiveQL: Queries- SELECT … FROM Clauses , Specify Columns with Regular Expressions , Computing with Column Values , Arithmetic Operators, Using Functions-Mathematical functions, Aggregate functions, Table generating functions, Other built-in functions ,LIMIT Clause ,Nested SELECT Statements, CASE … WHEN … THEN Statements, WHERE Clauses, Predicate Operators, LIKE and RLIKE, GROUP BY

Clauses , HAVING Clauses ,JOIN Statements -Inner JOIN ,LEFT OUTER JOIN,RIGHT OUTER JOIN, FULL OUTER JOIN, Cartesian Product JOINs , Map-side Joins, ORDER BY and SORT BY, DISTRIBUTE BY with SORT BY , CLUSTER BY

UNIT IV BIG DATA ANALYTICS USING R PROGRAMMING 9

Analyzing, Visualization and Exploring the Data, Statistics for Model Building and Evaluation, Introduction to R and RStudio, Basic analysis in R, Intermediate R, Intermediate analysis in R, Advanced Analytics - K-means clustering, Association rules-Speedup, Linear Regression, Logistic Regression, Naïve Bayes, Decision Trees, Time Series Analysis, Text Analysis

UNIT V FRAMEWORKS 9

Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services –- fundamentals of HBase and ZooKeeper - IBM InfoSphereBigInsights and Streams. Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications

TOTAL : -- 45 h

TEXT BOOKS:

T1: Prajapati, Big Data Analytics with R and Hadoop, 2014

T2:StephanKudyba, Big Data, Mining, and Analytics: Components of Strategic Decision Making, Auerbach Publications, March 12, 2014 .

T3: Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications,2013

T4:Jason Rutherglen, Dean Wampler and Edward Capriolo, Programming Hive, O'REILLY, 2012

REFERENCES:

R1: Michael Berthold, David J. Hand, ―Intelligent Data Analysis‖, Springer, 2007.

R2: Tom White ― Hadoop: The Definitive Guide‖ Third Edition, O'reilly Media, 2012.

R3:Chris Eaton, Dirk De Roos, Tom Deutsch, George Lapis, Paul Zikopoulos, ―Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data‖, McGraw Hill Publishing, 2012

R4: Anand Rajaraman and Jeffrey David Ullman, ―Mining of Massive Datasets, Cambridge University Press, 2012.

WEBLINKS:

W1: https://scholar.harvard.edu/files/msseo/files/1.introduction_to_bigdata_chap1.pdf

COURSE OUTCOMES

CO1:	Identify the purpose and need of big data programming and compare it with conventional systems.	**K3**
CO2:	Examine and compare various components of Hadoop and develop a Map Reduce application.	**K4**
CO3:	Develop Hive queries using Hive QL interface.	**K3**
CO4:	Discuss various statistics modeling techniques and its evaluation using R and other clustering methods.	**K6**

CO5:	Discuss various big data frameworks, Applications on Big Data Using Pig, fundamentals HBASE, Zookeeper, IBM Info Sphere Big Insights and also test Visual data analysis techniques	**K6**

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
CO1	2	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3
Avg	2.4	2.6	2.6	2.2	2.4	-	-	-	-	-	-	-	-	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 -17	**BIOINFORMATICS**	**3**	**0**	**0**	**3**

Course Objectives

- To study the scope of Bioinformatics, types of Databases and their uses, Tools and Algorithms
- To learn the Pair wise Sequence Alignment methods

UNIT I Bioinformatics: An Introduction 9

Introduction-Historical Overview and Definition- Bioinformatics Applications - Major Databases in Bioinformatics- Data Management and Analysis- Molecular Biology and Bioinformatics- Central Dogma of Molecular Biology

UNIT II Databases 9

Introduction- Characteristics of Bioinformatics Databases- Categories of Bioinformatics Databases- Navigating databases- Sequence Databases-Nucleotide sequence database- secondary Nucleotide sequence database – protein sequence databases- structure databases- Structure file formats- Protein Structure Database Collaboration- PDB- CATH –SCOP- Other databases- Enzyme Databases- MEROPS- Pathway Databases:CAZy

UNIT III Tools **9**

Introduction- Need for Tools- Knowledge Discovery- Data- Mining Tools- Data Submission tools- Nucleotide Sequence Submission and Protein Submission tools- Data Analysis tools- Prediction Tools- Phylogenetic trees and Phylogenetic Analysis- Modelling Tools

UNIT IV Algorithms **9**

Introduction- Classification of Algorithms- Biological Algorithms- Implementing Algorithms- Biological Algorithms- Bioinformatics Tasks and Corresponding Algorithms- Data Analysis Algorithms- Sequence Comparison Algorithms – Substitution Matrices Algorithms –Sequence Alignment Optimal Algorithms- Prediction Algorithms- Phylogenetic prediction Algorithm – Protein Structure Prediction

UNIT V Genome Analysis and Sequence Alignment **9**

Introduction- Genome Analysis- Genome mapping- The Sequence Assembly Problem- Genome Sequencing- Biological Motivation of Alignment Problems Methods of Sequence Alignments- Using Scoring matrices- Measuring Sequence Detection Efficiency- Working with FASTA and BLAST

TOTAL : -- 45 h

TEXT BOOKS:

T1: OrpitaBosu, SimminderKaurThukral , “Bioinformatics: Database, Tools, Algorithms”, Oxford University Press, Chennai, 2007. (Part B---Unit-II, Part C---Unit-III, Part D---Unit-IV)
T2: Applications: Genomics, Proteomics and Drug Discovery”, Third Edition, PHI Learning Pvt. Ltd., New Delhi, 2011

REFERENCES:

R1: Bryan Bergeron, “Bioinformatics computing”, PHI Learning Pvt. Ltd, New Delhi, 2010.
R2: Rastogi S.C., Namita Mendiratta, Parag Rastogi, “Bioinformatics: Concepts”, Skills & Applications, Second Edition, CBS Publishers & Distributors Pvt. Ltd, 2009
R3:Arthur M. Lesk, “Introduction to Bioinformatics”, Third Edition, Oxford University Press, Chennai, 2010
R4:Gautham N., “Bioinformatics: Databases and Algorithms”, alpha Science 2006

WEB LINKS:

W1: http://staff.aub.edu.lb/~webbic/nemer/index.html
W2:http://bip.weizmann.ac.il/education/course/introbioinfo/04/lect1/introbi oinfo04/index.html
W3:http://engineeringppt.net/algorithms-in-bioinformatics-pdf-lecture- notes/

COURSE OUTCOMES

CO1:	Comprehend the data management and analysis of Bio Informatics	**K3**
CO2:	Understand the Structure Database Collaboration like PDB, CATH, SCOP	**K3**
CO3:	Analyze the various Tools for data mining, submission and prediction	**K4**
CO4:	Implement the Classification of Algorithms and prediction of protein structure	**K6**
CO5:	Measure sequence detection efficiency in bioinformatics	**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**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3
Avg	2.6	2.6	2.6	2.2	2.4	-	-	-	-	-	-	-	-	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- 18	CYBER FORENSICS	3	0	0	3

COURSE OBJECTIVE:

- To understand the fundamentals of Computer Forensics and computing Investigations.
- To recognize the legal underpinnings and critical laws affecting forensics
- To apply the tools and methods to uncover hidden information in digital systems.
- To learn about current licensing and certification requirements to build the career in digital forensic.

UNIT I INTRODUCTION 9

The Scope of Computer Forensics - Windows Operating and File Systems –Handling Computer Hardware – Anatomy of Digital Investigation.

UNIT II INVESTIGATIVE SMART PRACTICES 9

Forensics Investigative Smart Practices – Time and Forensics – Incident closure

UNIT III LAWS AND PRIVACY CONCERNS 9

Laws Affecting Forensic Investigations – Search Warrants and Subpoenas – Legislated Privacy Concerns – The admissibility of Evidence – First Response and Digital Investigator

UNIT IV DATA ACQUISITION AND REPORT WRITING 9

Data Acquisition – Finding Lost Files – Document Analysis – Case Management and Report Writing – Building a Forensics Workstation

UNIT V TOOLS AND CASE STUDIES 9

Tools of the Digital Investigator - Licensing and Certification – Case Studies: E-mail Forensics – Web Forensics – Searching the Network – Excavating a Cloud – Mobile device Forensics.

TOTAL: 45 h

TEXT BOOKS:

T1: Michael Graves, ―Digital Archaeology: The Art and Science of Digital Forensics, Addison-Wesley Professional, 2014.

T2: Darren R. Hayes, ―Practical Guide to Computer Forensics Investigation, Pearson, 2015.

T3: Albert J. Marcella and Frederic Guillossou, ―Cyber Forensics: From Data to Digital Evidence ―, Wiley, 2015.

REFERENCES:

R1: Bill Nelson, Amelia Phillips and Christopher Steuart, ―Guide to Computer Forensics and Investigations‖, Fourth Edition, Cengage, 2013**.**

WEB LINKS:
W1:https://nptel.ac.in/courses/106106129
W2:https://www.techtarget.com/searchsecurity/definition/computer-forensics

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

Course Outcome	Description	Knowledge Level
CO1	Acquire knowledge on Forensic Investigative smart practices.	K3
CO2	Analyze the importance and need for smart practices in computer investigation.	K4
CO3	Analyze the ethical standards of the profession and apply those standards to all aspects of the study and practice of digital forensics.	K4
CO4	Evaluate the effectiveness of available digital forensics tools and use them in a way that optimizes the efficiency and quality of digital forensics investigations.	K5
CO5	Describe web and mobile device forensics.	K6

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
CO1	3	3	3	3	2								3	2
CO2	3	3	3	3	2								3	2
CO3	3	3	3	3	2								3	2
CO4	3	3	3	3	2								3	2
CO5	2	3	3	3	2								3	2
Average	**2.8**	**3**	**3**	**3**	**2**								**3**	**2**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**

✓	✓		✓	✓

PEC-19	**DATA WAREHOUSING AND DATA MINING**	**3**	**0**	**0**	**3**

Course Objective:

- To introduce the concept of data warehousing with special emphasis on architecture and design.
- To introduce the concept of data mining with a detail coverage of basic tasks, metrics, issues, and implication.
- To learn the core topics like classification, clustering and association rules.

UNIT I DATA WAREHOUSING 9

Data warehousing Components: Data Warehouse Database**,** Sourcing, Acquisition, Cleanup and Transformation Tool, Data Warehouse Administration and Management**,** Information Delivery System –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

UNIT II BUSINESS ANALYSIS 9

Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu Online Analytical Processing (OLAP) – Need –Multidimensional Data Model – OLAP Guidelines –Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet -Data Cube Technology, From Data warehousing to Data Mining.

UNIT III DATA MINING 9

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems- comparison of classification and prediction methods – Data Mining Task Primitives –Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.-, Mining Descriptive Statistical Measures in Large Databases.

UNIT IV ASSOCIATION RULE MINING AND CLASSIFICATION 9

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction – Basic Concepts - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification By Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction

UNIT V CLUSTERING, APPLICATIONS AND TRENDS IN DATA MINING 9

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – K-means– Partitioning Methods –Hierarchical Methods - Density-Based Methods –GridBased Methods – Model-Based Clustering Methods –Clustering High Dimensional Data- Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications.- Case Study.

TOTAL:45 h

TEXT BOOKS:

T1: Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", TataMcGraw – Hill Edition,Tenth Reprint 2007.(I & II)

T2: Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, 2007.(IIIto V)

REFERENCES:

R1: Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction To Data Mining,Person Education, 2007.

R2: K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter EconomyEdition, Prentice Hall of India, 2006.

R3: G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India,2006.

R4: Daniel T.Larose, "Data Mining Methods and Models", Wile-Inderscience, 2006.

Web Links:

W1:https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Course Outcomes

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

Course Outcome	Description	Knowledge Level

CO1	Apply the basic concepts of DBMS with data warehousing and data mining	**K3**
CO2	Identify the data warehouse components to build a data warehouse.	**K3**
CO3	Explain the functionalities and classifications of data mining systems	**K5**
CO4	Identify the issues and understand the integration of a data mining system with a data warehouse	**K3**
CO5	Explain cluster analysis, outlier analysis and data mining applications	**K5**

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	3	3	3	3								3	2
CO2	2	3	3	3	3								3	2
CO3	3	3	3	3	3								3	2
CO4	3	3	3	3	3								3	2
CO5	2	3	3	3	3								3	2
Avg	**2.6**	**3**	**3**	**3**	**3**								**3**	**2**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC -20	E COMMERCE	3	0	0	3

COURSE OBJECTIVES

- To understand the nature of e-Commerce and recognize the business impact and potential of e-Commerce
- To learn the technologies required to make e-Commerce viable.
- To know about the current drivers and inhibitors facing the business world in adopting and using e-Commerce

UNIT I INTRODUCTION 9

Traditional commerce and Ecommerce - Categories of Electronic commerce – Business models – Revenue models – Business processes. Internet and WWW–role of WWW–value chains–strategic business – Revenue Strategy issues – Industry value chains - supply chain management–role of Ecommerce

UNIT II INFRASTRUCTURE FOR E-COMMERCE 9

Packet switched networks–Routing packets. TCP/IP protocol script: IP Addressing – Domain names – E-mail protocols. Internet utility programs–SGML,HTML and XML–web client and servers–Web client/server architecture– intranet and extranets – Public and private networks – Virtual private network

UNIT III WEB BASED TOOLS FOR E-COMMERCE 9

Web server: Server computers –performance evaluation – Hardware architectures. Web server software feature sets–web server software and tools– Internet Utility programs – Data analysis software – Link checking utilities. web protocol–search engines–intelligent agents –EC software–webhosting–cost analysis

UNIT IV SECURITY 9

Computer security classification–copyright and Intellectual property–electronic commerce threats: Secrecy threats – Integrity threats – Necessity threats Encryption solutions. Protecting client computers–electronic payment systems– electronic cash–strategies for marketing–sales and promotion–cryptography – authentication

UNIT V INTELLIGENT AGENTS 9

Definition and capabilities–limitation of agents – History of software agents – Characteristics and properties a of agents – Tele script Agent Language – safe-Tcl –security–web based marketing–search engines and Directory registration–online advertisements– Portables and info mechanics–website design issues.

TOTAL : -- 45 h

TEXT BOOKS:

T1: RaviKalakota, Andrew B. Whinston“ Frontiers of Electronic Commerce”,Pearson Education, 2008
T2: Gary PSchneider “Electronic commerce”, Thomson learning & James TPeny Cambridge USA, 2001
T3: Manlyn Greenstein and Miklos “Electronic commerce” McGraw-Hill, 2002.

REFERENCES:

R1: EfraimTurvanJ.Lee, David Kug and Chung,“Electronic Commerce” Pearson EducationAsia2001.
R2: Brenda Kienew Ecommerce Business Prentice Hall,2001.

WEBLINKS:

W1:https://www.slideshare.net/munishsingla71/e-commerce-ppt-10713485
W2:https://www.geeksforgeeks.org/e-commerce/

COURSE OUTCOMES

CO1:	Construct the implement various business models of E-Commerce	**K3**
CO2:	Develop a policy and regulatory issues in E-commerce	**K4**
CO3:	Evaluate the basic networking concepts	**K5**
CO4:	Make use of the web client server architecture	**K3**
CO5:	Develop and acquire knowledge on web server concepts and its performance evaluation	**K6**

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**
CO1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO5	3	2	3	2	3	-	-	-	-	-	-	-	-	3
Avg	**2.8**	**2.6**	**2.6**	**2.2**	**2.4**	-	-	-	-	-	-	-	-	**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 - 21	ETHICAL HACKING	3	0	0	3

COURSE OBJECTIVES

- To understand how intruders escalate privileges.
- To understand Intrusion Detection, Policy Creation, Social Engineering, Buffer Overflows and different types of Attacks and their protection mechanisms
- To learn about ethical laws and tests.

UNIT I ETHICAL HACKING 9

Types of Data Stolen from the Organizations, Elements of Information Security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors

UNIT II FOOT PRINTING AND SOCIAL ENGINEERING 9

Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking

UNIT III DATA SECURITY 9

Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography – Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking

UNIT IV NETWORK PROTECTION SYSTEM & HACKING WEB SERVERS **9**

Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking

UNIT V ETHICAL HACKING LAWS AND TESTS **9**

An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing

TOTAL : 45h

TEXT BOOKS:

T1: Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.

REFERENCE BOOKS:

R1: Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.

R2: Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series – Elsevier, August 4, 2011.

R3: Whitaker& Newman, "Penetration Testing and Network Defence", Cisco Press, Indianapolis, IN, 2006.

WEBLINKS:

W1:https://www.javatpoint.com/ethical-hacking
W2:https://www.synopsys.com/glossary/what-is-ethical-hacking.html

COURSE OUTCOMES

CO1:	Utilize the basics of ethical hacking, elements of Information Security, authenticity, non-repudiation and security challenges	K3
CO2:	Develop a acquire knowledge on Malicious Software (Malware), Protection Against Malware and Intruder Attacks on Computers	K4
CO3:	Evaluate the web tools for Foot Printing, Competitive Intelligence and Google Hacking.	K5
CO4:	Determine Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering and shoulder surfing	K5
CO5:	Develop &analyze Attacks and enhance Physical Security, and Protection	K6

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	PSO1	PSO2
CO 1	3	3	3	3	2	-	-	-	-	-	-	-	-	3
CO 2	2	2	2	2	2	-	-	-	-	-	-	-	-	3
CO 3	3	3	3	2	2	-	-	-	-	-	-	-	-	3
CO 4	2	3	2	2	3	-	-	-	-	-	-	-	-	3
CO 5	2	2	3	2	3	-	-	-	-	-	-	-	-	3
Average	2.4	2.6	2.6	2.2	2.4	-	-	-	-	-	-	-	-	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- 22	GAME PROGRAMMING	3	0	2	4

Course Objectives

- To provide an in-depth introduction to technologies and techniques currently used in the game industry
- To understand game design and development
- To understand the processes, mechanics, issues in game design, and game engine development
- To understand modeling, techniques, handling situations, and logic

- To build and then integrate technologies such as multimedia, artificial intelligence, and physics modeling into a cohesive, interactive game application.

UNIT I INTRODUCTION TO GAME PROGRAMMING & GAME ENGINE ARCHITECTURE 9

Overview of game programming -Structure of a typical game team - game industry - game engine history -Real Time Game Architecture - Engine Support: Subsystem Start-Up and Shut-Down - Memory Management - Containers and Strings - Resource Management: File System, Resource Manager.

UNIT II BASICS OF 2D & 3D GRAPHICS AND MATHEMATICS IN GAMING & RENDERING ENGINE 9

2D Graphics: Sprites, Tiled Images and Backgrounds - 3D Graphics: 3D Graphics Pipeline, 3D Math, Coordinates and Coordinate Systems - Quaternion Mathematics - Transformations & Geometry - The Rendering Engine: Triangle Rasterization, The Rendering Pipeline

UNIT III LIGHTING AND TEXTURING EFFECTS IN GAME ENVIRONMENT 9

Ray Tracing - Lighting in Computer Graphics - Types of Light Sources - Light Models - Materials: Lambert Diffuse, Phong - Bump Mapping - Lighting Technique: Point Lights, Bloom - Shadows in Games: Real-Time Versus Pre-processed Shadows, Types of Shadows, Texture mapping techniques - Special Effects: Blurring, Particle Systems, Weapon Effects

UNIT IV INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN GAME 9

Why Games for Artificial Intelligence - Why Artificial Intelligence for Games - Game AI Panorama: Methods (Computer) Perspective, End User (Human) Perspective, Player-Game Interaction Perspective.

UNIT V SOLVING SEARCH PROBLEMS FOR GAME MOVE PREDICTION AND OPTIMIZATION USING AI 9

Tree Search: Uninformed Search, Best-First Search, Minimax, Monte Carlo Tree Search - Evolutionary Algorithms - Supervised Learning: Artificial Neural Networks, Support Vector Machines.

TOTAL: 45 h

TEXT BOOKS:

T1: Game Engine Architecture, 3rd Edition, Jason Gregory, A K Peters, 2019.
T2: Palmer G. Physics for game programmers. Berkeley: Apress; 2005
T3: Artificial Intelligence and Games, Georgios N. Yannakakis and Julian Togelius, January 26, 2018, Springer

REFERENCES:

R1: Sherrod A. Game Graphic Programming. Cengage Learning; 2008.
R2: McShaffry M. Game coding complete. Nelson Education; 2014
R3: Akenine-Mo, T., Haines, E. and Hoffman, N., 2018. Real-time rendering

Web Links:

W1: https://onlinecourses.nptel.ac.in/noc19_ge32/preview

CURSE OUTCOMES

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

COURSE OUTCOMES

CO1:	Understand the basics of Game Programming and Game Engine Architecture.	K3
CO2:	Develop 2D and 3D Images using Mathematical coordinates.	K4
CO3:	Apply various Lighting and Texturing Effects in game environment.	K5
CO4:	Extend the Game Programming using Artificial Intelligence.	K5
CO5:	Solve search problems for Game move prediction and optimization using AI	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2	2	3	2	3	-	-	-	-	2	2	2
CO2	2	3	2	2	2	3	2	-	-	-	-	2	2	2
CO3	2	2	3	2	2	2	3	-	-	-	-	3	2	3
CO4	3	2	3	2	2	3	2	-	-	-	-	2	3	2
CO5	2	3	2	2	3	2	1	-	--	-	-	3	2	3
Average	**2.2**	**2.4**	**2.4**	**2**	**2.4**	**2.4**	**2.2**	**-**	**-**	**-**	**-**	**2.4**	**2.2**	**2.4**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓			✓	✓

PEC – 23	INFORMATION RETRIEVAL TECHNIQUES	3	0	0	3

COURSE OBJECTIVES

- To understand the basics of information retrieval with pertinence to modeling
- To understand various components of IR system
- To understand machine learning techniques for text classification and clustering
- To explore various IR applications.

UNIT I INTRODUCTION AND MODELING 9

Basic Concepts: Retrieval process – Architecture – Boolean retrieval; IR Models: Taxonomy and characterization of IR models – Classical IR models – Alternative algebraic models – Models for Browsing – Retrieval Evaluation: Performance evaluation.

UNIT II INDEXING AND QUERYING 9

Indexing: Inverted indices – Suffix trees – Suffix arrays – Compression; Querying: Query languages; Query Operations: Relevance feedback and query expansion – Automatic local and global analysis.

UNIT III SEARCHING 9

Searching: Sequential searching – Pattern matching; Searching the Web: Characterising the Web – Search engines – Browsing – Searching using hyperlinks.

UNIT IV CLASSIFICATION AND CLUSTERING 9

Text Classification: Naive Bayes; Vector Space Classification: Rocchio – k-Nearest Neighbour; Flat Clustering: K-Means – Model-based clustering – Hierarchical clustering – Matrix decompositions and latent semantic indexing.

UNIT V APPLICATIONS 9

XML Retrieval – Multimedia IR – Parallel and Distributed IR – Digital Libraries – Social Media Retrieval – Content-based Image Retrieval – Online Public Access Catalogs (OPACs).

Total : 45h

TEXT BOOKS

T1: Ricardo Baeza Yates, Berthier Ribeiro Neto, "Modern Information Retrieval: The Concepts and Technology behind Search", ACM Press Books, 2nd Edition, 2011.

T2: Christopher D Manning, Prabhakar Raghavan, Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press, 1st South Asian Edition, 2008.

REFERENCES

R1: Stefan Buttcher, Charles L A Clarke, Gordon V Cormack,"Information Retrieval – Implementing and Evaluating Search Engines", The MIT Press, Cambridge, Massachusetts London, England, 2010.

R2: Cheng Xiang Zhai, Sean Massung, "Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining", ACM Books, 2016.

R3: Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining: An Introduction", 1st Edition, Cambridge University Press, 2014.

R4: VipinTyagi, "Content-Based Image Retrieval: Ideas, Influences, and Current Trends", 1st Edition, Springer, 2017.

WEBLINK

W1:https://www.researchgate.net/publication/242403883_Information_Retrieval_Techniques

W2:https://www.researchgate.net/publication/372383476_Information_Retrieval_Recent_Advances_and_Beyond

COURSE OUTCOMES

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

CO1:	Describe various IR modeling techniques	K3
CO2:	Identify and design the various components of an Information Retrieval system	K3
CO3:	Apply machine learning techniques to text classification and clustering for efficient Information Retrieval	K5
CO4:	Describe various IR applications	K2
CO5:	Apply IR evaluation metrics to measure the performance of IR systems	K3

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	P O4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	3	2	3	-	-	-	-	2	2	2
CO2	2	3	2	2	2	3	2	-	-	-	-	2	2	2
CO3	2	2	3	2	2	2	3	-	-	-	-	3	2	3
CO4	3	2	3	2	2	3	2	-	-	-	-	2	3	2
CO5	2	3	2	2	3	2	1	-	--	-	-	3	2	3
Average	**2.2**	**2.4**	**2.4**	**2**	**2.4**	**2.4**	**2.2**	**-**	**-**	**-**	**-**	**2.4**	**2.2**	**2.4**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC-24	OBJECT ORIENTED ANALYSIS AND DESIGN	3	0	0	3

Course Objective:

• To understand the system modelling and design based on requirements, converting design to code.

• To use various UML design diagrams and to apply the appropriate design patterns.

• To learn the basic Object-oriented analysis and design skills through an elaborate case study.

• To apply the process of OOAD in software development.

UNIT I INTRODUCTION 9

Introduction to OOAD – What is OOAD? – What is UML? An Overview of Object Oriented Systems Development - Object Basics – Object Oriented Systems Development Life Cycle: The Software Development Process – Building High-Quality Software – OOSD: A Use-Case Driven Approach - Use case Modeling - Relating Use cases: include, extend and generalization.

UNIT II OBJECT ORIENTED METHODOLOGIES 9

Rumbaugh Methodology - Booch Methodology - Jacobson Methodology - Patterns – Frameworks – Unified Approach – Unified Modeling Language: Static and dynamic model – UML diagrams - UML class diagram – Use case diagram UML dynamic modeling (Sequence diagram, Collaboration Diagram, State Diagram) - Activity Diagram –Implementation diagrams (Component diagram, Deployment diagram).

UNIT III OBJECT ORIENTED ANALYSIS 9

Identifying use cases : Business object analysis –The unified approach- Business process modeling – Use case model– Developing effective documentation - Object Analysis Classification : Classifications theory – Approaches for identifying classes – Noun phrase approach – Common class patterns approach – Use case driven approach –Classes, responsibilities and collaborators – Naming classes - Identifying Object relationships, Attributes and Methods: Associations – Super sub class relationship – A part of relationships (aggregation) – Class responsibility – Object responsibility.

UNIT IV OBJECT ORIENTED DESIGN 9

Design Axioms: The object oriented design process – Design axioms – Corollaries – Design patterns – Designing Classes: The process - Class visibility – Refining attributes – Designing methods and protocols. Access Layer: Object Storage and Object Interoperability: DBMS – Distributed databases and client server computing – Object relational systems – Multidata base systems – Designing Access layer classes.

UNIT V SOFTWARE QUALITY AND USABILITY 9

View Layer : Designing Interface Objects : Designing view layer classes – Macro level , Micro level process – Purpose of a view layer interface – Prototyping the user interface- Software Quality Assurance: Quality Assurance Tests – Testing strategies – Impact of Object Orientation – Test Cases – Test Plan – Myer's Debugging Principles – System Usability and Measuring User Satisfaction : Usability Testing – User Satisfaction Test (Test Templates) – Mapping design to code.

TOTAL: 45 h

TEXT BOOKS:

T1: Ali Bahrami, "Object Oriented Systems Development", Tata McGraw-Hill, 1999.

T2: Craig Larman, "Applying UML and Patterns: An Introduction to object-oriented Analysis and Design and iterative development", Third Edition, Pearson Education,2005.

REFERENCE BOOKS:

R1: Mike O'Docherty, "Object-Oriented Analysis & Design: Understanding System Development with UML 2.0", John Wiley & Sons, 2005.

R2: James W- Cooper, Addison-Wesley, "Java Design Patterns – A Tutorial", 2000.

WEBLINK

W1:https://www.geeksforgeeks.org/object-oriented-paradigm-object-oriented-analysis-design/

W2:https://medium.com/omarelgabrys-blog/object-oriented-analysis-and-design-introduction-part-1-a93b0ca69d36

COURSE OUTCOMES

CO1:	Construct the Software Development Process	K6
CO2:	Analyzeobject oriented design methodologies	K5
CO3:	Use Attributes and Methods in use case driven approach	K3
CO4:	Design Object relational and Multidatabase systems	K6
CO5:	Be Familiar with the test Cases, test Plan and Myer's Debugging Principles	K3

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**
CO1	3	2	2	2	3								2	1
CO2	3	2	3	3	2								3	2
CO3	2	3	2	2	2								2	3
CO4	2	3	2	2	3								3	3
CO5	2	3	3	3	3								3	3
Average	**2.4**	**2.6**	**2.4**	**2.4**	**2.6**								**2.6**	**2.4**

ASSESSMENT METHODS:

CAT 1	**CAT 2**	**Model Exam**	**End Semester Exams**	**Assignments**
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC-25	**SOFTWARE ENGINEERING**	**3**	**0**	**0**	**3**

Course Objective:

- To understand the phases in a software project
- To understand the fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures

UNIT I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models –Introduction to Agility-Agile Process-Extreme programming-XP Process.

UNIT II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis, PetriNets- Data Dictionary.

UNIT III SOFTWARE DESIGN 9

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV TESTING AND MAINTENANCE 9

Software testing fundamentals-Internal and external views of Testing-white box testing – basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection – Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

Total: 45h

TEXT BOOKS:

T1: Roger S. Pressman, ―Software Engineering – A Practitioner‟s Approach, Seventh Edition, Mc Graw-Hill International Edition, 2010.

T2: Ian Sommerville, ―Software Engineering, 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

R1: Rajib Mall, ―Fundamentals of Software Engineering‖, Third Edition, PHI Learning PrivateLimited, 2009.

R2: Pankaj Jalote, ―Software Engineering, A Precise Approach‖, Wiley India, 2010.

R3: Kelkar S.A., ―Software Engineering, Prentice Hall of India Pvt Ltd, 2007.

R4: Stephen R.Schach, ―Software Engineering, Tata McGraw-Hill Publishing Company Limited,2007.

WEBLINK

W1:https://www.javatpoint.com/software-engineering

W2:https://www.geeksforgeeks.org/software-engineering/

COURSE OUTCOMES

CO1:	Identify the key activities in managing a software project	K2
CO2:	Compare different process models	K4
CO3:	Apply systematic procedure for software design and deployment	K3
CO4:	Compare and contrast the various testing and maintenance.	K4
CO5:	Manage project schedule, estimate project cost and effort required	K3

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**
CO1	3	3	2	2	2								2	1
CO2	2	2	3	2	3								3	3
CO3	3	2	2	2	2								2	3
CO4	2	3	3	2	3								3	3
CO5	2	3	3	2	3								3	3
Average	**2.4**	**2.6**	**2.6**	**2**	**2.6**								**2.6**	**2.6**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
			✓	✓

PEC- 26	SOFTWARE PROJECT MANAGEMENT	3	0	0	3

Course Objective:

- To understand the basic knowledge of software management principles.
- To familiarize in choosing an appropriate project development methodology and identifying project risks, monitoring and tracking project deadlines.
- To develop the capability to work in a team environment and be aware of different modes of communications.

UNIT I INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT 9

Project Definition – Contract Management – Activities Covered by Software Project Management – Plans, Methods and Methodologies – Management – Objectives – Stakeholders – Requirement Specification – Management control – Activities Covered By Software Project Management – Overview Of Project Planning – Stepwise Project Planning.

UNIT II PROJECT EVALUATION 9

Strategic Assessment – Technical Assessment – Cost Benefit Analysis –Cash Flow Forecasting – Cost Benefit Evaluation Techniques : Net Profit – Payback Period – Return on Investment – Net Present Value – Internal Rate of Return – Risk Evaluation : Identification and Ranking – Cost-benefit Analysis – Risk Profile Analysis – Using Decision Trees.

UNIT III ACTIVITY PLANNING 9

Objectives – Project Schedule – Sequencing and Scheduling Activities –Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning and Control.

UNIT IV MONITORING AND CONTROL 9

Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting Project Back to Target – Change Control – Managing Contracts – Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management – Acceptance.

UNIT V MANAGING PEOPLE AND ORGANIZING TEAMS 9

Introduction – Understanding Behavior – Organizational Behaviour : a Background – Selecting The Right Person For The Job – Instruction In The Best Methods – Motivation– The Oldman – Hackman Job Characteristics Model – Working In Groups – Becoming A Team –Decision Making – Leadership – Organizational Structures – Stress –Health and Safety – Case Studies.

TOTAL : 45 h

TEXT BOOK:

T1: Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.

REFERENCE BOOKS:

R1: Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
R2: Royce, "Software Project Management", Pearson Education, 1999.
R3: Jalote, "Software Project Manangement in Practive", Pearson Education, 2002.

WEBLINK

W1:https://www.geeksforgeeks.org/software-engineering-software-project-management-spm/

W2:https://clickup.com/blog/software-project-management/

COURSE OUTCOMES:

CO1:	Determine the Plans, Methods and Methodologies of Software project Management	**K5**
CO2:	Assess the project evaluation techniques based on cost and risk	**K5**
CO3:	Elaborate the Sequencing and Scheduling Activities & Hazards	**K6**
CO4:	Examine the Stages in Contract Placement	**K4**
CO5:	Organize people in team and develop decision making skills	**K3**

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
CO1	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO2	3	2	2	3	3	-	-	-	-	-	-	-	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	2	3
CO4	3	3	2	3	3	-	-	-	-	-	-	-	2	3
CO5	2	2	3	3	3	-	-	-	-	-	-	-	2	3
Average	2.8	2.6	2.6	3	3	-	-	-	-	-	-	-	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 - 27	USER INTERFACE DESIGN AND EXTENSION	3	0	0	3

Course Objectives

- To gain knowledge about how to create a User Interface, how to use different type of controls, Menu usage.
- To learn different types and components, different methodologies used to implement User Interface and how to use multimedia, prototypes and analyzing different types of testing

UNIT I INTRODUCTION 9

Human Computer Interface – A brief History of Screen Design - Characteristics Of Graphics Interface –Direct Manipulation Graphical System – Web User Interface –Popularity –Characteristic of Web Interface Principles of User Interface Design

UNIT II HUMAN COMPUTER INTERACTION 9

User Interface Design Process – Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed–Business Functions and Requirement Analysis : Direct Methods and Indirect

Methods – Basic Business Functions -Design Standards – System Training – Structures Of Menus – Functions Of Menus–Contents Of Menu– Formatting-Phrasing The Menu – Selecting Menu Choice– navigating Menus– Kinds of Graphical Menus.

UNIT III WINDOWS 9

Window Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– Device Based Controls Characteristics–Screen Based Controls Characteristics – Operate Control – Text Entry Controls – Selection Control–Combination Control– Custom Control– Presentation Control.

UNIT IV MULTIMEDIA 9

Text For Web Pages – Providing the Proper Feedback– Guidance & Assistance–International Consideration – Accessibility– Icons– Image– Multimedia – Coloring.

UNIT V WINDOWS LAYOUT– TEST 9

Prototypes – Kinds Of Tests – Analyze ,Modify and Retest – Evaluating the Working System - Information Search – Visualization –Hypermedia – Software Tools : Interface Design Tools,Software Testing Tools

TOTAL:45 h

TEXT BOOKS:

T1: Wilbent. O. Galitz ,"The Essential Guide To User Interface Design", John Wiley& Sons, 2007.

T2: Ben Sheiderman, "Design The User Interface", Pearson Education, 2008.

REFERENCES:

R1: Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd.,2002

WEB LINKS:

W1: https://onlinecourses.nptel.ac.in/noc21_ar05/preview

W2: https://www.coursera.org/specializations/user-interface-design

COURSE OUTCOMES

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

CO1:	Identify the concept of Human Computer Interface and Direct Manipulation Graphical System.	K1
CO2:	Discuss User Interface Design Process, Obstacles and Usability	K3
CO3:	Compare Window Characteristics, Presentation Styles, Organizations and Operations.	K6
CO4:	Discuss International Consideration and Accessibility of multimedia.	K3

PEC – 28	VIRTUAL REALITY	3	0	2	4

CO5:	Analyze the concept of Visualization and Hypermedia.	K4

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO1	PO2	PO3	P O4	PO5	PO6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	2	2	3	-	2	-	-	-	-	-	-	3	2	3
CO2	1	3	2	-	3	-	-	-	-	-	-	2	3	2
CO3	3	2	3	-	2	-	-	-	-	-	-	1	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2	2
CO5	3	3	1	-	1	-	-	-	-	-	-	3	3	3
Average	**2.2**	**2.4**	**2.2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2.2**	**2.4**	**2.4**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

Course Objectives

- To understand geometric modeling and Virtual environment.
- To study about Virtual Hardware and Software
- To develop Virtual Reality applications

UNIT I INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality & Virtual Environment: Introduction – Computer graphics – Real time computer graphics –Flight Simulation – Virtual environments –requirement – benefits of virtual reality- Historical development of VR : Introduction-Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT II GEOMETRIC MODELLING 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction – VR Systems.

UNIT III VIRTUAL ENVIRONMENT 9

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and nonlinear translation - shape & object inbetweening – free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field – Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT IV VR HARDWARES & SOFTWARES 9

Human factors : Introduction – the eye - the ear- the somatic senses - VR Hardware : Introduction – sensor hardware - Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction –Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

UNIT V VR APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL: 45 h

TEXT BOOK:

T1: John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

REFERENCE BOOKS:

R1: Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.

R2: Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology", Wiley Interscience, 2nd Edition, 2006.

R3: William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design", Morgan Kaufmann, 2008.

WEB LINKS:

W1: https://nptel.ac.in/courses/106106138

W2: www.vresources.org

W3: www.vrac.iastate.edu

W4: www.w3.org/MarkUp/VRML

COURSE OUTCOMES

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

CO1:	Assess the concept of Virtual Reality, Virtual Environment and 3D Computer Graphics Shading algorithms	K1

CO2:	Explain Geometric Modelling Know Geometric Transformations and Generic VR system	K2
CO3:	Appraise the details of Physical Simulation in Virtual Environment	K3
CO4:	Explain Integrated VR systems, VR Software and VRML	K4
CO5:	Develop a Virtual Reality Applications with different modes of interaction	K6

MAPPING OF COURSE OUTCOMES TO PROGRAM OUTCOMES

	PO 1	**PO 2**	**PO 3**	**PO4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	2	2	2								3	2
CO2	2	2	2	2	2								3	3
CO3	3	2	2	2	2								2	2
CO4	2	2	3	3	2								3	2
CO5	2	3	2	3	2								1	3
Average	**2.4**	**2.2**	**2.2**	**2.4**	**2**								**2.4**	**2.4**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC - 29	AGILE METHODOLOGIES	3	0	0	3

COURSE OBJECTIVES

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I AGILE METHODOLOGY 9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

UNIT II AGILE PROCESSES 9

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT 9

Agile Information Systems – Agile Decision Making - Earl'S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment , Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING 9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILITY AND QUALITY ASSURANCE 9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

TOTAL : -- 45 h

TEXT BOOKS:

T1: David J. Anderson and Eli Schragenheim, "Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results", Prentice Hall, 2003.

T2: Hazza and Dubinsky, "Agile Software Engineering, Series: Undergraduate Topics in Computer Science", Springer, 2009.

REFERENCE BOOKS:

R1: Craig Larman, "Agile and Iterative Development: A Manager's Guide", Addison-Wesley, 2004.

R2: Kevin C. Desouza, "Agile Information Systems: Conceptualization, Construction, and Management", Butterworth-Heinemann, 2007.

WEB LINKS:

W1: https://www.guru99.com/scrum-testing-beginner-guide.html

W2:https://www.inflectra.com/Ideas/Whitepaper/Introduction%20to%20Agile%20Development%20Methods.aspx

COURSE OUTCOMES

CO1:	Realize the importance of interacting with business stakeholders in determining the requirements for a software system	**K4**
CO2:	Perform iterative software development processes: how to plan them, how to execute them.	**K3**
CO3:	Point out the impact of social aspects on software development success	**K1**
CO4:	Develop techniques and tools for improving team collaboration and software quality.	**K6**
CO5:	Perform Software process improvement as an ongoing task for development teams.	**K3**

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**
CO1	3	3	3	3	3	-	-	-	-	-	-	-	-	3

CO2	3	2	2	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	3
CO4	2	3	2	3	3	-	-	-	-	-	-	-	-	3
CO5	1	2	3	3	3	-	-	-	-	-	-	-	-	3
Avg	**2.4**	**2.6**	**2.6**	**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**
√	√		√	√	√

PEC-30	**INFORMATION SECURITY**	**3**	**0**	**2**	4

Course Objective:

- To understand the basics of Information Security and to know the legal, ethical and professional issues in Information Security.

- To know the aspects of risk management and to become aware of various standards and the technological aspects of Information Security.

UNIT I INTRODUCTION **9**

Information security: Definition, History, Critical Characteristics of Information-NSTISSC Security Model- Components of an Information System- Securing the Components-Balancing Security and Access-The System Development Life Cycle- The Security System Development Life Cycle

UNIT II SECURITY INVESTIGATION **9**

Need for Security- Business Needs: protecting the functionality of an organization, enabling the safe operation of an application, protecting the data that organization collects and use, safeguarding technology assets in organization- Threats-Attacks- Legal, Ethical and Professional Issues: Law and ethics in Information security, relevant U.S Laws, International laws and legal bodies, ethics and information security, codes of ethics and professional organization.

UNIT III SECURITY ANALYSIS **9**

Risk Management: Introduction- Risk Identification: plan and organize the process, asset identification and inventory, classifying and prioritizing information assets, information assets valuation, identifying and prioritizing threats, vulnerability identification and Assessing Risk, Assessing and Controlling Risk

UNIT IV LOGICAL DESIGN **9**

Blueprint for Security- Information Security Policy, Standards and Practices- ISO17799/BS 7799-NIST Models-VISA International Security Model- Design of Security Architecture- Planning for Continuity: Business impact analysis, incident response planning, disaster recovery planning, business continuity planning, crisis management, model for a consolidated contingency plan, law enforcement involvement.

UNIT V PHYSICAL DESIGN **9**

Security Technology- IDS- Scanning and Analysis Tools-Cryptography: Foundation of cryptology, cipher methods, cryptographic algorithms, cryptographic tools, protocols for secure communications, attacks on cryptosystems- Access Control Devices- Physical Security-Security and Personnel

TOTAL: 45h

TEXT BOOK:

T1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003

REFERENCE BOOKS:

R1. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRC Press LLC, 2004.

R2. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw- Hill, 2003

R3. Matt Bishop, "Computer Security Art and Science", Pearson/PHI, 2002

WEB LINKS:

W1. http://web.cse.ohio-state.edu/~champion.17/4471/

W2. https://slideplayer.com/slide/4409575/

COURSE OUTCOMES:

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

CO1	Discuss the development Life Cycle and components of the information security system	K6
CO2	Assess the protection of functionalities in an organization with Ethical and Professional Issues	K5
CO3	Examine the information assets Risk Assessment and Controlling of Risk	K4
CO4	Evaluate the Standards and Practices of various security models with Planning for Continuity	K5
CO5	Elaborate Scanning and Analysis Tools and cryptographic algorithms	K6

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
CO1	3	3	3	3	3								3	2
CO2	3	3	3	3	3								3	2
CO3	3	3	3	3	3								3	2
CO4	3	3	3	3	3								3	2
CO5	2	3	3	3	3								3	2
Average	**2.8**	**3**	**3**	**3**	**3**								**3**	**2**

ASSESSMENT METHODS:

CAT 1	CAT 2	Model Exam	End Semester Exams	Assignments
✓	✓	✓	✓	✓
Quiz	**MCQ**	**Projects**	**Seminars**	**Demonstration / Presentation**
✓	✓		✓	✓

PEC - 31	JAVA PROGRAMMING	3	0	0	3

Course Objectives

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and pre processing steps
- To understand the mathematical skills in statistics
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

UNIT I JAVA INTRODUCTION **9**

Review of object oriented programming - Objects and classes in Java – Defining classes – Methods - Access specifiers – static members – static fields - static methods - static variables – constructors - Default constructor - parameterized constructor – finalize method – Arrays – Strings – Packages – user defined packages – Java Doc comments

UNIT II OBJECT-ORIENTED PROGRAMMING IN JAVA 9

Inheritance – class hierarchy – polymorphism - Runtime polymorphism - compile time polymorphisms– Encapsulation - static and dynamic binding – final keyword – abstract classes – the Object class: Method of object class – java Reflection – interfaces – Properties of interfaces – object cloning – inner classes – use of inner classes – proxies-Design Patterns in Java

UNIT III HTML,CSS CLIENT SIDE SCRIPTING 9

Understanding Internet - Understanding websites and web servers - HTML - – forms – frames – tables – web page design – CSS - Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,- Regular Expressions- JavaScript Events - Event Handling and Validation -Exception Handling-

UNIT IV SERVER SIDE PROGRAMMING 9

Understanding Java Server Pages-JSP Standard Tag Library(JSTL)-Creating HTML forms by embedding JSP code- Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server;- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example – JSP:.

UNIT V Web Applications development with Rest APIs 9

Rest API development with spring boot, Spring boot project with STS/MAVEN, Controller and Rest Controller annotations, Request Body, Response Body annotations, Error handling with spring boot

TOTAL : 45 h

TEXT BOOKS:

T1: Herbert Schildt, “Java The complete reference”, 8th Edition, McGraw Hill Education, 2011.

T2: Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

REFERENCE BOOKS:

R1: Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3rd Edition, Pearson, 2015.

R2: Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition,

WEB LINKS:

W1: https://onlinecourses.nptel.ac.in/noc22_cs47/preview

COURSE OUTCOMES

CO1:	Develop Java programs using OOP principles	**K2**
CO2:	Develop Java programs with the concepts inheritance and interfaces	**K4**
CO3:	Design simple web pages using markup languages like HTML and XHTML.	**K3**
CO4:	Program server side web pages that have to process request from client side web pages.	**K4**
CO5:	Understand various web services and how these web services interact..	**K1**

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	2	-	-	-	-	-	-	-	-	3
CO2	3	2	2	2	2	-	-	-	-	-	-	-	-	3
CO3	3	2	3	2	2	-	-	-	-	-	-	-	-	3
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	3
CO5	2	2	3	2	3	-	-	-	-	-	-	-	-	3
	2.8	**2**	**2.6**	**2.2**	**2.4**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**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 - 32	**MACHINE LEARNING ALGORITHMS**	**3**	**0**	**2**	4

UNIT I INTRODUCTION **9**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODELS **9**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT III TREE AND PROBABILISTIC MODELS **9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V GRAPHICAL MODELS 9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TEXT BOOKS:

T1: Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

T 2:Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.

REFERENCES:

R1: Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.

R2: Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014

R3. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014 CS7603 PARALLEL AND DIST.

WEB LINK

W1:https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/MACHINE%20LEARNING%28R17A0534%29.pdf

W2:https://news.vidyaacademy.ac.in/wp-content/uploads/2018/10/NotesOnMachineLearningForBTech-1.pdf

COURSE OUTCOMES:

CO1	Differentiate between supervised, unsupervised, semi-supervised machine learning approaches	**K4**
CO2	Discuss the decision tree algorithm and overcome the problem of over fitting	**K4**
CO3	Discuss and apply the back propagation algorithm and genetic algorithms to various problems	**K4**
CO4	Apply the Bayesian concepts to machine learning	**K3**
CO5	Analyse and suggest appropriate machine learning approaches for various types of problems	**K4**

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
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 - 33	**DATA SCIENCE**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the data science fundamentals and process.
- To learn to describe the data for the data science process.
- To learn to describe the relationship between data.
- To utilize the Python libraries for Data Wrangling.
- To present and interpret data using visualization libraries in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation - Exploratory Data analysis – build the model– presenting findings and building applications - Data Mining - Data Warehousing – Basic Statistical descriptions of Data.

UNIT II DESCRIBING DATA 9

Types of Data - Types of Variables -Describing Data with Tables and Graphs –Describing Data with Averages - Describing Variability - Normal Distributions and Standard (z) Scores

UNIT III DESCRIBING RELATIONSHIPS 9

Correlation –Scatter plots –correlation coefficient for quantitative data –computational formula for correlation coefficient – Regression –regression line –least squares regression line – Standard error of estimate – interpretation of r2 –multiple regression equations –regression towards the mean

UNIT IV PYTHON LIBRARIES FOR DATA WRANGLING 9

Basics of Numpy arrays –aggregations –computations on arrays –comparisons, masks, boolean logic– fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – Hierarchical indexing – combining datasets – aggregation and grouping – pivot tables

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL:45 h

TEXT BOOKS

T1: David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (Unit I)

T2: Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Units IIand III)

T3: Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Units IV and V)

REFERENCES:

R1: Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press,2014.

WEBLINKS

W1:https://mrcet.com/downloads/digital_notes/CSE/II%20Year/DS/Introduction%20to%20Datascience%20[R20DS501].pdf

W2: https://www.newtondesk.com/introduction-to-data-science-study-notes-pdf/

COURSE OUTCOME:

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

CO1	Define the data science process	**K1**
CO2	Understand different types of data description for data science process	**K2**
CO3	Gain knowledge on relationships between data	**K4**
CO4	Use the Python Libraries for Data Wrangling	**K5**
CO5	Apply visualization Libraries in Python to interpret and explore	**K3**

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 - 34	**NATURAL LANGUAGE PROCESSING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques to IR applications

UNIT I **9**

Introduction – Models -and Algorithms - The Turing Test -Regular Expressions Basic Regular Expression Patterns -Finite State Automata -Regular Languages and FSAs – Morphology -Inflectional Morphology - Derivational Morphology -Finite-State Morphological Parsing - Combining an FST Lexicon and Rules -Porter Stemmer

UNIT II **9**

N-grams Models of Syntax - Counting Words - Unsmoothed N-grams – Smoothing Backoff - Deleted Interpolation – Entropy - English Word Classes - Tagsets for English - Part of Speech Tagging -Rule-Based Part of Speech Tagging - Stochastic Part of Speech Tagging - Transformation-Based Tagging

UNIT III **9**

Context Free Grammars for English Syntax- Context-Free Rules and Trees – Sentence Level Constructions –Agreement – Sub Categorization – Parsing – Top-down – Earley Parsing -Feature Structures - Probabilistic Context-Free Grammars

UNIT IV **9**

Representing Meaning - Meaning Structure of Language - First Order Predicate Calculus - Representing Linguistically Relevant Concepts -Syntax-Driven Semantic Analysis - Semantic Attachments - Syntax-Driven Analyzer - Robust Analysis - Lexemes and Their Senses - Internal Structure - Word Sense Disambiguation -Information Retrieval

UNIT V **9**

Discourse -Reference Resolution - Text Coherence -Discourse Structure - Dialog and Conversational Agents - Dialog Acts – Interpretation – Coherence -Conversational Agents - Language Generation – Architecture -Surface Realizations - Discourse Planning – Machine Translation -Transfer Metaphor – Interlingua – Statistical Approaches.

TOTAL: 45h

TEXT BOOKS:

T1. D. Jurafsky and J. Martin “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”,

T2. C. Manning and H. Schutze, “Foundations of Statistical Natural Language Processing”,

REFERENCE:

R1. James Allen. “Natural Language Understanding”, Addison Wesley, 1994.

WEBLINKS

W1: https://www.studocu.com/in/document/punjabi-university/information-technology/nlp-natural-languag e-processing-notes/41790327

COURSE OUTCOMES:

CO1	Tag a given text with basic Language features	**K4**
CO2	Implement a rule-based system to tackle morphology/syntax of a language	**K4**
CO3	Design an innovative application using NLP components	**K4**
CO4	Design a tag set to be used for statistical processing for real-time applications	**K5**
CO5	Compare and contrast the use of different statistical approaches for different types of NLP applications.	**K6**

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**
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 – 35	DEEP LEARNING	3	0	0	3

COURSE OBJECTIVES:

To understand the basic ideas and principles of Neural Networks

- To understand the basic concepts of Big Data and Statistical Data Analysis
- To familiarize the student with The Image Processing facilities like Tensor flow and Keras
- To appreciate the use of Deep Learning Applications
- To understand and implement Deep Learning Architectures

UNIT I BASICS OF NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT III CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning

UNIT IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Auto encoders – Standard- Sparse – Denoising – Contractive- Variational Auto encoders – Adversarial Generative Networks – Auto encoder and DBM

UNIT V APPLICATIONS OF DEEP LEARNING 9

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer

Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL: 45h

TEXT BOOKS:

T1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017.

T2. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress , 2017.

REFERENCE BOOKS :

R1. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 2018. 2. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 2018.

R2. Joshua F. Wiley, "R Deep Learning Essentials",Packt Publications, 2016.

R3. Francois Chollet, "Deep Learning with Python", Manning Publications, 2018

WEB LINKS

W1: https://www.tutorialsduniya.com/notes/deep-learning-notes/

W2:https://www.studocu.com/in/document/gl-bajaj-institute-of-technology-and-management/btech/deep-learning-notes/42783284

COURSE OUTCOMES:

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

CO1	Understand the role of Deep learning in Machine Learning Applications	K2
CO2	Explain the Flow/ Keras in Deep Learning Applications.	K4
CO3	Analyse Different Deep Learning Models in Image Related Projects.	K4
CO4	design and implement Convolutional Neural Networks.	K5
CO5	Develop the applications of Deep Learning in NLP and Image Processing.	K6

MAPPING OF COURSE OUTCOMES: TO PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	2	-	-	-	-	2	1	2	1
CO2	2	1	1	3	1	1	-	-	-	-	1	1	2	2
CO3	1	2	2	1	1	2	-	-	-	-	2	2	3	2
CO4	2	1	2	3	3	2	-	-	-	-	2	2	3	2
CO5	1	3	1	2	2	2	-	-	-	-	2	1	2	1
Avg	**1.6**	**1.8**	**1.4**	**2.2**	**1.6**	**1.8**					**1.8**	**1.4**	**2.4**	**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 - 36	CYBER SECURITY	3	0	0	3

COURSE OBJECTIVES:

- To understand various types of cyber-attacks and cyber-crimes
- To learn threats and risks within context of the cyber security
- To have an overview of the cyber laws & concepts of cyber forensics
- To study the defensive techniques against these attacks

UNIT–I INTRODUCTION TO CYBER SECURITY 9

Basic Cyber Security Concepts, layers of security, Vulnerability ,threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIATriad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks,

hardware attacks, Cyber Threats Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage,etc.,Comprehensive Cyber Security Policy.

UNIT–II CYBERSPACE AND THE LAW & CYBER FORENSICS 9

Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyberforensics, Digital Forensics Science, The Need for Computer Forensics ,Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT–IIICYBER CRIME:MOBILE AND WIRELESS DEVICES 9

Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT-IV CYBER SECURITY: ORGANIZATIONAL IMPLICATIONS 9

Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT–V PRIVACY ISSUES & MINI CASES 9

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains-medical,financial,etc

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Fraudsin Cyber Domain.

TOTAL: 45 h

TEXT BOOKS:

T1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

T2: B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

REFERENCE BOOKS:

R1: Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.

R2: Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

WEBLINKS:

W1: www.ibm.com/in-en/topics/cybersecurity
W2: www.kaspersky.co.in/resource-center/definitions/what-is-cyber-security

COURSE OUTCOME:

CO1:	Analyze and evaluate the cyber security needs of an organization.	K4
CO2:	Understand Cyber Security Regulations and Roles of International Law.	K2
CO3:	Design and develop a security architecture for an organization.	K6
CO4:	Understand fundamental concepts of data privacy attacks	K2
CO5:	Criticize privacy issues in different domains	K5

CO-PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
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
	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-37	**SOFTWARE DEFINED RADIO**	**3**	**0**	**0**	**3**

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

UNIT I 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

Modelling Discrete Random Events in Communication Systems, Binary Communication Channels and Conditional Probability, Modelling Continuous Random Events in Communication Systems-Cumulative Distribution Functions, Time-Varying Randomness in Communication Systems-Stationary, 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 Interleaving Encoding-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 OUTCOME WITH PROGRAM OUTCOMES

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO 1	2	2	2	2	-	-	-	-	-	2	2	2	2	2
CO 2	2	2	1	2	-	-	-	-	-	1	2	2	3	2
CO 3	1	1	2	2	-	-	-	-	-	2	1	1	2	2
CO 4	2	2	1	2	-	-	-	-	-	2	2	2	2	2

CO 5	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-38	**CYBER PHYSICAL SYSTEMS**	**3**	**0**	**0**	**3**

Course Objectives:

- To provide Introduction to Microcontroller and Embedded Systems.
- To equip students with essential tools for embedded systems.
- To foster understanding through real-world applications related to embedded systems.

UNIT 1 INTRODUCTION: CYBER-PHYSICAL SYSTEM 9

Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT 1I CPS PLATFORM COMPONENTS 9

CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT 1II SYNCHRONOUS AND ASYNCHRONOUS MODEL 9

Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission.

UNIT IV SECURITY OF CYBER-PHYSICAL SYSTEMS 9

Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Counter measures, Advanced Techniques in CPS Securities.

UNIT V CPS APPLICATION 9

Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber Physical Systems, WSN based Cyber-Physical Systems, Smart Cities.

TOTAL: 45 h

TEXT BOOKS:

T1: E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.

T2: R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

T3: Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2017

REFERENCE BOOKS:

R1: Rajeev Alur, "Principles of Cyber-Physical Systems", MIT Press, 2015

R2: Fei Hu, "Cyber-Physical Systems", CRC Press 2013

WEBLINK:

W1: https://www.cs.cmu.edu/~aplatzer/course/fcps14/fcps14.pdf

W2: https://ptolemy.berkeley.edu/projects/cps/

W3: https://www.sciencedirect.com/topics/engineering/cyber-physical-systems

COURSE OUTCOMES:

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

CO1:	Understand the basics of cyber physical systems	**K2**
CO2:	Apply Embedded system concepts to solve real word problems.	**K3**
CO3:	Distinguish synchronous and Asynchronous models for Real Time applications	**K4**
CO4:	Explain and implement cyber physical system and address the problems and limitations for real world problems	**K5**
CO5:	Choose concepts, logics towards solving a unknown problem in research and industry.	**K6**

MAPPING OF COURSE OUTCOME WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2									2	2
CO2	3	3	3	3									3	3
CO3	3	3	3	3									3	3
CO4	3	3	2	2									2	2

CO5	3	2	3	3									2	3
Avg	**3**	**2.8**	**2.6**	**2.6**									**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-39	**ANDROID AND WEB DEVELOPMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop applications for current and emerging mobile computing devices, performing tasks at all stages of the software development life-cycle
- To design Web HTML and Java script

UNIT I INTRODUCTION TO ANDROID 9

Introduction to mobile technologies, mobile operation systems, Mobile devices - pros and cons, Introduction to Android, Versions, Features, Architecture, UI Widgets and Events handling, Layouts, Required tools - Eclipse, ADT, AVD, Application structure, Android Manifest file, Creating Android applications.

UNIT II OBJECTIVE C PROGRAMMING 9

Objective C-Objects and Classes, Property, Messaging, Categories and Extensions, Fast Enumeration – NS Array, NS Dictionary, Methods and Selectors, Static & Dynamic objects, Exception handling, Memory management, Swift language essentials: Arrays, Dictionaries, functions

UNIT III INTRODUCTION TO iOS 9

Introduction to i-Phone, MVC Architecture, View Controller - Building the UI and Event handling, Application life cycle, Tab Bars, Story Boards and Navigation Controllers, Table View, Push Notification, Database handling, Introduction to icloud, Webkit framework in iOS8, Deploying and publishing application.

UNIT IV WEB DESIGN - HTML MARKUP FOR STRUCTURE 9

Working of Web - HTML Mark-up for Structure - Creating simple page - Marking up text - Adding Links – Adding Images - Table Mark up - Forms – HTML

UNIT V CSS AND JAVASCRIPT 9

CSS - Formatting text - Colours and Background - Padding, Borders and Margins - Floating and positioning - Page Layout with CSS - Transition, Transforms and Animation - Javascript - Using Java Script

TOTAL : 45 hours

TEXT BOOKS:

T1: Reto Meier, "Professional Android Application Development", Wrox Edition.
T2: Stephen G. Kochan, "Programming in Objective C", Addition Wesley, 4th Edition.
T3: Reto Meier, "Professional Android Application Development", Wrox Edition.
T4: Stephen G. Kochan, "Programming in Objective C", Addition Wesley, 4th Edition.

REFERENCE BOOKS:

R1. David Mark, Jack Nutting and Jeff La Marche, "Beginning iOS 5 Development", Apress Edition.

R2: Baijian Yang, Pei Zheng, Lionel M. Ni, "Professional Microsoft Smartphone Programming", Wrox Edition.

WEBLINK:

W1: https://info448-s17.github.io/lecture-notes/introduction.html

COURSE OUTCOME:

CO1:	Explain and use key Android programming concepts.	K2
CO2:	Interpret features of Android operating systems	K3
CO3:	Design and develop user Interfaces for the Android platform	K4
CO4:	Apply Java programming concepts to Android application development.	K3
CO5:	Create Android application using database	K6

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	PS O2
CO 1	3	2	1	2	-	2	-	-	-	2	-	1	2	2
CO 2	2	2	1	2	-	2	-	-	-	2	-	1	2	2
CO 3	2	2	1	2	-	2	-	-	-	2	-	1	-	-
CO 4	2	2	1	2	-	2	-	-	-	2	-	1	2	2
CO 5	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-40	**WEB OF THINGS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To be familiar with the basic concepts and differences between IoT and WoT
- To apply the concept of WoT in application development and product design.

UNIT - 1 FROM THE INTERNET OF THINGS TO THE WEB OF THINGS 9

The Future Web of Things – Comparing IoT and WoT -Characteristics of IoT, Challenges and Issues - Set up cloud environment - Cloud access from sensors - Data Analytics for IOT- Rest Architectures

UNIT -2 WoT FUNDEMENTALS 9

Introduction to Web of Things - Web of Things architecture - Architecture standardization for WOT - WOT vs Cloud of Things - The web of Things, Resource Identification and Identifier Richardson Maturity Model.

UNIT - 3 TECHMOLOGIES 9

Introduction to IoT protocols and devices - WSNs and the Web of Things - RFID, Wireless Sensor Networks, M2M - IOT Enabling Technologies - Cloud Computing, Embedded Systems.

UNIT - 4 PROGRAMMING THE MICROCONTROLLER 9

Working principles of sensors - IOT deployment for Raspberry Pi /Arduino/Equivalent platform- Reading from Sensors, Communication: Connecting microcontroller with mobile devices - communication through Bluetooth, WiFi and USB - Contiki OS- Cooja Simulator.

UNIT - 5 APPLICATIONS & RECENT RTRENDS 9

RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition) - Green energy buildings and infrastructure, Smart farming, Smart retailing and Smart fleet management – BigData Analytics,Recent trends

TOTAL: 45 h

TEXT BOOKS:

T1: Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1 st edition, Wiley Publications, 2019.

T2: Dominique D. Guinard and Vlad M. Trifa. Building the Web of Things

T3: Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach, 1st edition, University press, 2014.

REFERENCE BOOKS:

R1: Vermesan, Ovidiu, and Peter Friess, eds. Internet of things-from research and innovation to market deployment, 1st edition, Aalborg: River publishers, 2014.

R2: Tsiatsis, Vlasios, Tsiatsis, Vlasios, Stamatis Karnouskos, Jan Holler, David Boyle, and Catherine Mulligan, Internet of Things: technologies and applications for a new age of intelligence, 2nd edition, Academic Press, 2018.

WEBLINKS:

W1: https://www.digimat.in/nptel/courses/video/106105166/L01.html

W2: https://www.digimat.in/nptel/courses/video/106105166/L05.html

W3: https://www.youtube.com/watch?v=nreFdG3HhLE

W4: https://www.youtube.com/watch?v=Ec7S9gqmLyk

COURSE OUTCOMES

CO1:	Understand the knowledge on Internet of Things (IoT) and to differentiate WOT and IoT.	**K2**
CO2:	Understand the fundamentals of WoT.	**K2**
CO3:	Analyze different Internet of Things technologies and their applications.	**K3**
CO4:	Analyze basic circuits, sensors and processor interfacing.	**K4**
CO5:	Apply the concept of Internet of Things in the real world scenarios.	**K3**

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**
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	2	2	3	2	3	-	-	-	-	-	-	-	2	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	2	1
Avg	**2.6**	**2**	**2.4**	**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**
✓	✓	✓	✓	✓	✓

OPEN ELECTIVE COURSES

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, 4th Edition 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**	**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 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 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.

R4: 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

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, 2nd Edition, 2004.

T5: J.Bhasker, "A Verilog HDL Primer", B.S.Publications, 2nd Edition, 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

REFERENCE 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, Nonideal 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 understand IoT 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, 2ndEdition, 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 develop 5G 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, 2nded., 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" Oxford Publications, 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 analyse multirate 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**
✓	✓		✓		✓

OEC – 24	MOBILE COMMUNICATION AND NETWORKS	3 0 0 3

PREREQUISITE: WIRELESS NETWORKS

COURSE OBJECTIVES:

1. To understand the working principles of the mobile communication systems.
2. To understand the relation between the user features and underlying technology.
3. To analyse 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 WIRELESS PROPAGATION CHANNELS 9

Signal propagation – Propagation mechanism – reflection, refraction, diffraction and scattering, large scale signal propagation. Fading channels – Multipath and small scale fading – Doppler shift, narrowband and wideband fading models, power delay profile, average and RMS delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

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 DEVICE-TO-DEVICE (D2D) COMMUNICATIONS 9

LTE architecture and its components ,D2D: from 4G to 5G, D2D standardization: 4G LTE D2D, D2D in 5G: research challenges, Radio resource management for mobile broadband D2D, RRM techniques for mobile broadband D2D, RRM and system design for D2D, 5G D2D RRM concept: an example, Multi-hop D2D communications for proximity and emergency,

services, National security and public safety requirements in 3GPP and METIS, Device discovery without and with network assistance.

COURSE OUTCOME:

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

CO1: Explain the principles of frequency reuse, cell splitting, channel assignment and handoff.
CO2: Analyze the various propagation mechanisms and its effects
CO3: Evaluate the various modulation schemes and reception of mobile signals
CO4: Evaluate the performance of mobile communication techniques using the various parameters
CO5: Compare the effects of the various antennas used in mobile terminals

TEXT BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.

REFERENCE BOOKS:

1. VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996
2. 5G Mobile and Wireless Communications Technology, Afif Osseiran, Jose F. Monserrat, Patrick Marsch Cambridge University Press, Second Edition 2011
3. 5G NR: The Next Generation Wireless Access Technology,Erik Dahlman, Stefan Parkvall, Johan Sko¨ld Elsevier ,First Edition 2016
4. Fundamentals of 5G Mobile Networks Jonathan Rodriguez Wiley First Edition 2010

WEB LINK:

1. NPTEL :https://nptel.ac.in/courses/108/105/108105134/ M1, M2, M3, M4, M5
2. Udemy:https://www.udemy.com/course/5g-mobile-networks-modern-wireless-communication-technology

OEC –25	5G BASED INTERNET OF THINGS	3	0	0	3

COURSE OBJECTIVES:

- To understand IoT 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:

T4: Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things-Architectures, Protocols, and Standards", Wiley 2018.

T5: 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.

T6: Viswanatha Reddy Allugunti, "Introduction to 5G Networks and Applications",2021

REFERENCE BOOKS:

R6: ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.

R7: Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols‖", Wiley, 2012.

R8: 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.

R9: Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

R10: Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.

WEBLINKS:

W4: https://archive.nptel.ac.in/courses/106/105/106105166/

W5: https://www.arduino.cc/ https://www.ibm.com/ smarterplanet/us/en /?ca =v_ smarterplanet

W6: 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 objects in 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 – 26	**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 hours : 45

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

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.

Web Links:

W1:https://nptel.ac.in/courses/108/105/108105134/

W2:https://www.udemy.com/course/5g-mobile-networksmodern-wireless-communication-technology/

ASSESSMENT METHODS

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

OEC-27	ADVANCED MOBILE COMMUNICATION	3 0 0 3

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, Retro directive Arrays, Beamforming, Adaptive Arrays, Butler Matrix, Spatial Filtering with Beam formers, 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 h

TEXT BOOKS:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press 2005.

2. Hamid Jafarkhani, "Space - Time Coding: Theory and Practices", Cambridge University Press 2005.

REFERENCE BOOKS:

1. 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.
2. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai mmWave Massive MIMO: A Paradigm for 5G

WEBLINKS:

1.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

	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**
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**
✓	✓			✓	✓