SYLLABUS

(With effect from 2024-25)

ಪಠ್ಯಕ್ರಮ

(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree

In

Electronics & Communication Engineering

V & VI Semester

Out Come Based Education

With

Choice Based Credit System

[National Education Policy Scheme]

P.E.S. College of Engineering, Mandya - 571 401, Karnataka

[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ

(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

08232- 220043, Fax : 08232 – 222075,Web : www.pescemandya.org

VISION

"PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals."

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

***P**rofessionalism*
***E**mpathy*
***S**ynergy*
***C**ommitment*
***E**thics*

Department of Electronics and Communication Engineering

The department of Electronics and Communication Engineering was incepted in 1967 with an undergraduate program in Electronics and Communication Engineering. Initially, the program had an intake of 60 students, which increased to 120 in 2012, and further increased to 180 in 2019. Almost 200 students graduate every year, and the long journey of 50 years has seen satisfactory contributions to society, the nation, and the world. The alumni of this department have a strong global presence, making their alma mater proud in every sector they represent.

The department started its PG program in 2012 in the specializations of VLSI design and embedded systems. Equipped with well qualified and dedicated faculty, the department has a focus on VLSI design, embedded systems, and image processing. The quality of teaching and training has yielded a high growth rate of placement at various organizations. The large number of candidates pursuing research programs (M.Sc. and Ph.D.) is a true testimonial to the research potential of the department. The department is recognized as a research centre by VTU, and Mysore University offers a part-time and full-time Ph.D. Program.

Vision

The department of E & C would endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfil their obligation in terms of social responsibility.

Mission

- M1: Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience conducive to imbibe technical knowledge and practicingethics.
- M2: Group and individual exercises to inculcate habit of analytical and strategic thinking to help the Students to develop creative thinking and instil team skills.
- M3: MoUs and Sponsored projects with industry and R & D organizations for collaborative learning.
- M4: Enabling and encouraging students for continuing education and moulding them for life-long learning process.

Program Educational Objectives (PEOs)

- **PEO1:** Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia.
- **PEO2:** Graduates to identify analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements.
- **PEO3:** Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.

Program Outcomes (POs)

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineeringsciences.
- **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.
- **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.
- **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 thelimitations.
- **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.
- **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.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.
- **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 clearinstructions.
- **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 multi disciplinary environments.
- **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.

Program Specific Outcomes (PSOs)

Electronics and Communication Engineering Graduates will be able to

- **PSO1:** An ability to understand the basic concepts in Electronics and Communication Engineering and to apply them in the design and implementation of Electronics and Communication Systems.
- **PSO2:** An ability to solve complex problems in Electronics and Communication Engineering, using latest hardware and software tools, along with analytical skills to arrive at appropriate solutions.

Bachelor of Engineering (V –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T	P	PJ		CIE	SEE	Total
1	P22EC501	Innovation Entrepreneurship and Management	EC	3	-	-	-	3	50	50	100
2	P22EC502	Digital CMOS VLSI Design	EC	3	-	-	-	3	50	50	100
3	P22EC503X	Professional Elective Course - I	EC	3	-	-	-	3	50	50	100
4	P22EC504	Digital Signal Processing (Integrated)	EC	3	-	2	-	4	50	50	100
5	P22EC505	Control Systems	EC	3	-	-	-	3	50	50	100
6	P22ECL506	Circuit Simulation Laboratory	EC	-	-	2	-	1	50	50	100
7	P22ECINT507	Internship - II	EC	-	-	-	-	2	-	100	100
8	P22HSMC508B	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9	P22UHV509	Social Connect and Responsibility	EC	1	-	-	-	1	100	-	100
Total								**21**	500	500	1000

Professional Elective Course – I (P22EC503X)	
Course Code	**Course Title**
P22EC5031	Fundamentals of object oriented Language and Data structures
P22EC5032	System Verilog
P22EC5033	Computer Organization
P22EC5034	ARM Processor

Bachelor of Engineering (VI –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T	P	PJ		CIE	SEE	Total
1	P22EC601	Analog CMOS VLSI Design	EC	3	-	-	-	3	50	50	100
2	P22EC602X	Professional Elective Course – II	EC	3	-	-	-	3	50	50	100
3	P22EC603X	Professional Elective Course - III	EC	3	-	-	-	3	50	50	100
4	P22EC604	Microwave and Antenna (Integrated)	EC	3	-	2	-	4	50	50	100
5	P22ECO605X	Open Elective – II	EC	3	-	-	-	3	50	50	100
6	P22ECL606	VLSI Laboratory	EC	-	-	2	-	1	50	50	100
7	P22ECMP607	Mini – Project	EC	-	-	2	2	2	50	50	100
8	P22HSMC608B	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9	P22UHV609	Universal Human Values and Professional Ethics	EC	1	-	-	-	1	50	50	100
Total								**21**	550	450	1000

Professional Elective Course – II (P22EC602X)	
Course Code	**Course Title**
P22EC6021	ITC and Multimedia
P22EC6022	DSP Processor and Applications
P22EC6023	Embedded Systems
P22EC6024	Operating System

Professional Elective Course – III (P22EC603X)	
Course Code	**Course Title**
P22EC6031	Radar and Navigational Systems
P22EC6032	Digital Image Processing
P22EC6033	Design for Testability
P22EC6034	Artificial Intelligence and Machine Learning in VLSI

Open Elective – II (P22ECO605X)	
Course Code	**Course Title**
P22ECO6051	Electronic Instrumentation
P22ECO6052	Introduction to Embedded Systems
P22ECO6053	Introduction to Image Processing
P22ECO6054	Automotive Electronics

L: Lecture	T: Tutorial	CIE: Continuous Internal Evaluation
P: Practical/ Drawing	PJ: Project	SEE: Semester End Examination

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Innovation, Entrepreneurship and Management**		
Course Code: **P22EC501**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Nil		
Course learning Objectives:		
CLO1: Relate the role and importance of innovation in economic growth, skills of innovator, types of innovation and output forms of innovation. CLO2: Understand various ways to create and manage intellectual property and prepare innovation proposal. CLO3: Understand the entrepreneurial development process and recognize the core role of creativity and innovation in managing the entrepreneurial process effectively. CLO4: Understand the fundamental concepts and principles of management, including the basic roles, skill, and functions of management. CLO5: Understand the procedure of creating an ownership and its types. CLO6: Express the meaning of Professional Ethics, its importance and needs.		
UNIT - I		**8 Hours**
Introduction to Innovation and Innovator: Introduction, understanding Innovation, Creativity and Research, Role of Innovation in economic growth of country, companies and community, phases of innovation journey, Roles of Innovator.		
Self-Study Content: 1. Prepare a Case study of An Innovator: How did he/she find the problem, thought about a solution and steps/situations came across during implementation.		
Textbook Map: **Text 1: Chapter 1 to 5**		
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Chalk and board		
UNIT – II		**8 Hours**
Innovator Skills and Innovation: Introduction to Innovative Skills, Types of Innovation, Introduction to patents and IP, preparing an innovation proposal Pitching an innovation proposal, Sustaining innovation.		
Self-Study Content: 1. Explore the innovative projects from IDC School of Design http://www.idc.iitb.ac.in/project/faculty-projects		
Textbook Map: **Chapter 6 to 13**		
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Quiz		
UNIT - III		**8 Hours**
Entrepreneurship and Entrepreneurs: Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an Entrepreneur & a Manager, Functions of an Entrepreneur, Types of Entrepreneur. Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.		
Self-Study Content: 1. Prepare a Case Study of an Entrepreneur / an Enterpriser or an Enterprise.		

Textbook Map: **1.1 to 1.10, 2.1 to 2.3**	
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Quiz	
UNIT - IV	**8 Hours**
Management and Business Ownership: Fundamentals of Management: Meaning of Management, Management as Science, Art & Profession, Importance of Management, Scope of Management, Functions of Management, Management Process, Principles of Management. Forms of Business Ownership: Sole Proprietorship, Partnership, Company, Cooperative, Selection of Appropriate Form of Ownership Structure.	
Self-Study Content: 1. Being in different positions as an employee: Understanding Self, Self-Management& Understanding others for Effective Relationships and Communication.	
Textbook Map: **24.1 to 24.9 & 18.1 to 18.5**	
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Chalk and board	
UNIT - V	**8 Hours**
Engineering and Professional Ethics: Making a Case: Introduction, Role Morality, What is a Profession?, Professional Ethics, The NSPE Board of Ethical Review, Engineering Ethics as Preventive Ethics **Honesty:** Introduction, Ways of Misusing Truth, Why is Dishonesty Wrong? **International Engineering Professionalism:** Introduction, Problems in International Professionalism, Problems in Interpreting and Applying the Codes, Striking a Balance, Guidelines for Interpreting the Codes: Human Rights, Avoiding Paternalism and Exploitation and Applying the Golden Rule, Bribery-Extortion-Grease Payments and Gifts.	
Self-Study Content: 1. Survey and Study the importance of Professional Ethics	
Textbook Map: **Text 3: 1.1 to 1.6, 6.1 to 6.3 & 10.1 to 10.8**	
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Case Study 3. Quiz	

Course Outcomes: At the end of the course students should be able to :
CO1: **Identify** the innovation phases and skills required for innovation
CO2: **Examine** the role of management in an organization
CO3: **Analyze** entrepreneurship with necessary theories
CO4: **Distinguish** among various types of business ownership and selecting appropriate form of ownership structure.
CO5: I**nterpret** the role of professional ethics including international engineering professionalism

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	A Conversation with the Innovator in You, Sudeendra Koushik and Pragya Dixit, Kindle Direct Publishing, ISBN-13: 978-152051271.			
2	Entrepreneurial Development, by Dr S S Khanka, S Chand & Company Ltd. ISBN-13: 978-8121918015.			
3	Engineering Ethics (2nd edition), Charles E. Harris, Michel S. Pritchard and Michel J. Rabins, Thomson Wadsworth Asia Pte Ltd, ISBN: 981-243-676-6.			

Reference Books:
Six thinking hats by Edward De bono, Penguin Books (2000). ISBN 10: 0140296662 ISBN 13: 9780140296662.
Entrepreneurship by Robert D Hisrich, Micheal P Peters, Dean A Shepherd, 6/e, TataMcGraw – Hill Companies. ISBN-10: 0078029198.
Principles and practice of management – L. M. Prasad. ISBN-13: 9789351610502

Web links and Video Lectures (e-resources)
1. Principles of Management By Prof. UshaLenka, IIT Roorkee https://onlinecourses.nptel.ac.in/noc23_mg33/preview 2. Design, Technology and Innovation By Prof. B.K. Chakravarthy, IIT Bombay https://onlinecourses.nptel.ac.in/noc24_de14/preview

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Digital CMOS VLSI Design**		
Course Code: **P22EC502**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Basic Electronics Circuits, Digital Logic Design

Course learning Objectives:

CLO1: Discuss the VLSI Design Flow, MOS Structure, and the MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current–Voltage Characteristics.

CLO2: Analyze the MOS Inverters, Static Characteristics, Switching Characteristics and Interconnect Effects.

CLO3: Examine the static and dynamic characteristics of Combinational MOS logic circuits and Pass Transistor Circuits.

CLO4: Explain the SR Latch Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High–Performance Dynamic CMOS Circuits.

CLO5: Examine the MOS Technology and MOS circuit design processes.

UNIT - I	**8 Hours**

Introduction: Historical Perspective, VLSI Design Flow,
MOS Transistor: The Metal Oxide Semiconductor(MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current –Voltage Characteristics.

Self-Study Content: 1. Understand the concept of Design hierarchy in VLSI and VLSI Design Styles.

Textbook Map: **1.1, 1.5, 3.1 to 3.4.**

Teaching Learning Process: Quiz

UNIT – II	**8 Hours**

MOS Transistor: MOSFET Scaling and Small geometry effects, MOSFET Capacitance
MOS Inverters, Static Characteristics: Introduction, CMOS Inverter: Calculation of V_{IL}, V_{IH}, and V_{th}, Design of CMOS Inverter, Supply Voltage Scaling in CMOS Inverter.

Self-Study Content: 1. Understand the working of Super buffer Design and Switching Power Dissipation of CMOS Inverter

Textbook Map: **3.5, 3.6, 5.1, 5.4,**

Teaching Learning Process: Simulation using Modern Tools

UNIT - III	**8 Hours**

Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Interconnect Delay.
Combinational MOS Logic Circuits: Introduction, CMOS Logic Circuits, Complex Logic Circuits, Basic Principles of Pass Transistor Circuits, CMOS Transmission Gates (Pass Gates).

Self-Study Content: 1. Modeling of MOS Transistor using SPICE: Know about MODEL statement in SPICE. Plot O/P characteristics of N-MOS and P-MOS transistors and C-MOS inverter using, LEVEL-1 and LEVEL-2 model in SPICE and Scilab/Math lab.

Textbook Map: **6.1, 6.2, 6.6, 7.1, 7.3, 7.4, 7.5, 9.2**	
Teaching Learning Process: Simulation using Modern Tools	
UNIT - IV	**8 Hours**
Sequential MOS Logic Circuits: Introduction, SR Latch Circuit **Dynamic Logic Circuits:** Introduction, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High–Performance Dynamic CMOS Circuits (Including only Domino CMOS logic).	
Self-Study Content: 1. Understand the concept of Clocked Latch and Flip-Flop Circuits 2. Explore the CMOS D-Latch and Edge Triggered Flip-Flop.	
Textbook Map: **8.1, 8.3, 9.1, 9.3 to 9.6**	
Teaching Learning Process: Simulation using Modern Tools	
UNIT - V	**8 Hours**
Introduction to MOS Technology: nMOS Fabrication, CMOS Fabrication, Thermal Aspects of Processing, Latch-up in CMOS Circuits. **MOS Circuits Design Processes:** MOS Layers, Design rules and Layout, General Observations on the Design rules.	
Self-Study Content: 1. Understand the Concept of BiCMOS Technology and BiMOS Circuits Design Processes	
Textbook Map: **1.7, 1.8, 1.9, 2.13, 3.1, 3.3, 3.4.**	
Teaching Learning Process: Flipped Classroom	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the basic knowledge of Physics and mathematics to understand the VLSI Design Flow, MOS Technology and derive the different current equations of MOS circuits.
CO2: **Interpret** the working of MOSFET, MOS Technology and MOS circuit design processes.
CO3: **Analyze** the MOSFET, MOS circuits, CMOS circuits and MOS Technology
CO4: **Create** the Combinational, Sequential and Dynamic MOS circuits for the given specifications and Simulate the circuits using modern tools

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	CMOS Digital Integrated Circuits Analysis and Design, Sung Mo Kang, Yusuf Leblebici, 3rd edition, McGraw Hill Education 2003, ISBN-13: 978-0-07-053077-5, ISBN-10:0-07-053077-7.			
2	Basic VLSI Design, Douglas A. Pucknell, Kamran Eshraghian, 3rd edition 2006, PHI, ISBN: 978-81-203-0986-9.			

Reference Books:

Introduction to VLSI Circuits and Systems, John .P. Uyemura, John Wiley, 3rd edition 2002. ISBN: 978-81-265-0915-7

Principles of CMOS VLSI Design, Neil. H. E. Weste, Kamran Eshraghian, 3rd edition, Pearson Education 2005, ISBN:978-81-317-6467-1.

Web links and Video Lectures (e-resources)
1. https://archive.nptel.ac.in/courses/108/107/108107129/ 2. https://www.youtube.com/watch?v=Iv4Cj2A3ldw&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=3

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Fundamentals of Object Oriented Language and Data Structures**		
Course Code: **P22EC5031**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Basic programming skills and understanding of variables, loops, and conditionals.
2. Experience with a programming language, such as C or Python.
3. Strong logical thinking and problem-solving abilities.
4. Basic knowledge of simple algorithms like sorting and searching.
5. Understanding of computer science basics, including memory management and data types.

Course learning Objectives:

CLO1: Explain the significance of object oriented concepts.
CLO2: Describe the concept of class, objects and methods in Java.
CLO3: Apply the concepts of inheritance and interfaces in Java.
CLO4: Illustrate usage of packages, string handling and exception handling in Java.
CLO5: Illustrate linear lists with arrays and linked lists, including singly, circular, and doubly linked lists.
CLO6: Analyze stacks and queues, their uses, and applications like parenthesis matching and railroad car rearrangement.

UNIT - I	**8 Hours**

Fundamentals of Object Oriented Programming: Introduction, Object oriented paradigm, Basics concepts of object oriented programming, Benefits of object oriented programming, Applications of object oriented programming.
Java: Features, Simple Java Program, Java Program Structure, Data types, Operators overview.
Decision Making and Branching: if, if else, else if ladder, nesting of if else statements, switch.
Decision Making and Looping: do, while, for, Jumps in loops.

Self-Study Content: 1. Illustrate the application of variables Labelled Loops.

Textbook 1 Map: **1.1-1.5, 2.2, 3.2, 3.5, 4.4, 4.5, 5.1-5.9, 6.2-6.7, 7.2-7.5.**

Teaching Learning Process: Lectures with Multimedia Presentations.

UNIT – II	**8 Hours**

Classes, Objects and Methods: Introduction, Defining a class, Fields declaration, Methods declaration, Creating objects, Accessing class members, Constructors, Method Overloading, Static members, Nesting of Methods, Inheritance, Overriding methods.
Arrays: Creating array, 1D array and 2D array.

Self-Study Content: 1. Use the concept of Inheritance to develop a java program using: subclasses.

Textbook 1 Map: **8.1-8.12, 9.2-9.3.**

Teaching Learning Process: Peer Instruction.

UNIT – III	8 Hours
Strings: String Arrays, String Methods. **Interfaces:** Introduction, Defining interfaces, Extending interfaces, implementing interfaces **Packages:** Introduction, Java API packages, Using System packages, Naming conventions, creating packages, accessing a package, using a package, adding a class to a package.	
Self-Study Content: 1. Develop a java program which access interface variables and String buffer class.	
Textbook 1 Map: **9.5, 10.1-10.4, 11.1-11.8.**	
Teaching Learning Process: Flipped Classroom.	
UNIT – IV	**8 Hours**
Stacks: Definition and Applications, The Abstract Data Type, Array Representation- Linked Representation, Applications- Parenthesis Matching, Towers of Hanoi, Rearranging railroad cars. **Queues**: Definition and Applications, The Abstract Data Type, Array Representation- Linked Representation, Applications- Railroad Car Rearrangement.	
Self-Study Content:1. Understand the concept of Singly Linked Lists & Write a Java program for sorting using linked lists. 2. Explore the use of Data Structures in the application - Rat in a Maze.	
Textbook 2 Map: **9.1,9.2,9.3,9.5,9.5.1,9.5.2,9.5.3,10.1,10.2,10.3,10.4,10.5,10.5.1.**	
Teaching Learning Process: Problem-Based Learning.	
UNIT - V	**8 Hours**
The Greedy Method: Optimization Problems, The Greedy Method, Applications - Container Loading, 0/1 Knapsack Problem, Topological Sorting, Bipartite Cover, Single-Source Shortest Paths, Minimum-Cost Spanning Trees. **Divide and Conquer:** The Method, Applications - Defective Chessboard, Merge Sort, Quicksort, Selection, Closest Pair of Points, Solving Recurrence Equations, Lower Bounds on Complexity - Lower Bound for the Minmax Problem, Lower Bound for Sorting.	
Self-Study Content: 1. Write a Java code to sort a given random number using the Divide & Conquer algorithm in Java. 2. Study the concept of Dynamic programming algorithms and highlights their advantages.	
Textbook 2 Map: **18.1,18.2,18.3,18.3.1-18.3.6,19.1,19.2,19.2.1-19.2.5,19.3,19.4,19.4.1,19.4.2.**	
Teaching Learning Process: Assessment for Learning.	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the basic knowledge of programming in understanding concept of OOPS and Data structures in Java Programming.
CO2: **Analyze** the problem statement and develop Java program.
CO3: **Develop** Java program using OOPS.
CO4: **Interpret** the required elements of data structures for implementing given requirements.
CO5: **Illustrate** mechanism Data structure and OOPS.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Programming with JAVA: A Primer, E Balagurusamy, 6th edition Tata McGraw Hill. ISBN 13: 978-93-5316-233-7, ISBN 10:-93-5316-233-5.			
2	Data Structures, Algorithms and Applications in JAVA – SartajSahni, 2nd edition, Universities Press (India) Private Limited, 2005, ISBN 81-7371-523-8.			

Reference Books:
The Complete Reference JAVA, J2SE, Herbert Schildt, 6th edition, Tata McGraw Hill, 2010. ISBN-0070598789.
Data Structures and Algorithms in Python, Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Wiley, 2013, ISBN- 11-1829-027-5

Web links and Video Lectures (e-resources)
1. Java Programming - https://nptel.ac.in/courses/106/105/106105191/. 2. https://www.youtube.com/watch?v=8hly31xKli0.

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **System Verilog**		
Course Code: **P22EC5032**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Digital Logic Design
2. C Programming
3. Verilog HDL

Course learning Objectives:

CLO1: Develop an understanding of the System Verilog language constructs.
CLO2: Introduce the facilities and features of System Verilog for unified Design.
CLO3: Illustrate the testing and verification in System Verilog Design.
CLO4: Introduce the programming approach for testing and verification.
CLO5: Provide framework of System Verilog for functional coverage.

UNIT - I	**8 Hours**

Verification Guidelines: The Verification Process, Basic Test Bench Functionality, Directed testing, Methodology Basics, Constrained Random Stimulus, Functional Coverage, Testbench Components, Layered Test bench.

Data Types: Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width.

Procedural Statements and Routines: Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview, Routine Arguments, Returning from a Routine, Local Data Storage, Time Values.

Self-Study Content: 1. Analyze different Synthesizable Constructs in System Verilog. (Refer: Synthesizing System Verilog Busting the Myth that System Verilog is only for Verification by Stuart Sutherland and Don Mills)

Textbook Map: **1.1,1.3-1.10,2.1-2.16, 3.1-3.7.**

Teaching Learning Process: 1. Power Point Presentation with Demonstration
2. Reading of IEEE LRM for System Verilog

UNIT – II	**8 Hours**

Basic OOPs: Your First Class, Where to Define a Class, Creating New Objects, Object De allocation, Using Objects, Class methods, Defining methods outside of the class. Static Variables vs. Global Variables, Scoping Rules, Using One Class inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Private Straying off Course, Building a Test bench.

Self-Study Content: 1. Understand different System Verilog Macro's and their usage for developing System Verilog instances.

Textbook Map: **5.3-5.18.**

Teaching Learning Process: 1. Power Point Presentation with Demonstration
2. Reading of IEEE LRM for System Verilog
3. Quiz

UNIT – III	8 Hours
Randomization and Constraints: Introduction, What to Randomize, Randomization in System Verilog, Constraint Details, Solution Probabilities, Controlling Multiple Constraint Blocks, Valid Constraints, In-line Constraints. The pre_randomize and post_randomize Functions, Random Number Functions, Constraints Tips and Techniques, Common Randomization Problems. Iterative and Array Constraints, Atomic Stimulus Generation vs. Scenario Generation, Random Control, Random Number Generators, Random Device Configuration.	
Self-Study Content: 1. Using Randomization Methods Write a test bench in system verilog.	
Textbook Map: **6.1-6.17.**	
Teaching Learning Process: 1. Power Point Presentation with examples and illustrations 2. Reading of IEEE LRM for System Verilog 3. Quiz	
UNIT – IV	**8 Hours**
Threads and Inter Process Communication: Working with Threads, Disabling Threads, Inter process Communication, Events, Semaphores, Mailboxes, Building a Test bench with Threads and IPC.	
Self-Study Content: 1. Develop system verilog code using Built in class process and related methods to control the process in Inter Process Communication.	
Textbook Map: **7.1-7.7.**	
Teaching Learning Process: 1. Power Point Presentation with Brain Storming Session 2. Use cases analysis with examples 3. Quiz 4. Expert talk	
UNIT – V	**8 Hours**
Functional Coverage: Gathering Coverage Data, Coverage Types, Functional Coverage Strategies, Simple functional Coverage examples, Anatomy of a cover group, triggering a cover group. Data Sampling, Cross coverage, Generic cover groups, Coverage Options, Analyzing Coverage Data, and Measuring Coverage Statistics during simulation, System Verilog Assertions.	
Self-Study Content: 1. Summarize the concepts of functional coverage constructs and functional coverage flow.	
Textbook Map: **9.1-9.12, 4.8.**	
Teaching Learning Process: 1. Power Point Presentation with Brain Storming Session 2. Use cases analysis with examples 3. Expert talk	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of Verilog and Digital Design to understand the System Verilog language constructs.
CO2: **Summarize** the System Verilog OOPs facilities and framework for the verification.
CO3: **Develop** programs by applying the System Verilog facilities and framework.
CO4: Explore and Understand **Modern Software tools** to perform different operations in System Verilog.
CO5: **Interpret** and **analyze** the given code for logical & design anomalies.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	System Verilog for Verification: A Guide to Learning the Test bench Language Features, Chris Spear, Springer-Verlag New York, Inc, 3rd edition, ISBN 978-1-4614-0714-0, 2012.			

Reference Books:
Hardware Verification with System Verilog (An Object Oriented Framework), Mike Mintz and Robert Ekehndal, Springer, USA, ISBN 0-387-71738-2, 2007.
System Verilog For Design A Guide to Using System Verilog for Hardware Design and Modeling", Stuart Sutherland, Simon Davidmann and Peter Falke, Springer, USA, ISBN 9781475766820, 1475766823, 2013.

Web links and Video Lectures (e-resources)
1. https://youtu.be/U18k9TDP5uw?si=gS3EMTBTFvoqj3LE 2. https://youtu.be/aNzTS1otRrs?si=XwJNweNiYcvxcTZ8

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Computer Organization**		
Course Code: **P22EC5033**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Basic knowledge of digital logic design and experience with programming Additionally, an introductory understanding of computer architecture, including CPU operations and memory hierarchy, is recommended.

Course learning Objectives:

CLO1: Conceptualize the basics of Organizational issues of a digital computer and compare the performance of machine instruction.
CLO2: Expose different ways of communication with I/O Devices.
CLO3: Notice how to perform computer arithmetic operation.
CLO4: Understand working of processing unit using different bus structures.
CLO5:Illustrate different Types of memory devices with their principles.

UNIT - I	**8 Hours**

Basic Structure of Computers: Basic operational Concepts, Performance.
Instruction Set Architecture: Memory Location and Addresses, Memory Operations, Instruction and Instruction Sequencing, Addressing Modes, Assembly Language,Stacks.

Self-Study Content: 1. Prepare a report on historical perspectives of electronic digital computers.

Textbook Map: **1.3 to 1.6 Ch 2:2.1-2.6**

Teaching Learning Process: Think Pair share- peer teaching

UNIT – II	**8 Hours**

Instruction Set Architecture: (Continued): Subroutines, Additional instructions.
Basic Input/Output: Accessing I/O Devices-I/O Device Interface, Program Controlled I/O, Interrupts-Enabling and Disabling Interrupts, Handling Multiple Devices, Exceptions.
Input/ Output Organization: Bus Structure, Bus Operation-Synchronous Bus, Asynchronous Bus, Arbitration.

Self-Study Content: 1. Understand the interconnection standards such as USB, SATA

Textbook Map: **2.7, 2.8.Ch 3:3.1.1,3.1.2,3.2.1,3.2.2,3.2.6.Ch 7:7.1,7.2.1,7.2.2,7.3**

Teaching Learning Process: Flipped Classroom

UNIT - III	**8 Hours**

Software: The Assembly Process, Loading and Executing Object Programs, The Linker, Libraries, The Compiler, The Debugger, Using a High-level Language for I/O Tasks, Interaction between Assembly Language and C Language, The Operating System

Self-Study Content: 1. Basics of Pipelining

Textbook Map: **4.1 - 4.9**

Teaching Learning Process: Quizzes and Assessments

UNIT - IV	**8 Hours**

Basic Processing Unit: Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control

Self-Study Content: 1. Compare and contrast performance evaluation of non-pipelined processor and pipelined processor.

Textbook Map: **5.1 to 5.6.**	
Teaching Learning Process: Mentorship and Peer Learning	
UNIT - V	**8 Hours**
The Memory System: Basic Concepts, Semiconductor RAM Memories, Read-only Memories, Direct Memory Access, Memory Hierarchy, Cache Memories, Virtual Memory, Memory Management Requirements.	
Self-Study Content: 1. Memory Management Requirements.	
Textbook Map: **Ch 8.1-8.6, 8.8**	
Teaching Learning Process: Seminars with Backup Videos/Assignment	

Course Outcomes: At the end of the course students should be able to :

CO1: **Understand** the operation and organization of a digital computer system.
CO2: **Apply** the knowledge of assembly language/ algorithmic techniques to solve the given problem.
CO3: **Analyze** the given assembly language code snippet.
CO4: **Describe** the operation of memory modules.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Computer Organization and Embedded Systems	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Tata McGraw Hill	6th Edition	ISBN-13: 978-9355323729

Reference Books:

1	Computer Organization &Architecture	William Stallings	9th Edition	PHI, 2013
2	Computer Systems Design and Architecture	Vincent P. Heuring & Harry F. Jordan	2nd Edition	Pearson Education, 2004

Web links and Video Lectures (e-resources)

1. Introduction to Computer System and its Submodules https://nptel.ac.in/courses/106103068
2. Computer Architecture and Organization, IIT Kharagpur by Prof. Indranil Sengupta and Prof. Kamalika Datta https://archive.nptel.ac.in/courses/106/105/106105163/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **ARM Processor**		
Course Code: **P22EC5034**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Knowledge of digital electronics.
2. Familiarity with hardware description languages like Verilog or VHDL.
3. Basic knowledge of assembly programming.
4. Knowledge of microcontroller architecture and applications.

Course learning Objectives:

CLO1: Understand basic components of embedded systems and its characteristic attributes
CLO2: Demonstrate the communication interface required to develop an embedded system
CLO3: Understand Memory system, exceptions and interrupt control.
CLO4: Provide the knowledge of fault interrupt behavior, Cortex-M3 and Exceptions programming.
CLO5: Develop a code for the embedded system using Embedded C.
CLO6: Choose proper IDE for the design and follow the recent trends in the embedded system design.

UNIT - I	**8 Hours**

Introduction to Embedded Systems: What is an Embedded System, Embedded Systems Overview, History of Embedded Systems, Classification of Embedded Systems, Major Application Area of Embedded Systems, Purpose of Embedded Systems
Introduction to ARM: What Is the ARM Cortex-M3 Processor, Background of ARM and ARM Architecture, Instruction Set Development, The Thumb-2 Technology and Instruction Set Architecture (ISA), Cortex-M3 Processor Applications

Programming in Embedded C: Embedded C, Compiler vs. Cross Compiler, Using C in Embedded C, Storage classes, Arrays and Pointers, Function Pointers, Structures and Unions, Pre-Processors and Macros, Constant Declarations, Volatile

Self-Study Content: 1. Study the C programming for advanced Cortex processors.
2. Discuss the various advantages of using Cortex-M3.

Textbook Map 1: **1.1 - 1.6.**
Textbook Map 2: **1.1 – 1.5, 9.3.1, 9.3.2, 9.3.3 9.3.3.3, 9.3.3.9, 9.3.3.12 - 9.3.3.16**

Teaching Learning Process: Classroom teaching

UNIT – II	**8 Hours**

Overview of the Cortex-M3:
Fundamentals, Registers, Operation Modes, The Pipeline, A Detailed Block Diagram, Bus Interfaces on the Cortex-M3, Other Interfaces on the Cortex-M3, The External Private Peripheral Bus, Typical Connections, Reset types and Reset Signals
Memory Systems: Memory System Features Overview, Memory Maps, Memory Access Attributes, Default Memory Access Permissions, Bit-Band Operations, Unaligned Transfers, Exclusive Accesses, Endian Mode.

Self-Study Content: 1. Identify the advantages and disadvantages of big Endian and little-Endian processor.
2. Identify the different reset signals in Cortex-M3.

Textbook Map 2: **5.1 - 5.8, 6.1 - 6.7**	
Teaching Learning Process: Flipped classroom	
UNIT - III	**8 Hours**
Exceptions: Exception Types, Definitions of Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions, **The NVIC and Interrupt Control:** NVIC Overview, the Basic Interrupt Configuration, Example Procedures in Setting up an Interrupt, Software Interrupts **Interrupt Behavior:** Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals, More on the Exception Return Value, Interrupt Latency, Faults Related to Interrupts.	
Self-Study Content: 1. Discuss the applications of Systick timer. 2. Understand the concept of supervisor calls and pendable service call	
Textbook Map 2: **7.1 - 7.5, 8.1 - 8.4, 9.1 - 9.8**	
Teaching Learning Process: Postal presentation	
UNIT - IV	**8 Hours**
Cortex-M3 Programming: A Typical Development Flow, CMSIS, Linker Script , makefiles. **Embedded networks:** communication interface. Onboard communication interface –I2C, SPI, UART. External communication interface- CAN and RS-485, USB, Bluetooth (BT). Need for Device drivers.	
Self-Study Content: 1. Understand communication protocols implementation. 2. Design and develop any one communication protocol as per current industry need using Cortex-M3 and embedded C.	
Textbook Map 1: **10.1 - 10.2, 10.4** Textbook Map 2 : **2.4, 2.4.1.1 to 2.4.1.3 , 2.4.2 , 2.4.2.1 ,2.4.2.2 , 2.4.2.4, 2.4.2.5, 10.9**	
Teaching Learning Process: Case study	
UNIT - V	**8 Hours**
Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization, how to Choose an RTOS. Debugging	
Self-Study Content: 1. Analyze Threads, Processes and Scheduling: Putting them all together with programming for cortex-M3 2. Understand different methods of task communication.	
Textbook Map 1: **10.1 to 10.5, 10.8, 10.10**.	
Teaching Learning Process: Seminar	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems CO2: **Analyze** the different issues involved in embedded system development using real time operating systems. CO3: **Analyze** and **relate** various communication interfaces involved in designing embedded applications. CO4: **Develop** embedded system applications for a given specification using embedded firmware. CO5: **Build** Embedded system applications using Modern tools to meet the current industry requirements.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1.	Introduction to Embedded Systems	Shibu K V, Tata McGraw Hill	2nd edition	ISBN 13: 978-0-07-014589-4.
2.	The Definitive Guide to the ARM Cortex-M3	Joseph Yiu	2nd edition	Newnes, (Elsevier), ISBN:978-0-7506-8534-4,2007.

Reference Books:				
1.	Embedded Systems – A contemporary Design Tool	James K Peckol, John Wiley	2008	ISBN 978-0-470-66000-3
2.	Embedded Systems Design, An Introduction to Processes, Tools, and Techniques	Arnold S. Berger	-	ISBN:1578200733 CMP Books

Web links and Video Lectures (e-resources)

1. https://youtu.be/TP1_F3IVjBc
2. https://nptel.ac.in/courses/108105057

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Digital Signal Processing (Integrated)**		
Course Code: **P22EC504**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 2	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 4		
Prerequisite: Mathematics, signals & Systems, Probability and Statistics, Fourier Analysis.		
Course learning Objectives:		
CLO1: Provide the knowledge of DFT/ IDFT and its various properties. CLO2: Explain the different Fast–Fourier–Transform (FFT) algorithms along with its applications. CLO3: Understand the design procedure of IIR filters and FIR filters using different techniques. CLO4: Design the IIR filters from analog filters using different methods. CLO5: Implementation scheme of IIR and FIR filters using different methods. CLO6: Exposure to different applications of DSP.		
UNIT - I		**8 Hours**
Discrete Fourier Transforms (DFT): Frequency Domain Sampling and Reconstruction of discrete-time Signals, Discrete Fourier Transforms, DFT as a linear transformation, its relationship with other transforms. Properties of DFT– Periodicity, linearity and Symmetry Properties, Multiplication of two DFTs–the circular convolution, use of DFT in linear filtering, overlap–save and overlap–add method.		
Self-Study Content: 1. Explore the Additional properties of DFT (circular-time shift, Circular- frequency shift, Time reversal, circular convolution, Parseval's relation). 2. Discuss the application of DFT		
Practical Topics:	**1.** Develop MATLAB code for Computation of the N point DFT and IDFT of a given sequence and to plot magnitude and phase spectrum. **2.** Develop MATLAB code Circular convolution of the two given sequences without using function and using DFT and IDFT. **3.** Develop MATLAB code for Linear convolution using DFT and IDFT without using inbuilt function and simulate.	
Textbook Map: **7.1.1 ,7.1.2, 7.1.3, 7.1.4, 7.2.1 7.2.2, 7.2.3, 7.3.1**		
Teaching Learning Process: 1. Flip Class 2. Assignment		
UNIT – II		**8 Hours**
Fast–Fourier–Transform (FFT) Algorithms: Efficient computation of the DFT (FFT algorithms), Direct computation of DFT, Goertzel algorithm, and chirp–z transform. Radix–2 FFT algorithm for the computation of DFT and IDFT–decimation in–time and decimation–in –frequency algorithms.		
Self-Study Content: 1. Using different tools develop simulations for applications of FFT algorithm.		

Practical Topics:	**1.** Develop MATLAB code for computing the frequency spectrum of a given sequence using FFT and IFFT. **2.** Develop MATLAB code for Autocorrelation and Cross correlation of the given sequence and verification of its properties. **3.** Develop MATLAB code for voice and Music. Plot the spectrum.
Textbook Map: **Text 1: 8.1, 8.1.1, 8.1.2, 8.1.3, 8.1.5, 8.1.6, 8.2**	
Teaching Learning Process: 1. Flip Class 2. Assignment	
UNIT - III	**8 Hours**
FIR Filter Design: Characteristics of Practical Frequency Selective filters, FIR filter design: Introduction to FIR filters, design of FIR filters using – Rectangular and Hamming windows, FIR filter design using frequency sampling technique	
Self-Study Content: 1. Explore the concept of Hanning window, Blackmann window	
Practical Topics:	**1.** Design and Develop MATLAB code for FIR Filters to meet the given specifications using Simulink. **2.** Experiments Using Digital Signal Processor (TMS320c54xx) and Code Composer Studio (CCS). a. Circular convolution of the two given sequences.
Textbook Map: **10.1.2, 10.2.1, 10.2.2, 10.2.3, 10.4**	
Teaching Learning Process: Design and Simulate the different types of FIR and IIR Filter using open source tools	
UNIT - IV	**8 Hours**
Design of IIR Filters From Analog Filters (Butterworth and Chebyshev): Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformations. Impulse invariance method. Mapping of transfer functions: Approximation of derivative (Bilinear transformation) method.	
Self-Study Content: 1. Understand the concept Matched z transforms. 2. Understand and design the transform the analog filter H(S) = $\frac{S+3}{(S+1)(S+2)}$ to a digital filter using Matched Z-Transform (T=0.5sec).	
Practical Topics:	**1.** Design and develop MATLAB code for IIR Filters to meet the given specifications using Simulink. **2.** Experiment Using Digital Signal Processor (TMS320C54xx) and Code Composer Studio (CCS): Computation of the N Point DFT of a given sequence.
Textbook Map: **10.3.1, 10.3.2, 10.3.3 ,10.3.4,10.4.1**	
Teaching Learning Process: Design and Simulate the different types of FIR and IIR Filter using open source tools	
UNIT - V	**8 Hours**
Implementation of Discrete–Time Systems: Structures for IIR and FIR systems– direct form I and direct form II systems, cascade and parallel realization, Applications of DSP	
Self-Study Content: 1. Understand the concept Speech processing with different application.	

Practical Topics:	**1.** Analyze the impulse response and step response of a system using MATLAB/SIMULINK **2.** Analyze the operation of Basic Communication model using Simulink. Noise: Add noise above 3 kHz and then remove; Interference suppression using 400 Hz tone.
Textbook Map: 9.1, 9.2, 9.3 **&** 12.1 to 12.8	
Teaching Learning Process: Design and Simulate the different types of FIR and IIR Filter using open source tools	

Course Outcomes: At the end of the course students should be able to :

CO1: **Explain** and solve the DFT, FFT and Filters problems.
CO2: **Differentiate the** DFT, FFT, IDFT, IFFT and filtering techniques.
CO3: **Appraise** the discrete–time systems using various DSP approaches
CO4: **Create** the FIR & IIR filters for given specification
CO5: **Conduct** experiments to verify DSP concepts and applications of DSP using Hardware DSP board.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Digital Signal Processing–Principles Algorithms and Applications, Proakis & Monalakis, PHI / Pearson Education, 4th Edition, New Delhi, 2007. ISBN: 978-81-317-1000-5.			
2	Digital Signal Processing – A. Nagoor Kani, McGraw Hill education, 2nd edition, 2012. ISBN-13: 978-0-07-008665-4, ISBN-10: 0-07-008665-6.			

Reference Books:

Discrete Time Signal Processing, Oppenheim and Schaffer, PHI, 2003, ISBN -10:9332535035, ISBN-13:9789332535039.

Digital Signal Processing, S. K. Mitra, Tata Mc–Graw Hill, 3rd Edition, 2007. ISBN: 9780070667563, ISBN-007066756X

Digital Signal Processing, Lee Tan, Elsevier publications, 2007. ISBN-9780124159822, ISBN-9780124158931

Digital Signal Processing using MATLAB, Sanjit K Mitra, TMH, 2001.

Digital Signal Processing using MATLAB, J.G. Proakis & Ingle, MGH, 2000

Web links and Video Lectures (e-resources)

1. http://acl.digimat.in/nptel/courses/video/117102060/L01.html

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Control Systems**		
Course Code: **P22EC505**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite:		
Basic Algebra and Mathematics, Fundamental Physics		
Course learning Objectives:		
CLO1: Obtain the mathematical model for electrical and mechanical systems. CLO2: Determine the time domain and frequency domain response of systems. CLO3: Deduce the transfer function from the block diagrams and signal flow graph. CLO4: Evaluate the system stability by using the time domain and frequency domain Responses. CLO5: Analyze electrical systems using state space models		
UNIT - I		**8 Hours**
Fundamental Concepts of Control Systems: Basic definitions of control systems, Classification, Open loop and closed loop systems, **Modeling of Systems:** Differential equations of physical systems, Determinations of transfer function models for Electrical, Mechanical and Analogous systems. **Block Diagrams and Signal Flow Graphs:** Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded).		
Self-Study Content: 1. 1.Study the Application of Control Theory in non-engineering fields. 2. Study the Dynamic of Robotic mechanism.		
Textbook Map: **1.1, 2.1, 2.2, 2.4, 2.5, 2.6, 2.7.**		
Teaching Learning Process: chalk and talk, smart board.		
UNIT – II		**8 Hours**
Time Domain (Transient and Steady State Response) Analysis of Feedback Control Systems: Standard test signals, Unit step response of First and second order systems. **Time Response Specifications:** Transient response specifications of second order systems, steady state errors and static error constants.		
Self-Study Content: 1. Design the second-order systems for the given specifications. 2. Write the MATLAB program to find the time response of second order systems.		
Textbook Map: **5.1, 5.2, 5.3, 5.4, 5.5**		
Teaching Learning Process: chalk and talk, smart board.		
UNIT - III		**8 Hours**
Stability Analysis: Concepts of stability, asymptotic stability, necessary conditions for stability, Routh-Hurwitz stability criterion, Routh's tabulation, special cases when Routh's tabulation terminates prematurely. **Root Locus Techniques:** The root locus concepts, summary of general rules for constructing Root Loci, Stability analysis.		
Self-Study Content: 1. Write the MATLAB program to draw the Root Locus diagrams of open loop transfer function of different systems. **(Refer Text 2)**		
Textbook Map: **6.1, 6.2, 6.4, 6.5, 6.6, 7.1, 7.2, 7.3**		
Teaching Learning Process: chalk and talk, Power point presentation, smart board.		

UNIT - IV	8 Hours
Frequency-Response Analysis: Stability in the frequency domain: Introduction to frequency domain analysis, Experimental determination of transfer functions in Bode plots. Assessment of relative stability using bode Plots. **Polar Plot:** Introduction to Polar plot and Nyquist plots, Nyquist stability criterion, Stability analysis using Polar plot, Numerical problems.	
Self-Study Content: 1. Write the MATLAB program to draw the Bode diagrams of open loop transfer function of different systems. **(Refer Text 2)** 2. Study the Frequency response specifications- resonant peak, resonant frequency and bandwidth	
Textbook Map: **8.1, 8.4, 8.5, 8.6, 9.1, 9.2, 9.3, 9.4.**	
Teaching Learning Process: chalk and talk, Power point presentation, smart board.	
UNIT - V	**8 Hours**
Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Controllability and Observability, Derivation of transfer functions from the state model, Solution of state equations.	
Self-Study Content: 1. Obtain the time response for different state models	
Textbook Map: **12.1, 12.2, 12.3, 12.6, 12.7**	
Teaching Learning Process: chalk and talk, Power point presentation, smart board.	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** mathematical knowledge to determine the Transfer function of a system.
CO2: **Analyze** the stability of the system using time domain, frequency domain and state variable techniques.
CO3: **Develop** the mathematical models using different techniques of state variables.
CO4: **Simulate** the given linear control system using MATLAB/SIMULINK.

Suggested Learning Resources:

Textbooks:

	Title	Author	Year & Edition	Publisher
1.	Control Systems Engineering	I. J. Nagarath and M. Gopal	2018- 4th edition	New Age International (P) Limited
2.	Modern Control Engineering	K. Ogata	2002,4th edition	Pearson Education Asia/ PHI

Reference Books:

1.	Automatic Control Systems	Benjamin C. Kuo, John Wiley	2008,8th edition,	India Pvt. Ltd
2.	Feedback Control System Analysis and Synthesis	J. J. D'Azzo and C. H. Houpis McGraw Hil		International student Edition

Web links and Video Lectures (e-resources)

1. NPTEL course on "Introduction to System and Control" by Prof Ramakrishna Pasumarthy, IIT Madras https://nptel.ac.in/courses/108/106/108106098/
2.https://www.google.co.in/books/edition/Control_Systems_As_Per_Latest_Jntu_Sylla/VMBWs_8hyBgC?hl=en&gbpv=1&dq=control+systems+by+ij+nagrath&printsec=frontcover

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Circuit Simulation Laboratory**		
Course Code: **P22ECL506**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=0 : 0 : 2	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 1		

Course learning Objectives:

CLO1: Learning computer aided design and simulation tools.
CLO2: Design and verification of circuits at system level.
CLO3: Capturing system requirements and optimize design.

The design flow must consists of the following

PART –A

Draw the schematic and perform

Transient analysis using **PSpice simulator** for given specification

1. Clipper and Clamper Circuit
2. CMOS Inverter
3. Current Controlled Voltage Source
4. Voltage Controlled Current Source
5. Summing Amplifier

PART –B

For the following set of experiments the design flow must consists of

- **Draw the schematic**
- **Draw the PCB layout and verify with DRC**
- **Generate the Gerber file for given specifications**

1. Inverting amplifier
2. Half wave Rectifier
3. Monostable multivibrator
4. Power supply design with regulators
5. Astable multivibrator

Open ended experiments:

1. Temperature monitoring based on environmental condition.
2. Implement home automation with the help of relays.

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the knowledge of the digital system to design the schematic in Pspice OrCAD tools.
CO2: **Interpret** the concept of transient and ac sweep analysis using PSpice Simulator.
CO3: **Create a** PCB for the basic analog and digital circuit using OrCAD tool.
CO4: **Analyze and Optimize** the circuit for given specification.

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Internship**		
Course Code: **P22INT507**	CIE Marks: -	CIE Weightage:
Teaching hours/week (L:T:P)=0 : 0 : 0	SEE Marks:100	SEE Weightage: 100%
Teaching hours of Pedagogy: --	Exam Hours: 3 Hours	
Credits: 2		

All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)

Internship-II: SEE component will be the only seminar/Presentation and question answer session

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Employability Enhancement Skills (EES) - V**		
Course Code: **P22HSMC508B**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=0 : 2 : 0	SEE Marks: 50	SEE Weightage: 50%
Teaching hours of Pedagogy: 28	Exam Hours: 3 Hours	
Credits: 1		

Course Learning Objectives: This course will enable the students to:

- Calculations involving Time and work, Speed & distance, trains, boats and streams and races.
- Explain concepts behind logical reasoning modules of clocks and calendars.
- Develop problem solving skills through Data structures.

UNIT – I		**06 Hours**

Quantitative Aptitude: Time and Work, Time, Speed and Distance.

Logical Reasoning: Clocks and Calendars.

Self-study component:	Decimal fractions

UNIT – II		**06 Hours**

Quantitative Aptitude: Trains, Boats and Streams, Races.

Verbal Ability: Reading Comprehension, Critical Reasoning.

Self-study component:	Game based assessments

UNIT – III	**ADVANCED DATA STRUCTURES - I**	**06 Hours**

Priority Queues: Introduction to Priority Queues, Ways to implement priority queues, Introduction to heaps, Introduction to Complete Binary Trees and its implementation, Insert and Delete operations in heaps, Implementing priority queues, Heap sort, Inbuilt Priority Queue

Hashmaps: Introduction to Hashmaps, Inbuilt Hashmap, Hash functions, Collision handling, Insert and Delete operation implementation in hashmap, Load factor, Rehashing

Self-study component:	Applications of Queues: Josephus Problem

UNIT – IV	**ADVANCED DATA STRUCTURES - II**	**06 Hours**

Tries: Introduction to Tries, making a Trie Node class, Insert, Search and Remove operation implementation in Tries, Types of Tries, Huffman coding.

Graphs: Introduction to Graphs, Graph Terminology, Graph implementation, Graph Traversals (DFS and BFS), Weighted and Directed Graphs, Minimum Spanning Trees, Cycle Detection in Graphs, Kruskal's algorithm, Prim's algorithm, Dijkstra's algorithm.

Self-study component:	Optimal Binary Search Trees.

UNIT – V	**ADVANCED DATA STRUCTURES - III**	**06 Hours**

Introduction to Dynamic Programming: Introduction to Memoization, Introduction to Dynamic Programming, Fibonacci numbers using recursion, memoization and dynamic programming

Applications of Dynamic Programming: Longest Common Subsequence (LCS) using recursion, memorization and dynamic programming, Edit distance using recursion, memorization and dynamic programming, Knapsack problem using recursion, memorization and dynamic programming

Self-study component:	Lower Bound Arguments, Decision trees.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on Time and work, Speed & distance, trains, boats and streams and races.	Applying	L3
CO2	Solve logical reasoning problems based on Clocks and calendars and verbal ability skills of reading comprehension and critical reasoning.	Applying	L3
CO3	Analyze and represent various data structures and its operations.	Analyzing	L4
CO4	Develop programs with suitable data structure based on the requirements of the real-time applications	Applying	L3

Text Book(s):

1. Data Structures and Algorithms Made Easy by Narasimha Karumanchi
2. Data Structures through C in Depth by by S K Srivastava and Deepali Srivastava
3. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.
4. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.

Reference Book(s):

1. Aaron M Tenenbaum, Yedidyah Langsam and Moshe J Augenstein, "Data Structures using C", 2014, low price edition ,Pearson education.
2. Seymour Lipschutz, Data Structures with C (Schaum's Outline Series) , July 2017, McGraw Hill Education.
3. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Data Structures and algorithms offered by NPTEL: https://nptel.ac.in/courses/106102064/
2. https://www.youtube.com/watch?v=CBYHwZcbD-s
3. https://www.youtube.com/watch?v=2ZLl8GAk1X4
4. https://www.youtube.com/watch?v=MdG0Vw9f1A4

COURSE ARTICULATION MATRIX (EMPLOYABILITY ENHANCEMENT SKILLS - V – P22HSMC508B)												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2										
CO4	1	1	2									1

Academic Year: 2024-25	Semester: V	Scheme: P22
Course Title: **Social Connect and Responsibility**		
Course Code: **P22UHV509**	CIE Marks: 100	CIE Weightage: 100%
Teaching hours/week (L:T:P)=1 : 0 : 0	SEE Marks:--	SEE Weightage: -
Teaching hours of Pedagogy: **25+5**	Exam Hours: 3 Hours	
Credits: 1		
Prerequisite:		
Course learning Objectives:		
CLO1: **Identify** the needs of the community and involve them in problem solving. CLO2: **Demonstrate** the knowledge about the culture and societal realities. CLO3: **Develop** sense of responsibilities and bond with the local community. CLO4: **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large CLO5: **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.		
Part - I		
Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an excpert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.		
Part – II		
Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - – Objectives, Visit, case study, report, outcomes.		
Part- III		
Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.		
Part- IV		
Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.		
Part- V		
Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking –Objectives, Visit, case study, report, outcomes.		

Course Outcomes: At the end of the course students should be able to :
CO1: **Identify** the needs of the community and involve them in problem **solving.** CO2: **Demonstrate** the knowledge about the culture and societal realities. CO3: **Develop** sense of responsibilities and bond with the local community CO4: **Make use** of the Knowledge gained towards significant contributions to the local community and the society at large. CO5: **Develop** among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Analog CMOS VLSI Design**		
Course Code: **P22EC601**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks: 50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Analog circuit theory, Circuit Theory, Signals and Systems		
Course learning Objectives:		
CLO1: Understand the basic MOS device physics and models. CLO2: Apply small signal and large signal models in the low and high frequency analysis of MOS circuits. CLO3: Under stand the working mechanism and significance of the Current mirrors in MOS circuits. CLO4: Analyze and Design the Operational amplifiers and oscillators		
UNIT - I		**8 Hours**
Single– Stage Amplifiers: MOS Device Models**,** Basic Concepts, Common–Source Stage, Source Follower, Common–Gate Stage, Cascode Stage.		
Self-Study Content: 1. Design and simulate a single stage Amplifier for given requirements across different technologies, note the limitations and benefits.		
Textbook Map: **2.4, 3.1to 3.5**		
Teaching Learning Process: Chalk & Talk / Power point presentation		
UNIT – II		**8 Hours**
Differential Amplifiers: Single– Ended and Differential Operation. Basic Differential Pair, Common–Mode Response, Differential Pair with MOS Loads, Gilbert Cell.		
Self-Study Content: 1. Explore and analyze the Difference Amplifier.		
Textbook Map: **4.1 to 4.3, 4.4 to 4.5**		
Teaching Learning Process: Chalk & Talk / Power point presentation/ Quizzes		
UNIT - III		**8 Hours**
Passive and Active Current Mirrors: Basic Current Mirrors Cascode Current Mirrors, Active Current Mirrors. **Frequency Response of Amplifiers:** General Considerations, Miller Effect, Association of Poles with Nodes Common source stage and Source Followers.		
Self-Study Content: 1. Study and understand the procedure of calculating Network functions along with the analysis of its Poles and Zeros (Ref: Ch.10 of Network Analysis, 3rdedn, M.E. Van Valkenburg, PHI.)		
Textbook Map: **5.1 to 5.3 and 6.1-6.3**		
Teaching Learning Process: Usage of modern EDA Tools? Backup Videos		
UNIT - IV		**8 Hours**
Frequency Response of Amplifiers: Common Gate stage, Cascode Stage and Differential Pair. **Operational Amplifiers:** General considerations, One stage op-amp, Two stage op-amp, Gain Boosting, Comparison, Common Mode feedback,		
Self-Study Content: 1. Read and explore the design of Fully differential OPAMP System of Cirrus Logic International (Patent No: US20180062583A1).		

Textbook Map: **6.4-6.6, 9.1 to 9.6**	
Teaching Learning Process: Power point presentation/ Expert Talk	
UNIT - V	**8 Hours**
Operational Amplifiers: Input Range limitations, Slew rate, Power supply rejection, Noise in Op-amps. **Oscillators:** General Considerations, Ring Oscillators, LC Oscillators, Voltage–Controlled Oscillators, Mathematical Model of VCOs.	
Self-Study Content: 1. Read and explore the Qualcomm VCO design.	
Textbook Map: **9.7 to 9.9 14.1 to 14.5 (excluding 14.4.1-14.4.2)**	
Teaching Learning Process: Case study/ Seminar/ Group Discussion	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the knowledge of basic principles of network theory and circuit topology in analysis of MOS amplifiers, current mirrors and oscillators.

CO2: **Analyze** the MOS circuits for input impedance, output impedance, gain and frequency response.

CO3: **Create a** single stage amplifiers, current mirrors, differential amplifiers and oscillators for given specifications'

CO4: **Simulate** the analog CMOS circuits using modern tools.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw Hill, Indian Edition, 2008, ISBN: 0-07-238032-2.			

Reference Books:

CMOS Analog Circuit Design, Phillip E. Allen, Douglas R. Holberg, Oxford University Press, 3rd edition 2011, ISBN: 9780199765072.

CMOS Circuit Design, Layout and Simulation, R. Jacob Baker, Harry W. Li, David E. Boyce, Prentice Hall of India, 1st edition 2005, ISBN-13: 978-0780334168

Web links and Video Lectures (e-resources)

1. https://nptel.ac.in/courses/117/101/117101105/ (By Prof. A N Chandorkar, IIT, Bombay)
2. https://nptel.ac.in/courses/108/106/108106105/ (By Prof. Aniruddhan S, IIT, Madras) SWAYAM:
3. https://swayam.gov.in/nd1_noc20_ee13/preview (By Prof. Hardik Jeetendra Pandya, IISC, Bengaluru).
4. https://www.youtube.com/@AliHajimiriChannel (By Prof. Ali Hajimiri, California Institute of Technology, Chicagos)

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **ITC and Multimedia**		
Course Code: **P22EC6021**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Mathematics (Statistics and Probability), Basic C Programming, Analog and digital communication		
Course learning Objectives:		
CLO1: Provide the knowledge of probability, information theory and source coding theorem CLO2: Analyze the efficient data compression methods and describe the most efficient compression method. CLO3: Develop the channel model and channel capacity theorem. CLO4: Describe the linear block codes, cyclic codes, BCH codes and Reed-Solomon codes. CLO5: Explain the types of multimedia network and its applications. CLO6: Describe the digitization principles of text and images and provide the understanding of digitization techniques of audio.		
UNIT - I		**8 Hours**
Information Theory and Source Coding: Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Relative Entropy, Source Coding Theorem, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, The Lempel-Ziv Algorithm, Run Length Encoding, Rate Distortion Function, Optimum Quantizer Design, Entropy Rate of a Stochastic Process, Introduction to Image Compression, The JPEG Standard for Lossless Compression, The JPEG Standard for Lossy Compression, Video Compression Standards.		
Self-Study Content: 1. Understand the properties of codes and applications of information theory. 2. Study and compare the different lossy and lossless compression techniques.		
Textbook Map: **1.1-1.18.**		
Teaching Learning Process: One minute Paper		
UNIT – II		**8 Hours**
Channel Capacity and Coding: Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, Parallel Gaussian Channels, The Shannon Limit, and Channel Capacity for MIMO Systems. **Error Control Coding (Channel Coding):** Linear Block Codes for Error Correction, Introduction to Error Correcting Codes, basic definitions , Matrix Description of Linear Block, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction), Perfect Codes, Hamming Codes, Low Density Parity Check (LDPC) Codes, Optimal Linear Codes.		
Self-Study Content: 1. Identify the practical Applications of MIMO system. 2. Understand the uses of Linear and non Linear block codes.		
Textbook Map: **2.1-2.8, 3.1-3.12.**		
Teaching Learning Process: Think-Pair-Share		

UNIT - III	8 Hours
Cyclic Codes: Introduction to Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Method for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Quasi-Cyclic Codes and Shortened Cyclic Codes. **Bose–ChaudhuriHocquenghem (BCH) Codes:** Introduction to BCH Codes, Primitive Elements, Minimal Polynomials, Generator Polynomials in Terms of Minimal Polynomials, Some Examples of BCH Codes, Decoding of BCH Codes, Reed-Solomon Codes.	
Self-Study Content: 1. Discuss the concept of Convolutional Codes, AWGN Channel and identify the noises associated. 2. Design the decoding and encoding circuits for linear block codes, cyclic codes, BCH of Reed-Solomon codes using MATLAB.	
Textbook Map: **4.1-4.6, 5.1-5.7.**	
Teaching Learning Process: Flipped Classroom	
UNIT - IV	**8 Hours**
Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks: Telephone, data, Broadcast television, ISDN and Broadband multiservice digital networks, Multimedia applications: Interpersonal communication, Interactive applications over the internet, Entertainment applications, Application and networking terminology: Media types, Communication modes, Network types..	
Self-Study Content: 1. Discuss the Multipoint conferencing modes of operation. 2. Study the Network QoS Parameters and its Applications.	
Textbook Map:**1.1 to 1.5**	
Teaching Learning Process: Mentorship and Peer Learning	
UNIT - V	**8 Hours**
Multimedia Information Representation: Introduction, Digitization principles: Analog signals, Encoder design, and Decoder design, Text: Unformatted text, Formatted text, Hypertext, Images: Graphics, Digitized documents, Digitized pictures, Audio: PCM speech, Video: Broadcast television, Digital Video.	
Self-Study Content: 1. Study the CD-quality audio and Synthesized audio. 2. Discuss the PC video digitization formats and video content.	
Textbook Map: **2.1 - 2.5.1, 2.6.1,2.6.2**	
Teaching Learning Process: Lectures with Multimedia Presentations	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of mathematics to understand concepts of Probability, Information theory, communication channel , source code and Error control coding
CO2: **Create** the decoding circuits for linear block codes, cyclic codes, BCH and encoding of Reed-Solomon codes.
CO3: **Compare** different networks and types in Multimedia Communication
CO4: **Analyze** different media types to represent in digital form.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Ranjan Bose: Information Theory, Coding and Cryptography, 3rd edition. Tata McGraw Hill. ISBN: 978-0-07-0669017, 2016.			
2	Fred Halsall: Multimedia Communications, Applications, Networks, Protocols and Standards, Fifth Impression, Pearson, 2011.ISBN: 978-81-317-0994-8.			

Reference Books:
Simon Haykin, John Wiley: Digital Communication Systems, 4th edition. ISBN-13: 978-0130426727.
Daniel J. Costello: Error Control Coding, Shu Lin, 2nd Edition, Pearson.
Ralf Steinmetz and Klara Nabrsted : "Multimedia: Computing, Communications and Applications", Pearson Education, 2004, ISBN: 9788177584417.

Web links and Video Lectures (e-resources)
1. https://nptel.ac.in/courses/108/102/108102117/ 2. https://nptel.ac.in/courses/117/105/117105083/#

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **DSP Processor and Applications**		
Course Code: **P22EC6022**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Mathematics, Signal Processing Fundamentals, Microprocessor Architecture.		
Course learning Objectives:		
CLO1: Provide the understanding of architecture, programming and interfacing of commercially available Digital Signal Processor. CLO2: Discuss the effective use of Digital Signal Processor in system implementation. CLO3: Provide the understanding of architecture features and programming concepts of TMS320C54XX for several basic DSP algorithms. CLO4: Understand the interfacing procedure to use programmable Digital Signal Processor. CLO5: Discuss the applications of programmable DSP devices		
UNIT - I		**8 Hours**
Architectures for Programmable DSP Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Speed Issues.		
Self-Study Content: 1.List and explain important features needed for external interfacing with DSP device. 2. Explain pipelining and parallel processing with real life example. Also comment on time requirement in each process.\		
Textbook Map: **4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.8**		
Teaching Learning Process: 1. Flip Class 2. Assessments		
UNIT – II		**8 Hours**
Programmable Fixed Point Digital Signal Processors: Introduction, Commercial Digital Signal– processing Devices, Data Addressing Modes of TMS32OC54xx DSPs, Memory Space of TMS32OC54xx Processors, Program Control, TMS32OC54xx Instructions, Pipeline Operation of TMS32OC54xx Processors.		
Self-Study Content: 1. Compare and contrast the capabilities of DSP processors and conventional processors, highlighting the unique strengths of DSPs in processing digital signals. 2. Study memory (internal and extended), peripherals and general purpose I/O pins characteristics of 54X processors.		
Textbook Map: **5.1, 5.2, 5.3.1, 5.3.2, 5.3.3, 5.4, 5.5, 5.6, 5.7.1**(Mentioned topics only)**, 5.10**		
Teaching Learning Process: 1. Flip Class 2. Assessments		
UNIT - III		**8 Hours**
Implementation of Basic DSP Algorithms: Introduction, the Q–notation, FIR Filters, IIR Filter, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters. **Implementation of FFT Algorithms:** Introduction, An FFT Algorithm for DFT, A Butterfly Computation, Overflow and Scaling.		

Self-Study Content: 1. Study an 8-point FFT implementation on the TMS320C54XX processor. 2. Design and implement 4 tap FIR filter using Verilog.	
Textbook Map: **7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3, 8.4**	
Teaching Learning Process: Design and implement FIR Filters using any modern tools of DSP and Verilog.	
UNIT - IV	**8 Hours**
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, External Bus Interfacing signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). **Interfacing and Applications of DSP Processor:** Introduction, Synchronous Serial Interface, A CODEC Interface Circuit.	
Self-Study Content: 1. Study of Multi-channel Buffered Serial Port Programming (McBSP). 2. Design a simple CODEC interface circuit and write a code snippet to program the CODEC for a specific application, such as audio compression or decompression.	
Textbook Map: **9.1, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 10.1, 10.2, 10.5**	
Teaching Learning Process: Design and Implement CODEC interface circuit using suitable tool.	
UNIT - V	**8 Hours**
Programmable Floating Point Digital Signal Processors: Introduction, Features of TMS320C6713, TMS320C6713 Architecture, Linear and Circular addressing modes, Instruction set, TMS 320C6713 DSK Boards, TMS 320C6713 Programming. **Applications of DSP Devices:** DSP Based Bio–telemetry DSP based Speech Processing System, Data compression in DSP Based Image Processing System.	
Self-Study Content: 1. Compare and contrast the performance of floating-point processors and fixed-point processors in various applications, analyzing their strengths and weaknesses. 2. Implement speech processing system using MATLAB.	
Textbook Map: **23.1 to 23.4, 23.5 (23.5.1 Excluded), 23.6, 23.7.1, 23.8**	
Teaching Learning Process: Implement speech and audio processing using modern tools of DSP.	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the knowledge of binary math problems to illustrate the internal architecture and its operation of the DSP processor.

CO2: **Demonstrate** programming proficiency using various addressing modes and data transfer instructions of DSP processor.

CO3: **Analyze** the application areas of DSP processor using signal processing concepts.

CO4: **Evaluate** electrical circuitry to the DSP processor I/O ports in order to interface the processor to external devices.

CO5: **Create** a DSP algorithms for given application using MATLAB.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Digital Signal Processing, Avatar Singh and S. Srinivasan, Thomson Learning, 1st edition 2004. ISBN 10: 0534391230 / ISBN 13: 9780534391232.			
2	Modern Digital Signal Processing, V. Udayashankara, Eastern Economy Edition, 2016. ISBN 10: 8120345673 / ISBN 13: 9788120345676.			

Reference Books:
Digital Signal Processors Architectures, Implementations, and Applications, Sen M Kuo, Woon-seng Gan, Pearson Edition, 2005.ISBN-13: 978-0130352149
Digital Signal Processors: Architecture, Programming and Applications, Venkataramani, Bhaskar, McGraw Hill Education, 2015.ISBN-10: 9780070702561

Web links and Video Lectures (e-resources)
1. https://youtu.be/t0otg_QxGeM?si=h9zTM_JM95UojtIZ 2. https://www.youtube.com/watch?v=04UvJkki0Ig

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Embedded Systems**		
Course Code: **P22EC6023**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Microcontroller, DLD and Basic C Programming.		
Course learning Objectives:		
CLO1: Understand basic components of embedded systems and its characteristic attributes. CLO2: Demonstrate the communication interface required to develop an embedded system. CLO3: Analyze embedded design problem and develop system to meet the needs. CLO4: Use of Firmware design tools based the industry requirements. CLO5: Develop a code for the embedded system using Embedded C. CLO6: Choose proper IDE for the design and follow the recent trends in the embedded system design.		
UNIT - I		**8 Hours**
Introduction to Embedded Systems: What is an Embedded System, Embedded Systems vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Area of Embedded Systems, Purpose of Embedded Systems. **Typical Embedded System:** General purpose and domain specific processors, Memory, Sensors and Actuators, Other System Components.		
Self-Study Content: 1. Discuss 'Smart' running shoes from Adidas- the Innovative Bonding of Lifestyle with Embedded Technology. 2. Demonstration of practical application of embedded design.		
Textbook Map: **1.1 - 1.6, 2.1.1, 2.2, 2.3, 2.6.**		
Teaching Learning Process: Flipped Classroom.		
UNIT – II		**8 Hours**
Embedded networks: communication interface. Onboard communication interface –I2C, SPI, Serial peripheral interface (SPI), UART. External communication interface- RS -232C and RS-485, USB, Infrared (IrDA), Bluetooth (BT). Need for Device drivers.		
Self-Study Content: 1. Understand other Communication Interfaces like Controller Area Network (CAN), Wi-Fi etc. 2. Understand different types of Device Drivers.		
Textbook Map: **2.4, 2.4.1.1 to 2.4.1.3 , 2.4.2 , 2.4.2.1 ,2.4.2.2 , 2.4.2.4, 2.4.2.5, 10.9**		
Teaching Learning Process: Poster Presentation.		
UNIT - III		**8 Hours**
Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems. **Embedded System- Application and Domain Specific**: Consumer (Washing Machine), Automotive. **Hardware Software Co-Design and Program Modeling**: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language.		
Self-Study Content: 1. Discuss How to use Or-CAD tool. 2. Understand schematic design using Or-CAD Capture CIS.		

Textbook Map: **3.1, 3.2, 4.1, 4.2, 7.1 - 7.3**	
Teaching Learning Process: Project-Based Learning (PBL).	
UNIT - IV	**8 Hours**
Embedded Firmware Design and Development: Embedded Firmware Design Approaches Embedded Firmware Development Languages. **Programming in Embedded C:** Programming in Embedded C**,** C vs Embedded C, Compiler vs Cross Compiler, Using C in Embedded C.	
Self-Study Content: 1. Understand Embedded C programs to control 8051 microcontrollers. 2. Design and develop any one application as per current industry need using embedded C.	
Textbook Map: **9.1 to 9.3, 9.3.1, 9.3.2, 9.3.3.**	
Teaching Learning Process: Case Study.	
UNIT - V	**8 Hours**
Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization, how to Choose an RTOS.	
Self-Study Content: 1. Analyze Threads, Processes and Scheduling : Putting them all together with programming 2. Understand different methods of task communication.	
Textbook Map: **10.1 to 10.5, 10.8, 10.10**	
Teaching Learning Process: Industry-Academia Collaboration.	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems.
CO2: **Analyze** the different issues involved in embedded system development using real time operating systems.
CO3: **Analyze** and **relate** various communication interfaces involved in designing embedded applications.
CO4: **Develop** embedded system applications for a given specification using embedded firmware.
CO5: **Build** Embedded system applications using Modern tools to meet the current industry requirements.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Introduction to Embedded	Systems,Shibu K V, Tata McGraw Hill,	2nd Edition,	ISBN 13: 978-0-07-014589-4.

Reference Books:

1	Embedded Systems Design, An Introduction to Processes, Tools, and Techniques by	Arnold S. Berger	2002	ISBN:1578200733 CMP Books

Web links and Video Lectures (e-resources)
1. https://youtu.be/TP1_F3IVjBc 2. https://nptel.ac.in/courses/108105057

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Operating Systems**		
Course Code: **P22EC6024**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Digital Electronics, Computer Organization		
Course learning Objectives:		
CLO1: Understand the architecture and principals of Operating System. CLO2: Examine the issues of Mutual Exclusion and deadlock. CLO3: Discuss the principle techniques of memory management. CLO4: Analyze various scheduling policies. CLO5: Understand RAID, CACHE and other I/O management		
UNIT - I		**8 Hours**
Operating System Overview: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Virtual Machines. **Process Description and Control**: What Is a Process?, Process States, Process Description, Process Control		
Self-Study Content: 1. Explore the concepts of Multicore Systems.		
Textbook Map: **2.1-2.5, 3.1-3.4**		
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Animations		
UNIT – II		**8 Hours**
Concurrency: Deadlock and Starvation - Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem.		
Self-Study Content: 1. Understand the Concepts of Mutual Exclusion and Semaphore.		
Textbook Map: **6.1 - 6.6**		
Teaching Learning Process: 1. Power Point Presentation 2. Quiz		
UNIT - III		**8 Hours**
Memory Management: Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Security Issues.		
Self-Study Content: 1. Comment on Fixed and Dynamic Memory partitioning.		
Textbook Map: **7.1 - 7.5**		
Teaching Learning Process: 1. Power Point Presentation 2. Video Clips 3. Quiz		
UNIT - IV		**8 Hours**
Uniprocessor Scheduling: Types of Processor Scheduling, Scheduling Algorithms, Traditional UNIX Scheduling		
Self-Study Content: 1. Learn about Multiprocessor Scheduling, Real-Time Scheduling		
Textbook Map: **9.1 - 9.3**		

Teaching Learning Process: 1. Brainstorming session 2. Animations 3. Power Point Presentation	
UNIT - V	**8 Hours**
I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling, RAID, Disk Cache.	
Self-Study Content: 1. Compare the types of I/O in UNIX, LINUX and WINDOWS.	
Textbook Map: **11.1 - 11.7**	
Teaching Learning Process: 1. Brainstorming session, 2. Power Point Presentation 3. Quiz	

Course Outcomes: At the end of the course students should be able to :

CLO1: **Applying** fundamental concepts of programming **Understand** the basic structure of operating system
CLO2: **Interpret** the key design aspects of modern operating systems.
CLO3: **Examine** the principle requirements for memory management and I/O management.
CLO4: **Illustrate** the mechanism of various scheduling policies.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Operating Systems by William Stallings, 7e, Pearson India. ISBN-13: 9789332518803			

Reference Books:

Operating Systems" by Godbole, 3rd Edition, McGraw Hill India. ISBN-13: 978-0070702035

Web links and Video Lectures (e-resources)

1. Operating System Fundamentals, IIT Kharagpur By Prof. Santanu Chattopadhyay
   https://archive.nptel.ac.in/courses/106/105/106105214/
2. Introduction to Operating Systems, IIT Madras
   By Prof. Chester Rebeiro, https://onlinecourses.nptel.ac.in/noc21_cs72/preview
3. Operating Systems - NPTEL IITDBy Prof. Sampat Ghosh
   https://www.youtube.com/playlist?list=PLsylUObW5M3CAGT6OdubyH6FztKfJCcF

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Radar and Navigational Systems**		
Course Code: **P22EC6031**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Electromagnetic theory, Signal processing, Antenna theory and design		
Course learning Objectives:		
CLO1: Describe the basic Radar operation, detection of echo signal and radar applications. CLO2: Discuss different radar range equations and calculate the effect of various external / Internal factors on radar accuracies. CLO3: Explain the idea behind MTI and radar tracking systems. CLO4: Examine the different technologies for Detection of targets. CLO5: Explain different Clutters that affect the detection of radar signals. CLO6: Discuss the different radar transmitters and receivers. CLO7: Explain different navigational aids.		
UNIT - I		**8 Hours**
An Introduction to Radar: Basic Radar, Simple form of the Radar equation, Radar block diagram, Radar frequencies, Applications of radar. **The Radar Equation:** Introduction, Detection of signals in noise, Receiver noise and signal to noise ratio, Probabilities of detection and false alarm, Radar cross section of targets.		
Self-Study Content: 1. Applications of modern radar systems. 2. Household Radar Can See Through Walls and Knows How You're Feeling:- https://spectrum.ieee.org/telecom/wireless/household-radar-can-see-through-walls-and-knows-how-youre-feeling. 3. MIT Lincoln Laboratory- Introduction to Radar Systems – Lecture 1 – Introduction; Part 1 https://www.youtube.com/watch?v=Hw5IaS6-Fzw		
Textbook Map: **1.1 to 1.5, 2.1 to 2.3, 2.5, 2.7.**		
Teaching Learning Process: PPT, One minute paper.		
UNIT – II		**8 Hours**
MTI and Pulse Doppler Radar: Introduction, Delay line cancellers, Digital MTI processing, Moving target detection. **Tracking Radar:** Tracking with Radar, Monopulse tracking, Conical scan and sequential lobing.		
Self-Study Content: 1. Limitations to tracking accuracy		
Textbook Map: **3.1, 3.2, 3.5 to 3.7, 4.1 to 4.3.**		
Teaching Learning Process: PPT, Flipped classroom.		
UNIT - III		**8 Hours**
Detection of Signals in Noise: Introduction, Matched filter receiver, Detection criteria, Detectors, Automatic detection. **Radar Clutter:** Introduction to Radar clutter, surface clutter radar equation, land clutter, sea clutter, weather clutter.		
Self-Study Content: 1. Detection of targets in clutter		
Textbook Map: **5.1 to 5.5, 7.1 to 7.4, 7.6.**		
Teaching Learning Process: Think-pair-share		

UNIT - IV	8 Hours
Radar Transmitter: Introduction, linear beam power tubes, solid state RF power sources, cross field amplifiers. **Radar Receiver:** Radar noise figures, Super-heterodyne receiver, Duplexers and receiver protectors, Radar displays.	
Self-Study Content: 1. Other RF Power Sources	
Textbook Map: **10.1 to 10.3, 10.5, 11.1 to 11.5.**	
Teaching Learning Process: Assessments for learning	
UNIT - V	**8 Hours**
Navigation: Hyperbolic Navigation: Introduction, LORAN-A, LORAN-C, DECCA, OMEGA, DECTRA, DERLAC. **Satellite Navigation:** Introduction, Doppler Navigation, GPS, Principle of operation of GPS, GPS Segments, GPS Navigation Message, GPS Data Subframe, Source of Errors in GPS. Modern Navigational Method.	
Self-Study Content: 1. Differential Global Positioning System (DGPS)	
Textbook Map: **14.1 to 14.10, 15.1, 17.3.**	
Teaching Learning Process: Seminars.	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the basics of electromagnetic field theory and mathematics concepts to understand the working of different radars, Tracking systems and Factors affecting radar system.

CO2: **Analysis** of Radar Equations, different types of Radar systems and Tracking systems.

CO3: **Analyze** the effect of various external / internal factors on Radar and its trans-reception.

CO4: **Analysis** of radar applications for different target detections.

CO5: **Analyz**e the concept of Navigation and Positioning Aids.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	**Introduction to Radar Systems**, Merill. I. Skolnik, 3rd Edition. Tata McGraw Hill, 2001. ISBN-13: 978-0-07-044533-8.			
2	**Radar Systems and Radio aids to Navigation**, Dr. A. K Sen, Dr. A .B Bhattacharya. Khanna Publishers. ISBN **:** 978-81-7409-08-9.			

Reference Books:

Elements of Electronic Navigation", N.S.Nagaraj, 2nd Edition, Tata McGRAW Hill

Radar and Electronic Navigation, Gerrit Jacobus Sonnenberg, Newnes-Butterworths; 5th edition (1978), ISBN-10: 0408002727, ISBN-13: 978-0408002721

Radar Engineering, G S N Raju, I. K. International Pvt Ltd, 2008,ISBN 8190694219, 9788190694216

Web links and Video Lectures (e-resources)

1.

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Digital Image Processing**		
Course Code: **P22EC6032**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
Mathematical background, Signals and system and digital signal processing.

Course learning Objectives:

CLO1: Understand the fundamentals of digital image processing.
CLO2: Understand the image enhancement techniques used in digital image processing.
CLO3: Understand the image restoration techniques used in digital image processing.
CLO4: Understand the Morphological Operations and Segmentation used in digital image processing.
CLO5: Understand the image Representation and Description in digital image processing.

UNIT - I	**8 Hours**

Digital Image Fundamentals: What is Digital Image Processing?, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception: Structure of the Human Eye, Brightness Adaption and discrimination, Image Sensing and Acquisition, Image Sampling and Quantization.

Self-Study Content: 1. Comprehend the array versus matrix operations.
2. Write MATLAB code to perform basic image processing operations.]

Textbook Map: **1.1,1.3-1.5,2.1,2.3,2.4**

Teaching Learning Process: 1. Power Point Presentation with illustrations
2. Chalk and board
3. Quiz

UNIT – II	**8 Hours**

Spatial Domain: The Basics of Intensity Transformation and Spatial Filtering, Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformation. **Smoothing Spatial Filters:** Order-Static Filters, **Sharpening Spatial Filters:** Using The Second derivative for image sharpening-The Laplacian, Using First-Order derivatives for image sharpening-The Gradient.

Self-Study Content: 1. Write MATLAB code to enhance the image in spatial domain.
2. Fundamentals of Frequency domain Filtering.

Textbook Map: **3.1, 3.2, 3.3,3.5, 3.6**

Teaching Learning Process: 1. Power Point Presentation
2. Chalk and board
3. Quiz

UNIT - III	**8 Hours**

Restoration: A model of the image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.

Self-Study Content: 1. Write MATLAB code toadd various intensity levels of a given noise to an image and remove.
2. Understand the Linear Position Invariant Degradations.

Textbook Map: **5.1-5.4, 5.6-5.8.**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. MATLAB Simulation	
UNIT - IV	**8 Hours**
Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing: Intensity slicing and color coding. **Morphological Image Processing**: Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms: Thinning, Thickening.	
Self-Study Content: 1. Write MATLAB code to extract boundary pixels of an image using morphological operations. 2. Write MATLAB code to perform any one morphological applications.	
Textbook Map: **6.1 - 6.3, 9.2-9.4,9.5.5,9.5.6**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. MATLAB Simulation	
UNIT - V	**8 Hours**
Segmentation: Point, Line, and Edge Detection, Thresholding: Foundation Optium global thresholding using OTSU'S Method, Region Based Segmentation.	
Self-Study Content: 1. Define a procedure for estimating the median of an image from its histogram. 2. Write MATLAB code to perform following image segmentation, Simple threshold, multiple threshold, Adaptive threshold and optimal threshold.	
Textbook Map: **10.2, 10.3, 10.4**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. MATLAB Simulation	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the basic mathematical and signal processing knowledge for the different image processing stages.

CO2: **Interpret** image in various data formats by applying image transformation or processing techniques for different applications

CO3: **Analyze** the various image processing techniques in spatial domain.

CO4: **Explore** the knowledge of image processing in Image Restoration, Color, Morphological processing and Representation and Description.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Pearson, 4th Edition 2018, ISBN: 9789353062989.			

Reference Books:

Digital Image Processing, S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014.

Fundamentals of Digital Image Processing, A. K. Jain, Pearson 2004.

Web links and Video Lectures (e-resources)
1. https://youtu.be/ArKe6zMkXnk 2. https://youtu.be/iZmHHVwp0Ow

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Design For Testability**		
Course Code: **P22EC6033**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Digital Logic Design
2. Verilog HDL
3. Digital CMOS VLSI Design

Course learning Objectives:

CLO1: Understand the principles and significance of testability in Integrated Circuits.
CLO2: Identify and categorize the faults in Integrated circuits.
CLO3: Interpret the Test Pattern Generation and related algorithms for Combinational and Sequential Circuits.
CLO4: Analyze the circuits and device test pattern generators for the circuits.
CLO5: Articulate the techniques, structure and methods associated with built-in self-test (BIST), boundary scan testing, and fault injection to improve testability.

UNIT - I	**8 Hours**

Introduction to Testing: Introduction, Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing.
Fault Modeling: Defects, Errors, and Faults, Functional Versus Structural Testing, Levels of Fault Models, A Glossary of Fault Models, Single Stuck-at Fault.
Text1:

Self-Study Content: 1. Design the modelling Circuits for Simulation
2. Analyze the Algorithms for True-Value Simulation

Textbook Map: **1.1 to 1.4, 4.1 to 4.5.**

Teaching Learning Process: 1. Presentation of DFT significance followed with case examples.
2. DFT architecture discussion

UNIT – II	**8 Hours**

Testability Measures: SCOAP Controllability and Observability, High-Level Testability Measures
Combinational Circuit Test Generation: Algorithms and Representations, Redundancy Identification (RID), Testing as a Global Problem, Definitions, Significant Combinational ATPG Algorithms (Expect Advanced Algorithms).

Self-Study Content: 1. Understand different Advanced Test Pattern Algorithms

Textbook Map: **6.1-6.2, 7.1 to 7.5**

Teaching Learning Process: Illustrate Theoretical examples

UNIT - III	**8 Hours**

Sequential Circuit Test Generation: ATPG for Single-Clock Synchronous Circuits, Time-Frame Expansion Method, Simulation-Based Sequential Circuit ATPG.
Memory Test: Memory Density and Defect Trends, Notation, Faults, Memory Test Levels, March Test Notation, Fault Modeling.

Self-Study Content: 1. Study on Memory Testing

Textbook Map: **8.1 to 8.2, 9.1-9.6.2**

Teaching Learning Process: Test strategy discussion along with numerical examples.	
UNIT - IV	**8 Hours**
Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan. **Built-In Self-Test:** The Economic Case for BIST, Random Logic BIST.	
Self-Study Content: 1. Know about Analog and Mixed-Signal Circuit Trends	
Textbook Map: **14.1 to14.4, 15.1, 15.2**	
Teaching Learning Process: 1. Power point presentation 2. Group discussion with case	
UNIT - V	**8 Hours**
Built-In Self-Test: Memory BIST, Delay Fault BIST. **Boundary Scan Standard:** Motivation, System Configuration with Boundary Scan, Boundary Scan Description Language.	
Self-Study Content: 1. Supply current measurement based test (IDDQ TEST) for manufacturing faults in IC's.	
Textbook Map: **15.3, 15.4, 16.1-16.3.**	
Teaching Learning Process: 1. Power point presentation. 2. Demonstration with simulation/case studies. 3. Interaction with expert in the domain	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the principles of testability in Integrated Circuits to categorize the faults in Integrated circuits.

CO2: **Interpret** the techniques of Test Pattern Generation and related algorithms for Combinational and Sequential Circuits.

CO3: **Analyze** the circuits and device test pattern generators for the circuits.

CO4: **Illustrate** the techniques, structure and methods used in built-in self-test (BIST), boundary scan testing and memory testing.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Essentials Of Electronic Testing For Digital, Memory And Mixed-Signal VLSI Circuits	Michael L. Bushnell, Vishwani D. Agrawal	2016	KLUWER ACADEMIC PUBLISHERS, 2016**,** ISBN 13: 978-0-12-408082-9.

Reference Books:

1	Digital Systems and Testable Design	AbramoviciBreuer and Friedman		Jaico Publishing House.

Web links and Video Lectures (e-resources)

1.https://www.youtube.com/watch?v=MEaMm423t0w&list=PLzkO3QQCXjbVIEsRgNkolAvs-SFXPUjpb

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Artificial Intelligence and Machine Learning In VLSI**		
Course Code: **P22EC6034**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Analog CMOS VLSI Design, Digital CMOS design , Verilog		
Course learning Objectives:		
CLO1: Understand structure of Neural Network and Deep Learning. CLO2: Analyze the architecture of processors for deep learning. CLO3: Learn streaming graph theory. CLO4: Study applications of Machine learning in physical verification. CLO5: Understand statistical analysis using Machine learning.		
UNIT - I		**8 Hours**
Introduction: Development History, Development History, Neural Network Classification, Neural Network Framework. **Deep Learning:** Neural Network Layer, Deep Learning Challenges.		
Self-Study Content: 1. Study introduction to AI and ML 2. Write a sample code in python for a neural network application		
Textbook Map: Chapter 1 and Chapter 2		
Teaching Learning Process: PPT/Assignment		
UNIT – II		**8 Hours**
Parallel Architecture: Intel Central Processing Unit (CPU), NVIDIA Graphics Processing Unit (GPU), NVIDIA Deep Learning Accelerator (NVDLA), GoogleTensor Processing Unit (TPU). Microsoft Catapult Fabric Accelerator **Streaming Graph Theory:** Blaize Graph Streaming Processor, Graph core Intelligence Processing Unit		
Self-Study Content: 1. Study the introduction to NVIDIA GPU applications, Tensor flow.		
Textbook Map: Chapter 3 and Chapter 4		
Teaching Learning Process: Quiz/PPT		
UNIT - III		**8 Hours**
In-Memory Computation: Neurocube Architecture, Tetris Accelerator, NeuroStream Accelerator **Near-Memory Architecture:** DaDianNao Supercomputer, Cnvlutin Accelerator.		
Self-Study Content: 1. Study the supercomputer architectures		
Textbook Map: Chapter 6 and Chapter 7		
Teaching Learning Process: Flip classroom/PPT		
UNIT - IV		**8 Hours**
Machine Learning in Physical Verification, Mask Synthesis, and Physical Design: Introduction, Machine Learning in Physical Verification, Machine Learning in Physical Design **Machine Learning-Based Aging Analysis**: Introduction, Negative Bias Temperature Instability, Related Prior Work, Proposed Technique, Offline Correlation Analysis and Prediction Model, Runtime Stress Monitoring, Results, Conclusions		

Self-Study Content: 1. Study the Machine Learning Applications in VLSI routing.	
Textbook Map: 4.1, 4.2, 4.4 and Chapter 9	
Teaching Learning Process: Flip class room/Assignment	
UNIT - V	**8 Hours**
Extreme Statistics in Memories: Cell Failure Probability: An Extreme Statistic, Extremes: Tails and maxima **Fast Statistical Analysis Using MachineLearning:** Introduction: Logistic Regression-Based ImportanceSampling Methodology for Statistical Analysis ofMemory Design, Application to State-of-the-Art FinFET SRAM Design	
Self-Study Content: 1. Study the Machine Learning regression techniques and sampling algorithms	
Textbook Map: 10.1, 10.2, 10.4, 11.1,11.5	
Teaching Learning Process: Quiz /PPT	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** the mathematical knowledge for understanding the concepts of Neural Network and Deep learning.
CO2: **Compare** Neutral Network for architecture and performance.
CO3: **Analyze** the requirement of architecture of processors for Machine Leaning.
CO4: **Illustrate** the use of machine learning algorithms in physical verification.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Artificial Intelligence Hardware Design: Challenges and Solutions, Albert Chun Chen Liu, Oscar Ming Kin Law, IEEE Press, Wiley, ISBN: 9781119810452			
2	Machine Learning in VLSI Computer - Aided Design, Ibrahim (Abe) M.Elfadel, Duane S.Boning, Xin_Li, Springer ISBN 978-3-030-04665-1			

Reference Books:

Artificial Intelligence: A Modern Approach , Stuart J. Russell and Peter Norvig, Prentice Hall, 4th Edition, 1995.

VLSI And Hardware Implementations Using Modern Machine Learning Methods Sandeep Saini, Kusum Lata, and G.R. Sinha, CRC Press 2022, ISBN: 978-1-032-06172-6

Web links and Video Lectures (e-resources)

1. https://www.youtube.com/watch?v=aircAruvnKk
2. https://www.youtube.com/watch?v=aircAruvnKk
3. https://www.youtube.com/watch?v=pMKuULBKxXY

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)

1. Flip Class
2. Seminar/ poster Presentation
3. Individual Role play/Team Demonstration/ Collaborative Activity
4. Case study
5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Microwaves and Antenna (Integrated)**		
Course Code: **P22EC604**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 2	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 4		
Prerequisite: Electromagnetic field theory, circuit theory		
Course learning Objectives:		
CLO1: Provide the basic knowledge of Microwave transmission lines, rectangular waveguides and planar transmission lines. CLO2: Discuss the working of Microwave active and passive devices. CLO3: Explain the concepts of types of antenna and parameters of antenna. CLO4: Discuss the field due to dipole antenna and array of antenna. CLO5: Describe the structure and working of helical, log-periodic and micro strip antennas and its Design procedure.		
UNIT - I		**8 Hours**
Microwave Transmission Lines: Introduction, Transmission lines equations, Characteristic and input impedances, Reflection and transmission coefficients, Standing waves, Planar transmission lines, Strip lines, rectangular waveguides, TE and TM wave solutions, dominant and degenerate modes.		
Self-Study Content: 1. Study the properties of Microwave Transmission lines using Smith chart. 2. Understand the concepts of MIC Manufacturing Process.		
Practical Topics: (2 Hours)	1. Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.	
Textbook Map: **3.1- 3.5, 3.10, 3.10.1, 3.11 - 3.11.4.**		
Teaching Learning Process:Quiz/PPT.		
UNIT – II		**8 Hours**
Microwave Passive Devices: Attenuators, phase shifters - Precision phase shifter, MIC Phase shifter, reciprocal and non-reciprocal phase shifter, Hybrid or magic Tee, Application of Magic –T (excluding E-Plane Tee & H-Plane Tee). **Microwave Solid State Devices**: Transferred electron devices (TED) - Gunn diodes, modes of operation, Gunn diode oscillator, TRAPATT diodes and Tunnel diodes- equivalent circuit, Tunnel diode Amplifiers, and Tunnel diode oscillator.		
Self-Study Content: 1. Understand the working principle of Avalanche transit time devices, Directional couplers, Power Dividers and Microstrip Ring Resonator. 2. Study the Microwave Radiation hazards in Industries.		
Practical Topics: (2 Hours)	1. Determination of coupling and isolation characteristics of a micro–strip directional coupler. 2. Measurement of power division and isolation characteristics of a micro–strip 3dB power divider. 3. Measurement of resonance characteristics of a micro–strip ring resonator and determination of dielectric constant of the substrate.	
Textbook Map: **6.4.14, 6.4.15, 6.4.16, 10.3-(10.3.1, 10.3.2), 10.4.3, 10.5, 10.5.1, 10.5.2, 10.5.3.**		

Teaching Learning Process:Quiz/PPT.	
UNIT - III	**8 Hours**
Introduction: Types of Antennas – Wire, Aperture, Micro-strip, Array, Reflector and Lens antennas, Radiation Mechanism – Single wire, Two-Wires and Dipole. **Fundamental Parameters of Antennas:** Introduction, Radiation Pattern – Isotropic, Directional, and Omnidirectional Patterns, Principal Patterns, Radiation Pattern Lobes, Field Regions, Radian and Steradian, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna Efficiency, Half-Power Beamwidth, Beam Efficiency.	
Self-Study Content: 1. Understand the concepts of Friis Transmission Equation and Radar Range Equation.	
Practical Topics: (2 Hours)	1. Plot the Radiation pattern and measure the Directivity of Dipole antenna.
Textbook Map: **1.1, 1.2, 1.3 – (1.3.1, 1.3.2, 1.3.3), 2.1 to 2.5, 2.7 to 2.10.**	
Teaching Learning Process: One minute paper writing.	
UNIT - IV	**8 Hours**
Linear Wire Antennas: Introduction, Infinitesimal Dipole – Radiated Fields, Power density and Radiation resistance, Radian Distance and Sphere, Near-field, Intermediate and Far – field region, Directivity. **Antenna Arrays:** Introduction, Two- Element Array**,** N-Element Linear Array **–** Uniform Amplitude and Spacing-Broadside array, ordinary End fire array and Phased array.	
Self-Study Content: 1. Study theproperties of N element linear array and Planar Array.	
Practical Topics: (2 Hours)	1. Design and Simulate Dipole antenna using Matlab and Plot the Radiation pattern, Directivity and Impedance graph.
Textbook Map: **4.1, 4.2, 6.1, 6.2, 6.3, 6.3.1 to 6.3.3.**	
Teaching Learning Process: Quiz/PPT.	
UNIT - V	**8 Hours**
Broadband Antennas: Helical Antenna - Design Concepts, Log-periodic Antennas – planar and wire surfaces and dipole array. **Micro strip Antennas:** Introduction - Basic Characteristics, Feeding Methods, Rectangular Patch - Transmission line model.	
Self-Study Content: 1. Explore the design concepts of Log periodic dipole array, Yagi-Uda and circular patch Antenna.	
Practical Topics: (2 Hours)	1. Plot the Radiation pattern and measure the Directivity of Micro Strip-Rectangular Patch antenna. 2. Design and Simulate Microstrip rectangular patch antenna using Matlab and Plot the Radiation pattern, Directivity and Impedance graph. 3. Measurement of Pitch angle alpha (in degrees), Axial ratio (AR), HPBW (in degrees) and Directivity (dimensionless and in dB) of Helical Antenna using Matlab.
Textbook Map: **10.3, 10.3.1, 11.4, 11.4.1, 11.4.2, 14.1, 14.2, 14.2.1.**	
Teaching Learning Process: Group Discussion,PPT presentation.	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of electromagnetic field theory and network analysis to understand the properties of transmission lines, microwave devices, the parameters of antennas and field due to antennas.
CO2: **Analyze** the working and performance of microwave devices, microwave transmission lines.
CO3: **Examine** the working and performance of antenna and antenna arrays.
CO4: **Create** the helical, Log-periodic dipole antenna and micro strip antennas.
CO5: **Conduct** the experiment on the properties and characteristics of various microwave devices and Simulate the characteristics of different types of microstrip antennas using matlab tool.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Microwave Engineering, Annapurna Das, Sisir K Das, 2nd edition-2009, T.M.H, ISBN (13): 978-0-07-066738-9. ISBN (10): 0-07-066738-1.			
2	Antenna Theory Analysis and Design, C. A. Balanis, 2nd edition – 2001, John Wiley, ISBN: 9971-51-233-5.			

Reference Books:
Microwave engineering, David M Pozar, 2nd edition – 2004, John Wiley, ISBN: 9780470631553.
Foundations for Microwave Engineering, Robert E Collin, 2nd edition – 2009, John Wiley & Sons Inc (Sea) Pte Ltd, ISBN: 9788126515288.
Microwave Devices and Circuits, Samuel Y Liao, 3rd edition – 2004, ISBN: 9780135846810. PHI
Antennas for all Applications, John D Kraus, Ronald J Marheka, Ahmad s Khan, 3rd edition-2006, T.M.H, ISBN:9780070601857.

Web links and Video Lectures (e-resources)
1. Introduction to Microwave engineering, IIT Guwhati. https://youtu.be/F07ApLj12sE?si=3pGcsPyljNbH0Emv 2. https://youtu.be/bi1nDg9CqRo?si=dfUJABg2SIVua4Uh NPTEL course: Antennas, by Prof. Girish Kumar, IIT Bombay. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee03/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Electronic Instrumentation**		
Course Code: **P22ECO6051**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Basic Electronics, Digital Electronics and Analog electronics.		
Course learning Objectives:		
CLO1: Discuss the concepts of signal conditioning and data acquisition system CLO2: Explain the different types of transducers and measurement errors CLO3: Differentiate between the DC and AC voltmeters CLO4: Analyze different types of digital voltmeter CLO5: Analyze the operation of ADC and different types of digital instruments. CLO6: Describe the operation of instrumentation amplifier and its applications.		
UNIT – I		**8 Hours**
Qualities of Measurements: Introduction, Performance Characteristics, Static Characteristics, Error in Measurement, Types of Static Error, Sources of Error, Dynamic Characteristics. **Voltmeters and Multimeters:** Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter , Extending Voltmeter Ranges, Loading , AC Voltmeter Using Rectifiers, AC Voltmeter Using Half Wave Rectifier, AC Voltmeter Using Full Wave Rectifier, Peak Responding Voltmeter, True RMS Voltmeter.		
Self-Study Content: 1. Learn about the companies that manufacture standard voltmeters and ammeters, range of operation and their salient features.\		
Textbook Map: **1.1 to 1.7, 4.1 to 4.6, 4.12 to 4.14, 4.17, 4.18**		
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz		
UNIT – II		**8 Hours**
Digital Voltmeters: Introduction, RAMP Technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly Used Principles of ADC, Successive Approximations, **Digital Instruments:** Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time , Universal Counter, Decade Counter, Electronic Counter.		
Self-Study Content: 1. List few practical applications of digital Instruments. 2. Design a digital meter to measure light intensity (Block diagram approach)		
Textbook Map: **5.1 to 5.6, 5.11, 6.1 – 6.7**		
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz		
UNIT – III		**8 Hours**
Transducers: Introduction, Electrical Transducer, Selecting a Transducer, Resistive Transducer, Resistive Position Transducer, Strain Gauges, Resistance Thermometer, Thermistor, Inductive Transducer, Differential Output Transducers, Linear Variable Differential Transducer, Piezo Electrical Transducer.		

Self-Study Content: 1. Analyze few electronic and fiber optic sensors which work on the principal of Transducers. 2. Design a weighing machine using single strain gage (Block diagram approach)	
Textbook Map: **13.1 to 13.11 and 13.15.**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz	
UNIT – IV	**8 Hours**
Signal Conditioning: Introduction, operational amplifier, basic instrumentation amplifier, Applications of instrumentation amplifiers, chopped and modulated DC amplifier. **Recorders:** Introduction, strip chart recorder, galvanometer type recorder, null type recorder, circular chart recorder, X-Y recorder.	
Self-Study Content: 1. Design an op-amp which amplifies every signal by a factor of 2.5 using any simulator tool ((Multisim, Ltspice etc.)	
Textbook Map: **14.1 to 14.5, 12.1 to 12.6.**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz	
UNIT – V	**8 Hours**
Data Acquisition System (DAS): Introduction, Objective of a DAS, Signal Conditioning of the Inputs, Single Channel Data Acquisition System, Multi-Channel DAS, Computer Based DAS, Digital to Analog and Analog to Digital Converters, Data Loggers, Sensors Based Computer Data Systems.	
Self-Study Content: 1. Gather information about data acquisition systems and its uses in fiber optic receivers. 2. Simulate an ADC and DAC using any simulator (Multisim, Ltspice etc.)	
Textbook Map: **17.1 to 17.9**	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz	

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of basic electrical engineering in understanding basic principles of data acquisition system, measuring systems, transducers, instrumentation amplifier and recorders.
CO2: **Identify** and **Determine** various measuring errors and other measurable parameters in measuring instruments
CO3: **Analyze** the working principle of various electronic measuring instruments.
CO4: **Interpret** data acquisition system and various electronic instrumentation systems.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Electronic Instrumentation, H. S. Kalsi, 3rd edition, McGraw Hill, 2010, ISBN-13: 9780-07-070206-6			

Reference Books:
Electronic Instrumentation and Measurements, David A. Bell, 3rd edition, Oxford University Press, 2015. ISBN-13 : 978-0195696141
Modern Electronic Instrumentation and Measuring Techniques, Cooper, Helfrick, Prentice Hall of India. ISBN-13 : 978-9332556065

Web links and Video Lectures (e-resources)
1. Electrical Measurement and Electronic Instruments by Prof. AvishekChatterjee, IIT Kharagpur https://archive.nptel.ac.in/courses/108/105/108105153/

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Introduction to Embedded Systems**		
Course Code: **P22ECO6052**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:100	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Microcontroller
2. Digital signal processing
3. Digital logic design
4. Basic C programming

Course learning Objectives:

CLO1: Provide the knowledge about basic concepts of embedded systems.
CLO2: Outline the concepts of typical embedded systems and its applications.
CLO3: Describe the characteristics and quality attributes of embedded systems.
CLO4: Provide the knowledge of software hardware co–design and EDLC.
CLO5: Describe the concepts of real time operating system based embedded systems.

UNIT – I	**8 Hours**

Introduction to Embedded Systems: What is an Embedded system? Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Wearable Devices-The Innovative Bonding of Lifestyle with Embedded Technologies.
The Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components.

Self-Study Content: 1. Study and understand the working operation of the following input devices: (i) IR proximity sensor (ii) Temperature sensor (iii) Humidity sensor.
2. Study the working of Hydraulic and Rotatory Actuators to understand the operation of output devices.

Textbook Map: **1.1 to 1.7, 2.1 to 2.6**

Teaching Learning Process: Flipped Classroom

UNIT – II	**8 Hours**

Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems.
Embedded Systems- Application and Domain Specific: Washing Machine – Application-Specific Embedded System, Automotive – Domain Specific Examples of Embedded System
Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified modeling Language (UML), Hardware Software Trade-offs.

Self-Study Content: 1. Illustrate the different areas that UML has been used in various domains.
2. Interpret how UML can be used for designing a door system. (that can only be opened and closed) also note down the state diagram.

Textbook Map: **3.1, 3.2, 4.1, 4.2, 7.1 to 7.4**

Teaching Learning Process: Poster Presentation

UNIT – III	8 Hours
Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Communication (Excluding Programs), Device Drivers.	
Self-Study Content: 1. Understand the basics of Real time operating systems. 2. Implement the multithread application to satisfy i) Two child threads are created with normal priority ii) Thread 1 receives and prints its priority, sleeps for 50 m sec and then quits.	
Textbook Map: **10.1 to 10.5, 10.7, 10.9**	
Teaching Learning Process: Think- pair- share	
UNIT – IV	**8 Hours**
Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages **The Embedded System Development Environment:** The Integrated Development Environment(IDE), Types of Files Generated on Cross compilation, Disassembler/ Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.	
Self-Study Content: 1. Tabulate the different IDE tools used for the development of embedded systems with proper examples. 2. Distinguish the concept of software for Embedded Systems.	
Textbook Map: **9.1, 9.2, 13.1 (excluding sub articles), 13.2 to13.6**	
Teaching Learning Process: Group discussion with Case study	
UNIT – V	**8 Hours**
The Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Objectives of EDLC, Different phases of EDLC, EDLC Approaches. **Trends in the Embedded Industry**: Processor Trends in Embedded System Embedded OSTrends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.	
Self-Study Content: 1. Discuss the recent key trends used in embedded systems market. 2. Illustrate the different categories of EDLC.	
Textbook Map: **15.1 to 15.5, 16.1 to 16.5**	
Teaching Learning Process: Mentorship and Peerlearning.	

Course Outcomes: At the end of the course students should be able to :
CLO1: **Apply** the knowledge of Microcontrollers to demonstrate various concepts of Embedded systems
CLO2: **Analyze** the different issues involved in embedded system development using real time operating systems.
CLO3: **Relate** the recent trends and overview in the Design of Embedded systems.
CLO4: **Develop** embedded systems applications for a given specification using high level and assembly level language.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Introduction to Embedded Systems, Shibu K V, Second edition, Tata McGraw Hill Education Private Limited, 2009, 2nd Edition, ISBN (13): 978-0-07-014589-4.			

Reference Books:
Embedded Systems: A Contemporary Design Tool, James K Peckol, Wiley, 2008.
Embedded Systems Design: An Introduction to Processes, Tools, and Techniques Arnold S. Berger, ISBN: 1578200733 CMP Books © 2002

Web links and Video Lectures (e-resources)
1. https://www.edx.org/learn/embedded-systems 2. https://www.youtube.com/watch?v=KfFBEBN5UHU

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Introduction to Image Processing**		
Course Code: **P22ECO6053**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks: 50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		
Prerequisite: Basic knowledge of electronics, mathematical background, Basics of signal processing.		
Course learning Objectives:		
CLO1: Understand the fundamentals of digital image processing. CLO2: Understand the image enhancement techniques used in digital image processing. CLO3: Understand the image restoration techniques and methods used in digital image processing. CLO4: Understand the morphological operations and algorithms. CLO5: Understand various segmentation methods used in digital image processing		
UNIT - I		**8 Hours**
Digital Image Fundamentals: What is Digital Image Processing?, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sampling and Quantization.		
Self-Study Content: 1. Prepare a report on basic relationships between pixels of an image		
Textbook Map: 1.1, 1.4, 1.5, 2.1, 2.2, 2.4		
Teaching Learning Process: 1. Power Point Presentation with illustrations 2. Chalk and board 3. Quiz		
UNIT – II		**8 Hours**
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing.		
Self-Study Content: 1. Comprehend the local Histogram Processing techniques		
Textbook Map: 3.1-3.3		
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz		
UNIT - III		**8 Hours**
Spatial Filters: Fundamentals of Spatial Filtering, Smoothing Spatial Filters. **Restoration:** A model of the image Degradation/Restoration Process, Noise models.		
Self-Study Content: 1. Develop an algorithm to add various intensity levels of salt and pepper noise to an image and remove.		
Textbook Map: 3.4 - 3.5, 5.1- 5.2.		
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. MATLAB Simulation		
UNIT - IV		**8 Hours**
Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Region Based Segmentation. A case study on impulse noise and Morphological Image Processing. (Refer, Ref1 and Ref2)		
Self-Study Content: 1. Develop an algorithm to show dilation and erosion of an image.		
Textbook Map: 10.1, 10.2.1 - 10.2.5, 10.3-10.3.2, 10.4.		

Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. Quiz	
UNIT - V	**8 Hours**
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms. **Color Image Processing:** Color Fundamentals, Color Models. A case study on Enhancement of Images using image processing methods.(Refer: Ref-3).	
Self-Study Content: 1. Develop an algorithm to convert colors of an image from RGB to HIS and vice versa.	
Textbook Map: 9.5.1, 9.5.5, 9.5.6, 6.1-6.2.	
Teaching Learning Process: 1. Power Point Presentation 2. Chalk and board 3. MATLAB Simulation	

Course Outcomes: At the end of the course students should be able to :

CO1: **Apply** basic mathematical and signal processing knowledge to understand different image processing stages/components.

CO2: **Interpret** image in various data formats by applying image transformation or processing techniques for different applications

CO3: **Evaluate** the techniques for image enhancement, segmentation and image restoration in the spatial domain.

CO4: **Analyze** the various image processing techniques in spatial domain.

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	Digital Image Processing- Rafael C Gonzalez and Richard E. Woods, PHI, 3e, 2010. **Reference-1**: A Case Study of Impulse Noise Reduction Using Morphological Image Processing with Structuring Elements by V. Elamara et.al., Asian Journal of Scientific Research / DOI: 10.3923/ ajsr.2015.291.303 **Reference-2**: Image Analysis Using Mathematical Morphology by Robert M. Haralicket. al., IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume: PAMI-9, Issue: 4, July 1987, DOI: 10.1109/TPAMI.1987.4767941. **Reference-3**: Enhancement of Images using Morphological Transformations by K.Sreedhar and B.Panlal, International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 1, Feb 2012.			

Reference Books:

Digital Image Processing, S.Jayaraman, S.Esakkirajan, T.Veerakumar, TMH 2014.

Fundamentals of Digital Image Processing, A. K. Jain, Pearson 2004.

Web links and Video Lectures (e-resources)

1. https://youtu.be/ArKe6zMkXnk
2. https://youtu.be/iZmHHVwp0Ow

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Automotive Electronics**		
Course Code: **P22ECO6054**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 3		

Prerequisite:
1. Introduction to Electronics
2. Basics of Mechanical Engineering
3. Basics of Electrical Engineering
4. Engineering Chemistry

Course learning Objectives:

CLO1: Understand the concepts of Automotive Electronics and its evolution and trends.
CLO2: Discuss the various application of electronics systems and ECU in automotive
CLO3: Illustrate the basic principles and applications of sensors and actuators in automotive electronics systems.
CLO4: Analyze various control systems and communication protocols in automotive.
CLO5: Compare and contrast different automotive technologies, analyzing their advantages, disadvantages and applications in various vehicle types and scenarios.

UNIT - I	**8 Hours**

Architecture: Overview, Vehicle system architecture.
Electronic control unit: Operating conditions, Design, Data processing, Digital modules in the control unit Control unit software, Software Development**.**

Self-Study Content: 1. Compare and contrast different automotive systems and components, analyzing their strengths, weaknesses, and applications in various vehicle types and scenarios.
2. Explain how automotive networking enables communication between various vehicle systems, such as engine control, braking, and infotainment, and describe its importance in modern vehicles.

Textbook Map:

Teaching Learning Process: Power Point presentation with brain storming session

UNIT – II	**8 Hours**

Basic principles of networking: Network topology, Network organization, OSI reference model, Control mechanisms.
Automotive networking: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, Coupling of networks, Examples of networked vehicles.
Bus systems: Controller Area Network.

Self-Study Content: 1. Design a simple electronic engine control system, using basic components and principles, to achieve specific performance or efficiency goals.
2. Compare and contrast different types of electronic ignition systems, analyzing their advantages, disadvantages, and applications in various engines and scenarios

Textbook Map:

Teaching Learning Process: Power Point presentation with illustrations

UNIT - III	8 Hours
Bus systems: LIN bus, Bluetooth, MOST bus, TTP/C, FlexRay, Diagnosis interfaces. **Automotive sensors:** Basics and overview, Automotive applications, Features of vehicle sensors, Sensor classification, Main requirements, trends, Overview of the physical effects for sensors, Overview and selection of sensor technologies. **Vehicle security systems:** Acoustic signaling devices, Central locking system, Locking systems, Biometric systems	
Self-Study Content: 1. Illustrate and present the basic principles and applications of Angular Rate Sensors (ARS) in automotive and aerospace industries. 2. Assess the performance, reliability, and durability of different actuators in various engine applications, considering factors like fuel type, engine load, and environmental conditions.	
Textbook Map:	
Teaching Learning Process: Power Point presentation with illustrations and case studies.	
UNIT - IV	**8 Hours**
Electronic Transmission Control: Drive train Management, Market Trends, Control of Automated Shift Transmission AST, Control of Automatic Transmissions, Control of Continuously Variable Transmission, ECUs for Electronic Transmission Control, Thermo-Management, Processes and Tools Used in ECU Development. **Antilock Braking System (ABS):** System overview, Requirements placed on ABS, Dynamics of a braked wheel, ABS control loop, Typical control cycles.	
Self-Study Content: 1. Discuss how the ECS integrates with various engine systems, describing its principles, components, and functions in controlling engine performance, efficiency, and emissions. 2. Demonstrate a Program control units(PCU) -based system for a specific engine control application, selecting appropriate hardware and software components to meet performance, efficiency, and emissions goals.	
Textbook Map:	
Teaching Learning Process: Power Point presentation with animations followed by interaction.	
UNIT - V	**8 Hours**
Electronic Diesel Control (EDC): System overview, Common-rail system for passenger cars, Common-rail system for commercial vehicles, Data processing, Fuel-injection control, Lambda closed-loop control for passenger-car diesel engines, Torque-controlled EDC systems, Data exchange with other systems, Serial data transmission (CAN) **Automatic brake functions, Sensotronic brake control (SBC):** Overview, Standard function, Additional functions, Purpose and function, Design, Method of operation. **Active steering:** Purpose, Design, Method of operation, Safety concept, Benefits of active steering for the driver.	
Self-Study Content: 1. Analyze and present the Design of diagnostic system for a specific Electronic Control System (ECS) application, selecting appropriate tools and techniques to detect and troubleshoot faults. 2. Compare and contrast different Lane Departure Monitor and Tyre Pressure Monitoring System, analyzing their accuracy, reliability and performance in various driving scenarios.	
Textbook Map:	

Teaching Learning Process: Power Point presentation with animations along with case studies, Industry visit/Service station.

Course Outcomes: At the end of the course students should be able to :
CO1: **Illustrate** the use of automotive components, subsystems and basics of Electronic Engine Control in automotive industry.
CO2: **Apply** the concept of automotive sensors and actuators to design automotive system
CO3: **Analyze** the networking of various modules in automotive systems and communication protocols that interface the different electronics components, systems and mechanical counterparts.
CO4: **Analyze** the different automotive control systems and safety-Related Systems.

Suggested Learning Resources:				
Textbooks:				
1.	Title	Author	Year & Edition	Publisher
1	Automotive Mechatronics, Editor: Konrad Reif, ISBN 978-3-658-03974-5, ISBN 978-3-658-03975-2(eBook), Springer Vieweg, 2015			

Reference Books:
Automotive Electronics Design Fundamentals, Nazamuz Zaman, 2015, Springer Publications. ISBN: 978-3-319-17584-3.

Web links and Video Lectures (e-resources)
1. hp-laserjet-1022-basic-driver-eng
2. https://youtu.be/zzpOtJA-Rqw

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **VLSI Laboratory**		
Course Code: **P22ECL606**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=3 : 0 : 2	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 1		

Course learning Objectives:

CLO1: Understand simulation and synthesis of digital design.
CLO2: Design and simulate the various basic CMOS digital circuits and use them in higher circuits like adders and shift registers using design abstraction concepts
CLO3: Explore the CAD tool and understand the flow of the Full Custom IC design cycle.
CLO4: Learn DRC, LVS and Parasitic Extraction of the various designs.
CLO5: Design and simulate the various basic CMOS analog circuits and use them in higher circuits like operational amplifiers using design abstraction concepts.

Course Content

Part A:

ASIC-Digital Design / FPGA Digital Design:

The following experiments involve synthesis and verification for logical equivalence.

1. Develop Verilog Code for ALU.
2. Develop Verilog code for Universal Shift Register.
3. Develop Verilog Code for Serial adder.
4. Develop Verilog Code for Radix-4 Booth Multiplier.
5. Develop Verilog Code for Parallel adder.
6. Develop Verilog code for State Machine.

Part B:

Analog Design Flow:

Perform the following steps for experiments listed below:

Steps:

1. Draw the schematic and verify the following: DC Analysis, Transient Analysis.
2. Draw the Layout and verify the DRC, ERC, and check for LVS.
3. RC extraction

Experiments

1. Design a NOT gate with given specification.
2. Design the following amplifiers in different topologies, for the given specification
   - Common source amplifier
   - Common Drain amplifier.

Design an OPAMP for given specifications using Differential Amplifier.

Open Ended Experiments:

1. Design and simulate Gilbert cell for Analog multiplication

Course Outcomes: At the end of the course students should be able to :
CO1: **Apply** the knowledge of the digital system to design the schematic and layout in cadence tool.
CO2: **Interpret** the outcome of DC Analysis, AC Analysis and Transient Analysis in analog circuits.
CO3: **Create** a basic CMOS circuits like inverter, common source amplifier and differential amplifiers.
CO4: **Analysis** of the **design** for power, timing and area in analog and digital circuits
CO5: **Develop** a Verilog code for digital system and verify its functionality in cadence tool

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Mini Project**		
Course Code: **P22ECMP607**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=0 : 0 : 2: 2	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 40	Exam Hours: 3 Hours	
Credits: 2		

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. **The marks awarded for the project report shall be the same for all the batch mates.**

(ii) **Interdisciplinary**: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

- **Single discipline**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.
- **Interdisciplinary**: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Employability Enhancement Skills (EES) – VI**		
Course Code: **P22HSMC608B**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=0 : 2 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: 28	Exam Hours: 3 Hours	
Credits: 1		

Course Learning Objectives: This course will enable the students to:

- Calculations involving permutations and combinations, probability, ages and data interpretation.
- Explain concepts behind logical reasoning modules of syllogisms and data sufficiency.
- Prepare students for Job recruitment process and competitive exams.
- Develop problem solving skills through various programming language.

UNIT – I		**06 Hours**
Quantitative Aptitude: Permutation and Combination, Probability, Ages.		
Self-study component:	Inferred meaning	
UNIT – II		**06 Hours**
Quantitative Aptitude: Data Interpretation. **Logical Reasoning:** Syllogisms, Data Sufficiency.		
Self-study component:	Chain rule	
UNIT – III		**06 Hours**
Soft skills: Group Discussions, Resume Writing, LinkedIn Profiling, Interview Skills. **Interview Preparation:** Mock GDs, Resume Validation and Personal Interviews.		
Self-study component:	Interpersonal communication	
UNIT – IV	**COMPETITIVE CODING - I**	**06 Hours**

Arrays: Find a peak element which is not smaller than its neighbors, K^{th} Smallest largest element, Kadane's Algorithm, Missing number in array, Rearrange Array Alternately, Sort 0s, 1s and 2s, Trapping Rain Water, Chocolate Distribution Problem, Array Leaders, Minimum Number of Platforms Required for a Railway/Bus Station, Rotate a matrix by 90 degree without using any extra space, Find maximum element of each row in a matrix, Print matrix in snake pattern.

Strings: Reverse words in a given string, Converting Roman Numerals to Integer, Find the

minimum distance between the given two words, Check whether two Strings are anagram of each other, Remove duplicates from a given string, Multiply Strings, Find largest word in dictionary, Longest Common Prefix, Reduce the string by removing K consecutive identical characters, Check if given String is Pangram or not, Compare Version Numbers.

Self-study component:	Logarithmic Complexity with Binary Search

UNIT – V	**COMPETITIVE CODING - II**	**06 Hours**

Linked List: Print the Middle of a given linked list, Reverse a Linked List, Reverse a Doubly Linked List, Rotate a Linked List, Delete middle of linked list, Pairwise Swap Nodes of a given Linked List, Remove duplicates from a sorted linked list, Convert singly linked list into circular linked list, Merge two sorted linked lists, check if a singly linked list is palindrome, Insert a node in the 5^{th} position in a singly linked list.

Stacks and Queues: Parenthesis Checker, Reverse a String using Stack, Reverse an array using Stack, Delete Middle element from stack, Find Next Greater Element using Stack, The Stock Span Problem, Reverse First k Elements of Queue, insert one element at front using queue, Implement a Queue using an Array, Maximum number of diamonds that can be gained in K minutes, Sorting a Queue without extra space.

Database: Introduction to database, Types of SQL statements, MySQL commands.

Self-study component:	Schema change statements in SQL.

Course Outcomes: On completion of this course, students are able to:

COs	**Course Outcomes** with ***Action verbs*** for the Course topics	**Bloom's Taxonomy Level**	**Level Indicator**
CO1	Solve the problems based on Permutation and combination, Probability, ages and data interpretation.	Applying	L3
CO2	Solve logical reasoning problems based on Syllogisms and Data Sufficiency.	Applying	L3
CO3	Apply suitable programming language and / or suitable data structures to solve the given problem.	Applying	L3

Text Book(s):

1. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests by Antti Laaksonen
2. Cracking the Coding Interview by Gayle Laakmann McDowell
3. Fundamentals of Database Systems – Elmasri and Navathe, 6th Edition, Addison-Wesley, 2011.
4. Quantitative aptitude by Dr. R. S Agarwal, published by S. Chand private limited.

5. How to sharpen your interview skills by Prem Vas

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India.
2. Data Base System Concepts – Silberschatz, Korth and Sudharshan, 5th Edition, Mc-Graw Hill, 2006
3. An Introduction to Database Systems – C.J. Date, A. Kannan, S. Swamynatham, 8th Edition, Pearson Education, 2006.
4. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd.

Web and Video link(s):

1. Problem Solving through Programming in C - https://archive.nptel.ac.in/courses/106/105/106105171/
2. https://onlinecourses.nptel.ac.in/noc22_cs91/
3. https://youtu.be/c5HAwKX-suM
4. https://onlinecourses.nptel.ac.in/noc18_cs15/preview
5. http://nptel.ac.in/courses/106106093/
6. http://nptel.ac.in/courses/106106095/

COURSE ARTICULATION MATRIX
(EMPLOYABILITY ENHANCEMENT SKILLS - VI – P22HSMC608B)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2										
CO2	2	2										
CO3	2	2	1									1

Academic Year: 2024-25	Semester: VI	Scheme: P22
Course Title: **Universal Human Values and Professional Ethics**		
Course Code: **P22UHV609**	CIE Marks: 50	CIE Weightage: 50%
Teaching hours/week (L:T:P)=1 : 0 : 0	SEE Marks:50	SEE Weightage: 50%
Teaching hours of Pedagogy: **25 + 5**	Exam Hours: 3 Hours	
Credits: 1		

Course learning Objectives:

CLO1: To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.

CLO2: To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.

CLO3: To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

CLO4: This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.

Module - 1	**3 Hours**

Introduction to Value Education

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations

Module - 2	**3 Hours**

Harmony in the Human Being :

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health

Module - 3	**3 Hours**

Harmony in the Family and Society :

Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order

Module - 4	**3 Hours**

Harmony in the Nature/Existence :

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence

Module - 5	3 Hours
Implications of the Holistic Understanding – a Look at Professional Ethics : Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	

Suggested Learning Resources:

Textbooks:

1.	Title	Author	Year & Edition	Publisher
1	The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1			
2	The Teacher‟s Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G			

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-resources)
Value Education websites, • https://www.uhv.org.in/uhv-ii, • http://uhv.ac.in, • http://www.uptu.ac.in • Story of Stuff, • http://www.storyofstuff.com • Al Gore, An Inconvenient Truth, Paramount Classics, USA • Charlie Chaplin, Modern Times, United Artists, USA • IIT Delhi, Modern Technology – the Untold Story • Gandhi A., Right Here Right Now, Cyclewala Productions • https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw • https://fdp-si.aicte-india.org/8dayUHV_download.php • https://www.youtube.com/watch?v=8ovkLRYXIjE • https://www.youtube.com/watch?v=OgdNx0X923I • https://www.youtube.com/watch?v=nGRcbRpvGoU • https://www.youtube.com/watch?v=sDxGXOgYEKM

Active Based Learning (Suggested Activity in Class)/ Practical Based Learning (Example)
1. Flip Class 2. Seminar/ poster Presentation 3. Individual Role play/Team Demonstration/ Collaborative Activity 4. Case study 5. Learn by Doing