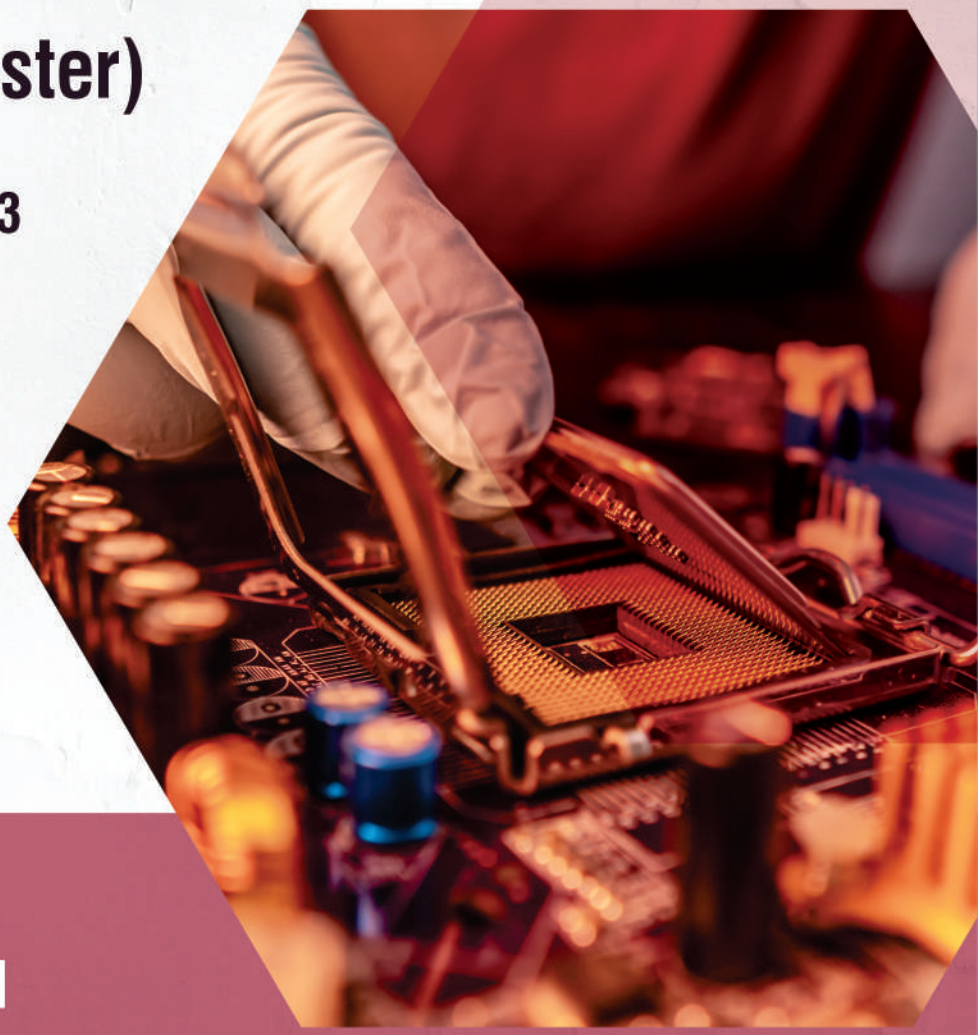
BE SCHEME & SYLLABUS

Third Year
(V and VI Semester)

With effect from 2022-23



Electronics and Communication Engineering

ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service & Excellence

VISION

To be a global premier Institution of professional education and research.

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular for quality professional education.
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies.
- Attract, nurture and retain the best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities (ESR) of the institution.

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E. (CSE, ECE, EEE, ME and CIV) & PG (MBA and MCA)
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2022-23)

Electronics and Communication Engineering

THIRD YEAR

(V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and two of the PG programs, namely MBA and MCA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

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ABOUT THE DEPARTMENT

The Department of Electronics and Communication Engineering was setup during the inception of the college in 2002. With the effort of well qualified faculty and best infrastructure, the Department has grown from strength to strength in the last decade. Currently, the student intake is 120 at the UG level. VTU has approved the Department to offer M.Sc (Engg.) by research and PhD from 2015. The Department strives to empower students with the skills required to thrive in the field of Digital System Design, VLSI, Wireless Communication, Optical Communication, Embedded Systems, Biomedical Engineering, IoT, Artificial Intelligence and Robotics. Students are encouraged to present papers in symposium and conferences, and to participate in various intercollege technical and nontechnical events.

The Department is well equipped with state-of-art laboratories with the latest tools such as Cadence VLSI Design Suite, Xilinx Vivado-2018, MATLAB 2023a, ARM CORTEX, NI Multisim 14.2, NEXYS 4 DDR Artix-7 FPGA Board, Analog Discovery Kits, Digital Storage Oscilloscopes, Digital Signal Generators, Workstations etc. to skill the students Industry ready. With a large collection of books and materials for students, faculty, and staff, the Department offers a well-organized library. In addition, the Department has Biomedical Electronics Research Lab to encourage students to develop projects in the field of Biomedical Engineering in association with Father Mullers Research Centre and Hospital Mangaluru, Cyclops MedTech Private Limited Bengaluru and DST-Nitte University Technology Enabling Centre.

The Department has MOU with "Karmic Design Pvt Ltd" Manipal to facilitate the students in semiconductor chip design. Also, Department has MoU with College of Electrical & Information Engineering, Asia University, Taiwan to encourage students for Internship in the emerging areas such as Image Processing, Artificial Intelligence, Deep Learning, Computer Networks, Cyber Security etc. The Department actively organizes Industry visits, Conferences, Workshops, Technical talks, Faculty Development Programs from Industry/Academic experts in order to enhance students' learning abilities, creative thinking and also to bridge the gap between the Industry and Academia.

PRODIGY student association and **Samarthya Club** of the Department provides ample opportunities for the students to excel in technical and extra-curricular activities. The Department has well qualified faculty who are specialized in their respective domain and are actively involved in research. The Department has been shaping industry-ready graduates who have carved successful careers in the industry with placements almost nearing 100%.

DEPARTMENT VISION

To Excel in Electronics and Communication Engineering Education and Research, focusing on the needs of Industry and Society, with professional ethics.

DEPARTMENT MISSION

- Provide opportunities to deserving students for quality professional education in the field of Electronics and Communication.
- Design and deliver curricula to meet the changing needs of industry through student centric learning methodologies to excel in their profession.
- Recruit, Nurture and Retain best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities of the institution.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide students with the solid foundation in mathematical, scientific, Electronics and Communication engineering to analyze data and technical concepts for application to product design and also to pursue higher education.

2. To train students with good scientific and engineering breadth, including proficiency in software language and use of latest software tools so as to comprehend, analyze, design and create novel products and solutions for the real-life problems.
3. To develop skills in students for successful careers in industry that meet the needs of Indian and multinational companies, through rigorous education.
4. To inculcate in students professional and ethical attitude, effective communication skills and teamwork, multidisciplinary approach, and an ability to relate engineering issues to broader social context.
5. To provide students with an academic environment to become aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

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

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

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

PSO1: Analyze and develop solutions in the areas of Signal Processing and Communication Systems.

PSO2: Apply knowledge of Embedded Systems and VLSI to design and develop solutions for societal problems.

V Semester (B.E. – Electronics and Communication Engineering)													
Sl. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	HSMC	22ECE51	Technological Innovation Management and Entrepreneurship	ECE	ECE	3	-	-	03	50	50	100	3
2	IPCC	22ECE52	Digital Signal Processing (Integrated)	ECE	ECE	3	-	2	03	50	50	100	4
3	IPCC	22ECE53	ARM Processor and Microcontroller (Integrated)	ECE	ECE	3	-	2	03	50	50	100	4
4	PCC	22ECE54	Digital Communication	ECE	ECE	3	-	-	03	50	50	100	3
5	PCCL	22ECE55L	Digital Communication Lab	ECE	ECE	-	-	2	03	50	50	100	1
6	PEC	22ECE56X	Professional Elective - I	ECE	ECE	3	-	-	03	50	50	100	3
7	AEC/ SDC	22RMI57	Research Methodology and Intellectual Property Rights	ECE	ECE	2	-	-	03	50	50	100	2
8	AEC/ SDC	22ETP58	Emerging Technologies: A Primer	COM	COM	-	-	2	03	100	-	100	1
					Total	**17**	**-**	**8**	**24**	**450**	**350**	**800**	**21**

22ECE56X : Professional Elective I			
22ECE561	Operating Systems	22ECE563	Data Structures and Algorithms
22ECE562	FPGA Based System Design	22ECE564	Basics of Machine Learning

VI Semester (B.E. – Electronics and Communication Engineering)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total Marks**	
						L	**T**	**P**					
1	IPCC	22ECE61	CMOS VLSI (Integrated)	ECE	ECE	3	-	2	03	50	50	100	4
2	IPCC	22ECE62	Computer Communication Networks (Integrated)	ECE	ECE	3	-	2	03	50	50	100	4
3	PCC	22ECE63	Microwave and Antennas	ECE	ECE	3	-	-	03	50	50	100	3
4	PEC	22ECE64X	Professional Elective -II	ECE	ECE	3	-	-	03	50	50	100	3
5	OEC	22ECE65X	Open Elective -I	ECE	ECE	3	-	-	03	50	50	100	3
6	PRJ	22ECE66	Major Project Phase - I	ECE	ECE	-	-	4	03	100	-	100	2
7	HSMC	22CIV67	Environmental Studies	CIV	CIV	1	-	-	02	50	50	100	1
8	AEC/SDC	22IIP68	Innovation and Intellectual Property	COM	COM	-	-	2	03	100	-	100	1
					Total	**16**	**-**	**10**	**23**	**500**	**300**	**800**	**21**

22ECE64X : Professional Elective II			
22ECE641	Information Theory and Coding	22ECE643	Biomedical Signal Processing
22ECE642	Verification of Digital Systems	22ECE644	Neural Networks and Deep Learning

22ECE65X : Open Elective I			
22ECE651	Fundamentals of Electronics Engineering	22ECE653	Microcontroller
22ECE652	Sensors and Signal Conditioning	22ECE654	Automotive Electronics

V Semester

Technological Innovation Management and Entrepreneurship			
Course Code	**22ECE51**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Identify trends and opportunities in technology entrepreneurship.
- Explain the five pillars of technology entrepreneurship.
- Generate and assess technology venture ideas using the idea generation process.
- Create a comprehensive business model canvas outlining the nine building blocks.
- Develop a technology business plan and understand reasons for business plan failures.
- Describe the nature, functions, and importance of management in technology ventures.

Module-1 Technology Entrepreneurship (8 hours)

Trends and Opportunities- Five Pillars of Technology Entrepreneurship: Value Creation, The Lean Start-up, Customer Discovery and Validation, The Business Model Canvas, The Entrepreneurial Method-Principles of entrepreneurial method.

Textbook 1: 1.1, 1.2 and Chapter 2

Module-2 Technology Innovation (8 hours)

Technology Venture Idea Generation, Fundamental Venture Types, The Idea Generation Process, The Opportunity Register, Non-traditional Idea Sources, The Idea Development Process, The Concept of Newness, Opportunity Assessment Plan, Disruptive Technology.

Textbook 1: Chapter 3

Module-3 Business Model Canvas (8 hours)

Need for business model, 9 Building blocks of Business Model: Customer Segments, Value Propositions, Channels, Customer Relationships, Revenue Streams, Key Resources, Key Activities, Key Partners, and Cost Structure.

Textbook 2: Chapter 1

Module-4 Business Plan (8 hours)

Developing and Implementing the Technology Business Plan- Purpose of the Plan- Elements of the Business Plan, why business plans fail?

Textbook 4: Selected topics from Chapter 8, Page No 159-164

Module-5 Management & Planning (8 hours)

Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession

Textbook 3: Selected topics from Chapters 1

Planning-Nature, Importance, Types, Steps and Limitations of Planning.

Textbook 3: Selected topics from Chapters 4

Course Outcomes: At the end of the course the student will be able to:	
22ECE51.1	Apply the five pillars of technology entrepreneurship.
22ECE51.2	Discuss the technology venture idea generation.
22ECE51.3	Discuss developing and implementing the technology business plan.
22ECE51.4	Create a comprehensive business model canvas outlining its 9 key components.
22ECE51.5	Summarize the Functions, Roles / Levels of Management.
22ECE51.6	Discuss the essentials of planning and its importance in the businesses.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Technology Entrepreneurship- Taking Innovation to the Marketplace	Thomas N. Duening, Robert D. Hisrich, Michael A. Lechter	Elsevier	2nd Edition 2015
2	Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers (The Strategyzer Series)	Alexander Osterwalder & Yves Pigneur	Wiley	1st Edition 2010
3	Principles of Management	P.C Tripathi, P.N Reddy	McGraw Hill Education	6th Edition 2017
4	Entrepreneurship Development Small Business Enterprises	Poornima M Charantimath	Pearson Education	3rd Edition 2018
Reference Books				
1	Essentials of Management: An International, Innovation and Leadership perspective	Harold Koontz, Heinz Weihrich	McGraw Hill Education	10th Edition 2016

Web links and Video Lectures (e-Resources):

https://jdmeier.com/10-best-innovation-frameworks/
https://ideascale.com/blog/what-is-technology-innovation/
https://www.investopedia.com/terms/b/business-plan.asp
https://hbr.org/1985/05/how-to-write-a-winning-business-plan

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE51.1	1									2				
22ECE51.2									2	2				
22ECE51.3				1					2	2				
22ECE51.4				1					2	2				
22ECE51.5										2				
22ECE51.6	1									2				

1: Low 2: Medium 3: High

Digital Signal Processing			
Course Code	**22ECE52**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Apply DFT as linear transformation
- Study the properties and the development of efficient algorithms for the computation of DFT.
- Realize FIR and IIR filters in different structural forms.
- Study the different windows used in the design of FIR filters and design appropriate filters based on the specifications.
- Learn the procedures to design IIR filters from the analog filters using bilinear transformation.
- Comprehend the architecture and working of DSP processor.

Module-1 Discrete Fourier Transform (8 hours)

The DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution, Additional DFT properties.
Textbook 1: 7.1.3,7.2

Module-2 Fast Fourier Transform (8 hours)

Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long Data Sequences.
Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT, Direct computation of DFT, Radix-2 FFT algorithms.
Textbook 1: 7.3, 8.1, 8.1.1, 8.1.3

Module-3 FIR Filter (8 hours)

Characteristics of practical frequency –selective filters, Design of FIR Filters-Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows, Blackman. Structures for FIR Systems: Direct form, Lattice structures**.**
Textbook 1: 10.1.2, 10.2, 10.2.1, 10.2.2, 9.2, 9.2.1, 9.2.4

Module-4 IIR Filter (8 hours)

Design of IIR filters from analog filters, IIR filter design by Bilinear Transformation, Characteristics of commonly used analog filters – Butterworth, Frequency Transformations in analog Domain, Realization of IIR Filters in Direct form I and II.
Textbook 1:10.3, 10.3.3, 10.3.4, 10.4.1,9.3.1

Module-5 Digital Signal Processor (8 hours)

DSP Architecture, DSP Hardware Units, Fixed- and floating-point formats, FIR and IIR filter implementations in Fixed point systems.
Textbook 2: 9.1, 9.2, 9.4, 9.5

PRACTICAL MODULE

A–Exercise (compulsorily to be conducted):

Following Experiments to be done using MATLAB:

1. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
2. Verification of DFT properties (like Linearity and Parsevals theorem, etc.).

3. Linear Auto and Cross correlation of two sequences and verification of their properties.
4. Circular Auto and Cross correlation of two sequences and verification of their properties.
5. Circular convolution of two given sequences
6. Design and implementation of Low pass and high pass FIR filter to meet the desired specifications (using different window techniques) and test the filter. Plot the spectrum.
7. Design and implementation of a digital IIR Filter-Butterworth (Low pass and High pass) to meet given specifications and test the filter. Plot the spectrum.

Following Experiments to be done using DSP kit

1. Compute Circular convolution of two sequences.
2. Compute the N-point DFT of a given sequence.
3. Generation of Sine wave and standard test signals.

B–Open Ended Experiments:

Design and implementation of filter to remove noise from ECG signal.

Course Outcomes: At the end of the course the student will be able to:	
22ECE52.1	Analyze discrete time signals in the frequency domain using DFT and its Properties.
22ECE52.2	Apply efficient algorithms for the computation of linear filtering and DFT.
22ECE52.3	Design Digital FIR filters using relevant structural forms and implement them for the given specification.
22ECE52.4	Design Digital IIR filters from an analog filter and implement their structures.
22ECE52.5	Analyze the architecture details of fixed- and floating-point DSPs.
22ECE52.6	Develop a System Utilizing DSP Concepts for Signal Processing Applications

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Signal Processing – Principles Algorithms & Applications	John G Proakis & Dimitris G Manolakis	Pearson education, New Delhi	4th Edition 2007
2	Digital Signal processing – Fundamentals and Applications	Li Tan	Elsevier	1st Edition 2008
Reference Books				
1	Digital Signal Processing	D.Ganesh Rao and Vineeth P Gejji	Cengage India Private Limited	1st Edition 2017
2	Digital Signal Processing	J. S. Chittode	Technical Publications	1st Edition 2022

Web links and Video Lectures (e-Resources):

- MIT OPEN COURSEWARE: https://ocw.mit.edu/courses/res-6-008-digital-signal-processing-spring-2011/

Author: Prof Alan V Oppenheim

- NPTEL: https://nptel.ac.in/courses/117102060 Digital Signal Processing by Prof S C Dutta Roy, IIT Delhi.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE52.1		2							1				2	
22ECE52.2				2					1				2	
22ECE52.3	2		2										2	
22ECE52.4	2		2										2	
22ECE52.5	2													
22ECE52.6	2			3	2				2				2	

1: Low 2: Medium 3: High

ARM Processor and Microcontroller			
Course Code	**22ECE53**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Introduce the outline architecture organization of the ARM Processor and Microcontroller.
- Give an overview of system peripherals which cover bus structure, memory map, register programming etc.
- To set up and customize a microcontroller development environment.
- To know the ARM instruction set covering branching, data processing instructions, swap instruction, THUMB instruction set and others.
- Know the internal architecture and interfacing details of the peripheral's devices to interact with other devices.
- Learn to write and debug programs for hardware and software interaction and integration.

Module-1 Introduction (8 hours)

The Microprocessor: Microprocessor Architecture Classification: Instruction Set Architecture, Memory Interface-Based Architecture Classification, Performance Comparison of Different Architectures.

Cortex-M Architecture: Introduction to Cortex-M Microcontroller, Microprocessor Architecture, Nested Interrupt Vector Controller, Bus System and Bus Matrix, Memory and Peripherals.

Exceptions and Interrupts Architecture: The Cortex-M Exceptions and Interrupts, Exception and Interrupt Priority, Handling of Exceptions or Interrupts.

Textbook 1:1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 3.4

Self-Study Topics:

Embedded Systems, Memory Information Storage Device, Interrupt Configuration

Textbook 1: 1.2, 1.4, 3.3

Module-2 Programming (8 hours)

Basics of Assembly Programming: Introduction to ARM Instruction Sets, Cortex-M Assembly Programming Basics, Instruction Set.

Data Processing Instructions: Shift, Rotate, and Logical Instructions, Basic Arithmetic Instructions, Data Movement Instructions, Bitfield Instructions, Test and Compare Instructions, Saturating Instructions.

Memory Access Instructions: Load and Store Instructions, LDR with PC-Relative Addressing Mode, The ADR Instruction, Stack Memory Access with PUSH and POP.

Branch and Control Instructions: Introduction to Conditional Execution, Branch Instructions, Conditional Branch Execution.

Textbook 1: 4.1, 4.2, 4.5, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 6.1, 6.2, 6.3, 6.4, 6.6, 7.1, 7.2, 7.3, 7.7, 7.12

Self-Study Topics: Our First Assembly Program. Implementing Loops and Switch-Case, Recursive Functions, Passing Parameters to Functions, If-Then Conditional Instruction Block, Table Branch Instructions.

Textbook 1: 4.3, 7.5, 7.6, 7.8, 7.9, 7.10, 7.11

Module-3 Interfacing (8 hours)

Fundamentals of Input-Output Interfacing: Basic Microcontroller GPIO Interfacing, Cortex-M-Based TM4C123 Microcontroller, TM4C123 Microcontroller Peripherals, Configuring Microcontroller Pins as GPIOs, Input-Output Interfacing for LED and Switch, Keypad Interfacing, Interfacing an LCD Module.

Textbook 1: 8.1, 8.2, 8.3, 8.4, 8.4, 8.5, 8.7, 8.8

Self-Study Topics: Seven-Segment LED Interfacing. **Textbook 1: 8.6**

Module-4 Timing Interfaces (8 hours)
Basics of Timing Interfaces, clocking a Microcontroller, Timer Basics, TM4C123 Timing Interfaces and Systick Timer, Timer as Input Device, Frequency Measurement Using Timers, Timer as Output Device, General Purpose Timer Modules in TM4C123. **Textbook 1:10.1, 10.2, 10.4, 10.5, 10.6, 10.7, 10.8, 10.9** **Self-Study Topics:** TM4C123 Clock Source and Frequency Configuration, TM4C123 Timer as Input/ Output Device. **Textbook 1: 10:10.3,10.10**
Module-5 Serial Communication Interfaces (8 hours)
Fundamentals of Serial Communication: UART Interface, UART details on TM4C123 Microcontroller, I2C Details on TM4C123 Microcontroller. **Analog Interfacing:** Digital Representation of Analog Signals, ADC Types, ADC Details on TM4C123 Microcontroller. **Textbook 1:11.1, 11.2, 11.3, 12.1, 12.2, 12.3, 12.4** **Self-Study Topics:** I2C Interface, Serial Peripheral Interface (SPI) , Need for Analog Interfacing **Textbook 1: 11.4, 11.6, 12.1**

PRACTICAL MODULE

A - Experiments with ARM using Keil software

Data Transfer Programs: Block Moves & Exchange, Sorting, Finding largest element in an array.

Arithmetic Operations: Addition, Multiplication & Division, square, Cube.

Programs to generate delay.

Programs on Counters.

Interfacing experiments with ARM- Keil software using C programming.

Illustrate the interfacing of LED with ARM Microcontroller.

Interface a Stepper motor and DC Motor to ARM Microcontroller.

Interface DAC to generate various waveforms with ARM Microcontroller.

Interface a simple Switch and display its status through Relay, and Buzzer.

B - Open Ended Experiments:

1. Open Ended Experiment on the hardware implementation using ARM microcontroller

Course Outcomes: At the end of the course the student will be able to:	
22ECE53.1	Interpret the basic concept of Microprocessor and Microcontrollers based digital systems.
22ECE53.2	Illustrate the detailed software and hardware structure of the Microprocessor and Microcontroller.
22ECE53.3	Analyze pin functions/ports for implementing peripheral interfaces with Microprocessor and Microcontrollers.
22ECE53.4	Develop Assembly language programming skill using the instruction set of Cortex-M
22ECE53.5	Describe the architectural features and instructions of ARM Cortex-M microcontroller.
22ECE53.6	Apply the knowledge gained on programming the ARM microcontroller for different real time applications.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	ARM Microprocessor Systems Cortex®-M Architecture, Programming, and Interfacing	Muhammad Tahir and Kashif Javed	CRC Press Taylor & Francis Group Boca Raton London New York	1st Edition 2017
Reference Books				
1	ARM assembly language: an Introduction	J. R. Gibson, ARM (Firm)	Cengage Learning	2nd Edition 2011
2	The Definitive Guide to the ARM Cortex-M3 and Cortex-M4 Processors	Joseph Yiu	Newnes, (Elsevier)	3rd Edition 2014
3	ARM System Developer's Guide Designing and Optimizing System Software	Andrew N. Sloss Dominic Symes Chris Wright	Morgan Kaufmann (Elsevier)	1st Edition 2004
4	ARM Assembly Language	William Hohl, Christopher Hinds	CRC Press	2nd Edition 2015

Web links/Video Lectures/MOOCs:

Embedded System Design With ARM: https://nptel.ac.in/courses/106105193

Embedded Software and Hardware Architecture.: https://www.coursera.org/lecture/embedded-

Arm Cortex-M Architecture and Software Development: https://www.coursera.org/learn/arm-cortex-m-processors- overview course1/home/week/1

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
22ECE53.1	2	2		2	2				2	2				1
22ECE53.2	2	2	3	2										1
22ECE53.3	2		3						2					1
22ECE53.4	2	2		2	2				2	2				1
22ECE53.5	2		2	2	2				2	2				1
22ECE53.6		2	3	2	2				2	2				1

1: Low 2: Medium 3: High

Digital Communication			
Course Code	**22ECE54**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: This Course will enable students to

- Analyze line coding techniques in representing digital data.
- Design different digital modulation techniques and measure their performances.
- Study distortion less baseband data transmission techniques.
- Compare the performances of different spread spectrum modulation techniques and identify their applications in communication systems.
- Analyze modulation and demodulation in OFDM systems.

Module-1 Bandpass Signal to Equivalent Low Pass (8 hours)

Digital Communications: Block Diagram of Digital Communication System. Line codes: Unipolar, Polar, Bipolar (AMI) and Manchester code and their power spectral densities Signaling over AWGN Channels: Introduction, Geometric representation of signals, Gram Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel, Optimum receivers using coherent detection: Maximum Likelihood Decoding, Correlation receiver, matched filter receiver

Textbook 1 :1.5, 6.10, 7.1, 7.2, 7.3, 7.4

Module-2 Digital Modulation Techniques (8 Hours)

Phase Shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM, Frequency shift keying techniques using Coherent detection: generation, detection and error probabilities of BFSK and MSK. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagram treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation)

Textbook 1: 7.6, 7.7, 7.8, 7.11, 7.12, 7.13

Module-3 Signaling over Band-Limited Channels (8 Hours)

Introduction, Error Rate Due to Channel Noise in a Matched-Filter Receiver, Intersymbol Interference, Signal Design for Zero ISI, Ideal Nyquist Pulse for Distortion less Baseband Data Transmission, Raised-Cosine Spectrum, Post-Processing Techniques: The Eye Pattern, Adaptive Equalization

Textbook 1: 8.1 to 8.6, 8.8, 8.9

Module-4 Principles of Spread Spectrum (8 Hours)

Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), The Interference Margin, Performance of Coded Spread Spectrum Signals, Some applications of DS Spread Spectrum Signals: Code Division Multiple Access, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95

Textbook 2: 11.3, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.4.2

Module-5 Orthogonal Frequency-Division Multiplexing (8 Hours)

Modulation and Demodulation in an OFDM System, An OFDM System Implemented via the FFT Algorithm, Spectral Characteristics of OFDM signals, Peak-To-Average Power Ratio In OFDM Systems, Applications of OFDM

Textbook 2: 11.2, 11.2.1, 11.2.2, 11.2.3, 11.2.4, 11.2.5

Course Outcomes: At the end of the course the student will be able to:	
22ECE54.1	Illustrate band pass signals and line coding techniques.

22ECE54.2	Analyze the properties of various digital modulation techniques in terms of waveforms, signal constellations and error probabilities.
22ECE54.3	Evaluate the effect of ISI and AWGN, recommend appropriate techniques to control the same for different band limited channel conditions.
22ECE54.4	Compare direct sequence and frequency hopped spread spectrum systems and discuss their applications in communication systems.
22ECE54.5	Investigate the working principle of multicarrier modulation schemes such as OFDM and identify the modulation schemes used in wideband digital communication systems.
22ECE54.6	Examine the spectral characteristics of OFDM signals.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Communication Systems	Simon Haykin	Wiley & sons	1st Edition 2014
2	Fundamentals of Communication Systems	John G Proakis and Masoud Salehi	Pearson Education	1st Edition 2007
Reference Books				
1	Digital Communications	John G Proakis and Masoud Salehi	McGraw -Hill	5th Edition 2014
2	Digital Communications Fundamentals and Applications	Bernard Sklar and Ray	Pearson Education	2nd Edition 2009

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE54.1	2	2		1					2	2			2	
22ECE54.2	2			1	1				2	2			2	
22ECE54.3	2			1					2	2			2	
22ECE54.4	2	1			1				2	2			2	
22ECE54.5	2								2	2			2	
22ECE54.6	2								2	2			2	

1: Low 2: Medium 3: High

Digital Communication Lab			
Course Code	**22ECE55L**	CIE Marks	50
Course Type	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	24 Hours	Credits	01

Course Learning Objectives: This Course will enable students to

- Demonstrate Pulse Code Modulation in digitization of the signal.
- Differentiate between different line codes and their power spectral densities.
- Design and implement digital modulation schemes.
- Measure propagation and bending losses of an optical fiber.
- Analyze and study the characteristic features of the microwave test bench.

Part A

Using discrete circuits:

1. Design and implement ASK transmitter and receiver.
2. Design and implement FSK transmitter and receiver.
3. Design and implement PSK transmitter and receiver.
4. Measurement of propagation loss, bending loss and numerical aperture of an optical fiber.
5. Time Division Multiplexing and Demultiplexing of two band limited signals.
6. Measurements of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.
7. Measurements of directivity and gain of antennas: printed dipole, microstrip patch antenna and printed yagi antennas.

Part B

Using MATLAB/SIMULINK:

8. Design and simulate Pulse Code Modulation and Demodulation system.
9. Simulate NRZ, RZ, Manchester, half-sinusoid and raised cosine pulses and analyze their eye patterns for different noise voltages.
10. Simulate matched filter receiver for improving SNR at the detector.
11. Design DPSK transmitter and receiver and observe the modulated and reconstructed signal.
12. Design QPSK transmitter and receiver and observe the modulation and reconstruction.
13. Open ended experiment covering the entire syllabus.

Course Outcomes: At the end of the course the student will be able to:	
22ECE55L.1	Design and implement pulse code modulation for analog to digital conversion.
22ECE55L.2	Analyze the working of microwave devices and antennas and study their Operating principles.
22ECE55L.3	Analyze the channel losses associated with optical fiber communication System.
22ECE55L.4	Design and implement different digital modulation techniques.
22ECE55L.5	Simulate different line codes and analyze the eye patterns.
22ECE55L.6	Design multiplexing and demultiplexing scheme for digital communication.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	MATLAB/Simulink for Digital Communication	Won Y. Yang, Yong S. Cho Jeong W. Lee	Hongrung Publishing	2nd Edition 2012
2	Digital Communication Systems	Simon Haykin	Wiley & sons	1st Edition 2014
Reference Books				
1	Digital Communications	John G Proakis and Masoud Salehi	McGraw-Hill	5th Edition 2014
2	Digital Communications - Fundamentals and Applications	Bernard Sklar and Ray	Pearson Education	2nd Edition 2009

Web links/Video Lectures/MOOCs/papers

https://in.mathworks.com/academia/courseware/digital-communication-laboratory.html
https://onlinecourses.nptel.ac.in/noc21_ee11/preview
https://nptel.ac.in/courses/117101051

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ECE55L.1			1	2	2				2	2		2	2	
22ECE55L.2			1	2					2	2			2	
22ECE55L.3				2					2	2			2	
22ECE55L.4			1	2	2				2	2		2	2	
22ECE55L.5				2	2				2	2			2	
22ECE55L.6			1	2					2	2		2	2	

1: Low 2: Medium 3: High

Operating Systems			
Course Code	**22ECE561**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain the working of a single user and multiuser operating system.
- Explain how processes are synchronized and scheduled in the system.
- Distinguish the approaches of memory management and virtual memory management.
- Describe the structure and organization of the file systems.
- Interpret the inter- process communication and deadlock situations in OS.

Module-1 Introduction to Operating Systems (8 hours)

Basics of Operating Systems, Goals of an OS, Types of Operating Systems, OS Service, Computational Structures, Resource allocation techniques, Efficiency, OS structure: Layered, Monolithic, Microkernel Operating Systems – Concept of Virtual Machine Resource allocation techniques, Classes operating System.

Textbook 1:1.1-1.3, 3.1-3.3, 4.3-4.7

Module-2 Process Management (8 hours)

OS View of Processes, process Control Block (PCB), Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non-pre-emptive scheduling- FCFS, Highest Response ratio next and SRN, Pre-emptive Scheduling- Round Robin (RR) and LCN, Scheduling in Unix and Scheduling in Linux.

Textbook 1: 5.1, 5.2.1, 5.2.2, 5.3, 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.6.1, 7.6.3

Module-3 Memory Management (8 hours)

Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Virtual Memory (VM) handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux.

Textbook 1: 11.6-11.10, 12.1-12.4, 12.8.1, 12.8.2

Module-4 File Systems (8 hours)

File systems and IOCS, File Operations, File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access.

Textbook 2: 13.1-13.5

Activities: Case studies, Program to analyse file transfer.

Module-5 Message Passing and Deadlocks (8 hours)

Overview of Message Passing, implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection Algorithm, Deadlock Prevention. Introduction to Semaphores.

Textbook 2: 6.6, 6.8.1, 8.3-8.7

Course Outcomes: At the end of the course the student will be able to:	
22ECE561.1	Discuss the Concepts and types of operating systems.
22ECE561.2	Apply the process management algorithms and analyse with suitable parameters.
22ECE561.3	Discuss the memory management techniques involved in operating systems.
22ECE561.4	Describe the file management techniques used in the operating system.
22ECE561.5	Describe message passing, deadlock detection and prevention methods.

22ECE561.6	Identify the latest operating system and discuss the related concepts.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Operating Systems – A concept-based approach	Dhamdhere	McGraw Hill Education	3rd Edition 2012
2	Operating systems concepts,	Silberschatz and Galvin	John Wiley India Pvt Ltd	Global Edition 2023
Reference Books				
1	Operating system–internals and design system	William Stalling	Pearson Education	6th Edition 2008
2	Design of operating systems	Tannanbhaum	Pearson	3rd Edition 2006

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/106/105/106105214/- Prof. Santanu Chattopadhyay
https://www.youtube.com/watch?v=dOiA2nNJpc0
https://www.youtube.com/watch?v=exlaEOVRWQM (scheduling)
Prof Chester Rebeiro, Dept of Computer science and Engineering, IIT Madras

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE561.1	2	2												
22ECE561.2	2	2	2											
22ECE561.3	2	2										2		
22ECE561.4	2	2			2							2		
22ECE561.5	2	2			2									
22ECE561.6	2				2							2		

1: Low 2: Medium 3: High

FPGA Based System Design			
Course Code	**22ECE562**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the FPGA based systems.
- Know FPGA architecture, interconnect and technologies.
- Know different FPGA's and implementation methodologies.
- Understand configuring and implementing digital embedded system and DSP algorithm on FPGA.

Module-1 FPGA Based Systems (6 hours)

Introduction, Basic concepts-Boolean algebra, schematics and logic symbols, Digital design and FPGAs-The role of FPGA, FPGA types, FPGAs vs custom VLSI, FPGA based system design-Goals and techniques, hierarchical design, design abstraction, methodologies.

Textbook 1: 1.1 to 1.4

Module-2 FPGA Architecture (10 hours)

Introduction, FPGA architecture, SRAM based FPGAs-Overview, logic elements, interconnection networks, configuration, Permanently programmed FPGAs-Antifuses, flash configuration, logic blocks, interconnection networks, programming, Chip I/O.

Textbook 1: 3.1 to 3.5

Module-3 Introduction to Programmable Logic (8 hours)

Introduction, History of Digital Logic, Programmable Logic versus Discrete Logic, Programmable Logic versus Processors, Types of Programmable Logic, PLD Configuration Technologies, Programmable Logic Vendors, Programmable Logic Design Methods and Tools.

Textbook 2: 1.1, 1.3 to 1.9

Module-4 Introduction to Digital Logic Design (8 hours)

Introduction, Binary Data Manipulation, Boolean Algebra, Combinational Logic Gates, Combinational Logic Design, Karnaugh Maps, Sequential Logic Design, State Machine Design, Moore versus Mealy State Machines, Memory, Random Access Memory, Read-Only Memory.

Textbook 2: 5.1, 5.3 to 5.6

Module-5 Commercial FPGAs (8 hours)

Commercial FPGAs: Xilinx Nexys 4 DDR, Case study Xilinx Artix 7: implementation of simple combinational and sequential circuits. Applications -Embedded system design using FPGAs, DSP using FPGAs.

Reference 3 - AMD Xilinx Release Notes

Course Outcomes: At the end of the course the student will be able to:	
22ECE562.1	Illustrate the basic concepts of FPGA based systems.
22ECE562.2	Analyze the architecture of FPGA.
22ECE562.3	Summarize the PLDs and CPLDs.
22ECE562.4	Analyze the design considerations of FPGA.
22ECE562.5	Infer different FPGA's and implementation methodologies.
22ECE562.6	Interpret the design of embedded systems and DSP using FPGA.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	FPGA-Based System Design	Wayne Wolf	Pearson Education	1st Edition 2009
2	Digital Systems Design with FPGAs and CPLDs	Ian Grout	Elsevier	1st Edition 2008
Reference Books				
1	Modern VLSI Design: System-on-Chip Design	Wayne Wolf	Pearson Education	3rd Edition 1997
2	Application Specific Integrated Circuits.	M.J.S. Smith	Pearson	1st Edition 2000

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/117/108/117108040/

Digital system design with PLDs and FPGAs – Kuruvilla Varghese, Dept of ECE, IISC Bangalore

https://www.amd.com/en/products/adaptive-socs-and-fpgas/fpga.html

AMD-XILINX Website

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE562.1	1	1										1		
22ECE562.2	1	1												
22ECE562.3	1	1	1									1		
22ECE562.4				1										
22ECE562.5		1	1									1		
22ECE562.6			1											

1: Low 2: Medium 3: High

Data Structures and Algorithms			
Course Code	**22ECE563**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain fundamentals of data structures and applications that are essential for programming and problem solving.
- Analyse linear and non-linear data structures.
- Design and develop various basic and advanced data structures.
- To introduce various techniques for representation of data in real world.
- Demonstrate sorting and searching algorithm.
- To understand the basic concepts of hashing.

Module-1 Introduction to C (8 hours)

Introduction to C: Constants, Variables, Data types, Input Output operations, Operators and Expressions, control statements, arrays, strings, built-in functions, user defined functions, structures, unions and pointers

Textbook 1: Chapter 1, 2

Module-2 Introduction to Algorithm & Data structures(8 hours)

Algorithms: Characteristics of an Algorithm, Representation of an Algorithm, Efficiency of an Algorithm Asymptotic Notations: Big-Oh Notation, Omega Notation, Theta Notation.

Introduction to data structures: Types of data structures, Data Structure Operations, Arrays.

Textbook 1: Chapter 3, 4

Module-3 Linked lists & Stacks (8 hours)

Basic Concepts of Linked lists: Representation of linked lists, Linked list Implementation: Node declaration, Linked list operations, Types of Linked lists: Circular Linked list, Doubly Linked list.

Stacks: Stack Representation in memory, Stack Operations, Stack Implementation

Textbook 1: Chapter 5, 6

Module-4 Queues & Trees (8 hours)

Queues: Basic concepts, Logical representation of Queues, Queue Operations, Queue Implementation, Circular Queues, Priority Queues, Double Ended Queues.

Trees: Basic Concept, Binary Tree, Binary Tree Representation, Binary Tree Traversal, Binary Search Tree, Tree Variants.

Textbook 1: Chapter 7, 8

Module-5 Graphs, Sorting & Searching(8 hours)

Graphs: Basic Concept, Graph Terminology, Graph Implementation, Shortest Path Algorithm, Graph Transversal.

Sorting & Searching: Sorting Techniques, Searching Techniques.

Textbook 1: Chapter 9, 10

Course Outcomes: At the end of the course the student will be able to:	
22ECE563.1	Apply data structures for data organization and traversal.
22ECE563.2	Analyze different data structures based on their organization and functionality.

22ECE563.3	Analyze and implement sorting, searching and data organization using the data structures Stacks and Linked Lists.
22ECE563.4	Discuss the Queues and Trees for data ordering, data searching and evaluating expressions.
22ECE563.5	Apply Graphs for data ordering and data searching.
22ECE563.6	Implement solutions to problems individually or in teams using searching and sorting algorithms.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Data Structures using C	E Balagurusamy	McGraw-Hill Education Pvt Limited	1st Edition 2013
Reference Books				
1	Fundamentals of Data Structures in C	Ellis Horowitz and Sartaj Sahni,	Universities Press	2nd Edition 2014
2	Data Structures using C	Reema Thareja	Oxford Press	2nd Edition 2014

Web links and Video Lectures (e-Resources):

NPTEL :: Computer Science and Engineering - Programming and Data Structure

NPTEL :: Computer Science and Engineering - Data Structures And Algorithms

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE563.1		2												
22ECE563.2		2		2	1									
22ECE563.3				2	2									
22ECE563.4	1	2			1									
22ECE563.5	1	2			2									
22ECE563.6	1	2			1				2					

1: Low 2: Medium 3: High

Basics of Machine learning			
Course Code	**22ECE564**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to be able to

- Understand the fundamental concepts and principles of machine learning.
- Gain hands-on experience in implementing basic machine learning algorithms.
- Develop the ability to evaluate and interpret machine learning models.
- Explore various applications of machine learning in real-world scenarios.

Prerequisites: Basic programming skills- preferably Python, and a fundamental understanding of algebra and statistics.

Module-1 Introduction (8 hours)

Towards Intelligent Machines, Well-Posed Machine Learning Problems, Examples of Applications in diverse fields, Forms of Learning, Basic linear algebra in Machine learning techniques.
Text book1:1.1, 1.2, 1.3, 1.7, 1.9

Module-2 Supervised Learning basics (8 hours)

Learning from Observations, Bias and Variance, Computational Learning Theory, Occam's Razor Principle and over fitting avoidance, Metrics for Assessing Regression and classification Accuracy, overview of Design Cycle and Issues.
Textbook 1:2.1, 2.2, 2.3, 2.4. 2.7, 2.8, 2.9

Module-3 Statistical Learning (8 hours)

Bayesian Reasoning, Bayes Theorem, Naive Bayes Classifier, k-NN Classifier, Discriminant Functions and Regression Functions, Linear Regression with Least Square Error Criterion, Logistic Regression for Classification Tasks.
Textbook 1: 3.3, 3.4, 3.5, 3.6, 3.7

Module-4 Learning with Support Vector Machines (8 hours)

Introduction, Linear Discriminant Functions for Binary Classification, Perceptron Algorithm, Linear Maximal Margin Classifier for Linearly Separable Data, Linear Soft Margin Classifier for Overlapping Classes, Regression by Support Vector Machines, Unsupervised Learning - Data Clustering, Different Clustering Methods.
Textbook 1:4.1, 4.2, 4.3, 4.4, 4.5, 4.8, 7.1, 7.3

Module- 5 Decision Tree learning (8 hours)

Introduction, Classification Decision Tree, Measure of Impurity for Evaluating Splits, ID3, C4.5, and CART Decision Trees, Pruning the Tree, Strengths and Weaknesses of Decision Tree Approach.
Textbook 1:8.1, 8.3, 8.4,8.5, 8.6

Course Outcomes: At the end of the course the student will be able to:	
22ECE564.1	Explain the basic concepts and terminologies of machine learning.
22ECE564.2	Implement supervised and unsupervised learning algorithms.
22ECE564.3	Apply the principal models in machine learning to appropriate problems.
22ECE564.4	Compare the assumption made in each machine learning model.
22ECE564.5	Identify the strengths and weakness of each machine learning model.
22ECE564.6	Analyse advanced machine learning algorithms and their application.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Applied Machine Learning	M. Gopal	McGraw Hill Education	2nd Edition 2021
Reference Books				
1	Introduction to Machine Learning	Ethem Alpaydin	MIT Press	2nd Edition 2010
2	Machine Learning in Action	Peter Harrington	Manning Publications,	1st Edition, 2012
3	Introduction to Machine Learning with Python	Andreas C. Müller & Sarah Guido	O'Reilly Media Inc.	1st Edition, 2017
4	Machine Learning	Tom M Mitchell	McGraw Hill	1st Edition, 2017

Web links and Video Lectures (e-Resources):

https://onlinecourses.nptel.ac.in/noc21_cs85/preview

https://github.com/microsoft/ML-For-Beginners

https://www.youtube.com/watch?v=6mSx_KJxcHI&list=PLlrxD0HtieHjNnGcZ1TWzPjKYWgfXSiWG

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ECE564.1	3													
22ECE564.2	2	1							3					
22ECE564.3	3		2		2									
22ECE564.4	2				3				2					
22ECE564.5	2	1	1		2									
22ECE564.6	2		1		3									

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**22RMI57**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE	3 Hours
Total Hours	25 hours	Credits	02

Course Learning Objectives:

1. To understand the basic concepts related to research
2. To learn the concept of literature survey, review and technical writing
3. To discuss the basics of intellectual property
4. To explain the patents, copyrights, trademarks, industrial designs and geographical indications

Module-1 Research Methodology and Literature Survey (5 hours)

Research Methodology: Meaning, Objectives, Types of research, Method versus methodology, Research process, Criteria of good research.

Literature Survey, Literature Review: Introduction, process, databases and management tools. Identifying gap areas from literature review. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Chapter 1 , Textbook 2: Ch 7-9, 14-17.

Module-2 Technical Writing and Presentations (5 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and Objectives, Methodology, Time frame, Results and discussions, Conclusions. Illustrations.

Research Proposal Writing: Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Chapter 20-22, 26-28, 35.

Module-3 Introduction to IPR and Patents (5 hours)

Introduction to Intellectual Property: Types of IP, Role of IP in the economic and cultural development of the society, IP governance, IP as a global indicator of innovation, National IPR Policy in India. Textbook 3: Chapter 1,

Patents: Conditions for patent, Non-patentable matters, Inventions Eligible for Patenting**,** Salient features of the Indian Patent 1970**,** Process of patenting**,** Types of patent applications**,** Patent infringements**.** Case examples. Textbook 3: Chapter 2: 2.1.

Module-4 Copyright and Trademarks (5 hours)

Copyright: Classes of copyrights, Salient features of the Indian Copyright Act 1957, Criteria for copyright, Copyrights of the author, Copyright Infringements, Non-Copyright Work, Process of copyright registration. Copyright cases.

Trademark: Eligibility Criteria, Classification, Trade Mark Rules 2017, Advantages of registration, Types of trademark registered in India, Process for Trademarks Registration, Case examples.

Textbook 3: Chapter 2: 2.2 and 2.3.

Module-5 Industrial Designs and Geographical Indications (5 hours)

Industrial Designs: Introduction, Eligibility criteria, Famous industrial designs, Features of Design Act 2000, Non-Protectable industrial designs in India, Procedure for Registration of Industrial Designs, Case examples.

Geographical Indications (GIs): Introduction, Rights granted to holders, Popular GIs registered in India, salient features of Geographical Indications of Goods (Registration & Protection) Act, 1999, Non-Registerable GI, Procedure for GI Registration**,** Case examples.

Textbook 3: Chapter 2: 2.4 and 2.5.

Course Outcomes: At the end of the course the student will be able :	
22RMI57.1	To conduct literature survey, review and define a research problem.
22RMI57.2	To follow research ethics and develop the art of writing technical papers and reports.
22RMI57.3	To discuss the role of Intellectual Property and Patents in India.
22RMI57.4	To explain the various aspects of Copyright and Trademark in Indian context.
22RMI57.5	To explain legal aspects of Industrial Designs and Geographical Indications in India.
22RMI57.6	To discuss the case studies related to the different Intellectual Property.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Research Methodology: Methods and Techniques	C R Kothari and Gaurav Garg	New Age International Publishers	4th Edition 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4th Edition 2014
2	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018

Additional Resources: Web links/NPTEL Courses

https://ipindia.gov.in/ (Official website of Intellectual Property India)
https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy
https://www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf
https://corpbiz.io/learning/design-infringement-in-india/
https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))
https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1**	**PO1**	**PO1**	**PSO**	**PSO**
22RMI57.1	-	2	-	-	1	-	-	-	-	-	-	2	-	-
22RMI57.2	-	-	-	-	1	-	-	3	-	2	-	-	-	-
22RMI57.3	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.4	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.5	-	-	-	-	-	2	-	-	-	2	-	-	-	-
22RMI57.6	-	-	-	-	-	2	-	-	-	2	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	22ETP58	CIE Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	1	Exam Hours	03

Course Learning Objectives:

1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

Course Outcomes: At the end of the course the student will be able to:

22ETP58.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
22ETP58.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
22ETP58.3	Apply RPA principles and tools to automate common tasks to boost productivity.
22ETP58.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
22ETP58.5	Explain the fundamentals of quantum computing and its real-world applications.
22ETP58.6	Develop a solution using emerging technologies for a real-world problem in teams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	Fourth Edition, 2020
2	Blockchain Technology	Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan	Universities Press (India) Pvt. Ltd.	First Edition 2020
3	Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology	Utpal Chakraborty	BPB Publications	First Edition, 2022
4	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath	Alok Mani Tripathi	Packt Publishing	First Edition 2018
5	Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity	Dr. Erdal Ozkaya	Packt Publishing Limited	First Edition 2019
6	Quantum Computing: A Gentle Introduction	Eleanor G. Rieffel, Wolfgang H. Polak.	MIT Press	First Edition 2014
Reference Books				
1	Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities	Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena	CRC Press	First Edition 2022
2	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress Berkeley, CA	2020
3	The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF)	Alan Calder	IT Governance Publishing	First Edition 2020

Web links/Video Lectures:

Introduction to Emerging Technologies:

1. https://aiethics.princeton.edu/case-studies/case-study-pdfs/
2. https://research.aimultiple.com/ai-ethics/
3. https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/
4. https://www.sciencedirect.com/science/article/pii/S0268401223000816
5. https://www.youtube.com/watch?v=G2fqAlgmoPo
6. https://www.youtube.com/watch?v=zizonToFXDs

Web 3.0: Blockchain and Metaverse

1. What is Ethereum? | ethereum.org
2. Navigating Remix — Remix - Ethereum IDE 1 documentation (remix-ide.readthedocs.io)

3. Solidity — Solidity 0.6.8 documentation (soliditylang.org)
4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s
5. The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan :: SSRN
6. Ethereum Smart Contract Best Practices (consensys.github.io)
7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

1. https://www.youtube.com/watch?v=nwFed03fS_s
2. https://www.youtube.com/watch?v=ScmK-bKJ4MI

RPA and Robotics:

1. https://www.youtube.com/watch?v=9URSbTOE4YI
2. https://www.youtube.com/watch?v=UEbw7dIOg0g
3. https://www.uipath.com/resources/automation-case-studies
4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

1. https://www.getastra.com/blog/security-audit/what-is-vapt/
2. https://owasp.org/www-project-top-ten/
3. https://owasp.org/www-project-mutillidae-ii/
4. https://www.youtube.com/watch?v=JAtwZoW76-I
5. Threat modelling (STRIDE framework): https://learn.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats
6. Cyber Kill Chain:https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html

Quantum Computing:

1. https://www.youtube.com/watch?v=e3fz3dqhN44
2. https://quantumai.google/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
22ETP58.1	-	-	-	-		3	-	2	-	--	-	-
22ETP58.2	-	2	-	-	3	-	-	-		-	-	1
22ETP58.3	-	-	-	3	2	-	-	-	--	-	-	-
22ETP58.4	-	-	-	-	3	-		-	-	-	-	1
22ETP58.5	2	-	-	-	3	-	-	-	-	-	-	-
22ETP58.6	-	-	2	-	3	-	--	-	2	-	-	1

1: Low 2: Medium 3: High

VI Semester

CMOS VLSI			
Course Code	**22ECE61**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Analyse the MOS Device Structure.
- Understand the Device Fabrication Process.
- Inspect the working of MOS Inverter with Constraints.
- Analyse the Interconnection Parameters.
- Design and examine the working MOS Combinational and Sequential Designs.

Module-1 MOS Device (8 hours)

The MOS (FET) Transistor – The MOS Transistor under Static Conditions, The Actual MOS Transistor – Some Secondary Effects, SPICE Models for the MOS Transistor.
VLSI Design Flow, Design Hierarchy, Computer – Aided Design Technology, Fabrication of MOSFETs – Introduction, Fabrication Process Flow: Basic Steps, The CMOS n-Well Process, MOSFET Scaling and Small- Geometry Effects – Full Scaling, Constant Voltage Scaling.
Textbook 1: 3.3, 3.3.2, 3.3.4
Textbook 2: 1.5-1.6, 1.11, 2.1-2.3, 3.5

Module-2 The MOS Inverter (8 hours)

Resistive-Load Inverter, Inverter with n-type MOSFET Load (Without Derivations).
Introduction, The Static CMOS Inverter -An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter – The Static Behavior, Performance of CMOS Inverter: The Dynamic Behavior, Power, Energy and Energy Delay.
Textbook 2: 5.2-5.3
Textbook 1: 5.1-5.6

Module-3 Layout and The Combinational Logic Design (8 hours)

MOS Layers, Stick Diagrams, Design Rules and Layout, General Observations on the Design Rules Introduction, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates, Basic Principle of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques – Dynamic Pass Transistor Circuits, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.
Textbook 4: 3.1-3.4
Textbook 2: 7.1, 7.3-7.5, 9.2-7.6

Module-4 The Interconnect (8 hours)

Interconnect Parameters – Capacitance, Resistance and Inductance, Electrical Wire Models – The Ideal Wire, The lumped Model, The Lumped RC Model, The Distributed rc Line
Delay Estimation – RC Delay Model, Linear Delay Model, Logical Effort, Parasitic Delay, Logical Effort and Transistor Sizing, Delay in Logic Gate, Delay in Multistage Logic Network, Choosing the Best Number of Stages, Summary and Observations.
Textbook 1: 4.3-4.4
Textbook 3: 4.2-4.3

Module-5 Sequential Logic Design (8 hours)

Sequencing Static Circuits – Sequencing Methods, Max-Delay Constraints, Min-Delay Constraints, Time Borrowing, Clock Skew.
Introduction, Behavior of Bistable Elements, SR Latch, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge Triggered Flip-Flop.
Textbook 3: 7.2, Textbook 2: 8.1-8.5

PRACTICAL MODULE

A–Exercise (compulsorily to be conducted using Cadence Design Tools):

1. Analysis of ID-VGS and ID-VDS Characteristics of an nMOS Transistor.
2. Verification of Capacitance of a MOS Transistor by simulation.
3. Analysis of Body Effect on a MOS Transistor.
4. Design of a Resistive Load Inverter and its analysis by simulation.
5. Design of a CMOS Inverter and Simulation.
6. Noise Margin and Delay Analysis of a CMOS Inverter.
7. Layout of a CMOS Inverter.
8. Design and analysis of CMOS Combinational Circuits – NAND, NOR and Complex Circuits.
9. Sizing of Combinational Circuits to meet the requirements of a minimum sized CMOS Inverter.
10. Layout of Combinational Circuits.
11. Analysis of a Pass Transistor and Transmission Gate Logic.
12. Design and analysis of CMOS D-Flipflop.

B–Open Ended Experiments:

1. Design of a Schmitt Trigger.

Course Outcomes: At the end of the course the student will be able to:	
22ECE61.1	Analyze MOS transistor and evaluate its secondary effects.
22ECE61.2	Design and examine working of a CMOS Inverter.
22ECE61.3	Illustrate MOS Design Rules and implement complex CMOS combinational designs.
22ECE61.4	Examine the effects of interconnection in a CMOS Design.
22ECE61.5	Design and Inspect CMOS sequential circuits.
22ECE61.6	Design and Analyze CMOS Circuits using Electronic Device Automation Tools.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Integrated Circuits – A Design Perspective	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic	PHI Learning	2nd Edition 2003
2	CMOS Digital Integrated Circuits Analysis and Design	Sung-Mo Kang, Yusuf Leblebici	Tata McGraw Hill	3rd Edition 2003
3	CMOS VLSI Design A Circuits and Systems Perspective	Neil H. E. Weste, David Harris, Ayan Banerjee	Pearson	3rd Edition 2006
4	Basic VLSI Design	Douglas A. Pucknell, Kamran Eshraghian	PHI Learning	3rd Edition 2012

Reference Books				
1	Microelectronic Circuits Theory and Applications.	Adel S Sedra and Kenneth C. Smith	International Version, Oxford University Press	7th Edition 2017

Web links and Video Lectures (e-Resources):

- **NPTEL:**
  https://archive.nptel.ac.in/courses/108/107/108107129/
- **CMOS Digital VLSI Design** by Prof. Sudeb Dasgupta, Electronics and Communication Engineering, IIT Roorkee

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ECE61.1	1	1	1	-	-	-	-	-	-	-	-	-	-	1
22ECE61.2	1	1	1	1	1	-	-	-	-	-	-	-	-	1
22ECE61.3	1	1	1	1	1	-	-	-	-	-	-	-	-	1
22ECE61.4	-	1	1	1	-	-	-	-	-	-	-	-	-	1
22ECE61.5	-	1	1	-	-	-	-	-	-	-	-	-	-	1
22ECE61.6	-	-	1	1	1	-	-	-	1	1	-	1	-	1

1: Low 2: Medium 3: High

Computer Communication Networks			
Course Code	**22ECE62**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: This course will enable students to:

1. Understand the basics of computer network types and network models
2. Understand function of different layers of network model
3. Understand data format headers at different layers
4. Understand design principles of protocol stack

Module-1 Introduction to Computer Networks (8 Hours)

Introduction: Types of Networks, Network Topology.
Network Model - OSI Model, TCP/IP.
Physical Layer – Functions of Physical Layer, Bandwidth Utilization by Multiplexing and Spreading, Line Encoding, Circuit, Packet and Virtual Circuit Switching.
Textbook 1: 1.2, 1.3, 2.2, 2.3, 4.1.2, 6.1, 8.1.1

Module-2 Data link & MAC Layer (8 Hours)

Data link & MAC Layer Services - Framing, Error Control, Channel Access.
Framing – Framing, Bit Stuffing and Character Stuffing.
Error Control - Error detection, CRC Check.
Flow Control - Flow Control in Noiseless and Noisy Channel, Piggybacking.
Media Access Control Layer - Multiple Access Techniques - Random Access – ALOHA, CSMA/CD, CDMA/CA, Ethernet Frame Format.
Textbook 1:10.1, 10.2, 10.3, 11.1, 11.2, 12.1, 13.2.1

Module-3 Network Layer (8 Hours)

Network Layer Services - Routing, Congestion Control, Fragmentation, QoS.
Network Layer Performance – Delay and Throughput.
Logical Addressing - IPv4 Header Classful and Classless Addressing, and IPv6 Header.
Routing - Shortest Path Algorithm**,** Distance Vector Routing, Link State Routing**,** Unicast routing.
Textbook 1:18.1, 18.2, 18.3, 18.4, 19.1, 20.2, 22.2

Module-4 Transport Layer (8 Hours)

Services of Transport Layer - Services of Transport Layer, Addressing, Connection Oriented and Connection Less Protocol.
UDP - Protocol & Header, Services & Application.
TCP - Service Model, Protocol & Header, Connection Management, Sliding Window Management, Timer Management, Congestion Control.
Textbook 1: 23.1.1, 23.1.2, 24.1, 24.2, 24.3

Module-5 Application Layer (8 Hours)

Client Server Protocol & Application Layer
Protocols FTP - FTP Model, Control & Data Connections.
DNS - Domain Name Space, DDNS.
WWW & HTTP -Architecture, Browser, Server, URL, HTTP Methods and connections.
Electronic Mail - Architecture, Message Transfer Agent (SMTP) Message Access Agent (POP & IMAP).
Textbook 1: 25.1, 25.2, 26.1, 26.2, 26.3, 26.6

Practical Module
Part A (Regular Practice Experiments - Compulsory) 1. Implement the HLDC frame for i) Bit stuffing ii) Character stuffing. 2. For the given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a. Without error b. With error. 3. Implement Dijkstra's algorithm to compute the shortest routing path. 4. Implement the distance vector algorithm to find a suitable path for transmission of data. 5. Implement congestion control using a leaky bucket algorithm. 6. Implementation of Stop and Wait Protocol and Sliding Window Protocol. 7. Implementation of Hamming code algorithm for error detection and correction.
Part B (Open Ended Experiments (Any One Experiment)) 1. Interface two computers and perform socket programming and analyze the communication packets. 2. Interface two computers and perform file transfer through FTP and analyze the communication packets. 3. Analyze the HTTP and other layer protocols using Wire shark whenever clients try to access resources from web server. 4. Experiment previously listed experiment on WIFI network and wired LAN and compare the link layer frames. 5. Transfer data between two systems through Bluetooth and analyze the frame structure. 6. Encrypt or Decrypt text message using DES and RSA encryption algorithm. 7. Perform ICMP test between two systems and explain the header structure. 8. Analyze UDP packets referring any application.

Course Outcomes: At the end of the course the student will be able to:	
22ECE62.1	Discuss different network types and network models.
22ECE62.2	Analyse the issues, purpose and functions of link layer.
22ECE62.3	Investigate different routing algorithms & Analyse IP header structure.
22ECE62.4	Discuss the significance of transport layer protocol.
22ECE62.5	Illustrate the design aspects and architecture of different application layer protocols.
22ECE62.6	Analyse the protocols associated with different layers of TCP/IP..

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Data Communication & Networking	Behrouz A. Forouzan	McGraw Hill	4th Edition, 2007
2	Computer Networks	Andrew Tanenbaum & David Wetherall	Pearson	5th Edition, 2014
Reference Books				
1	Data and Computer Communications	William Stallings	Pearson	10th Edition, 2017

2	Introduction to Data Communication and Networking	Wayne Tomasi	Pearson	1st Edition, 2007

Web links/Video Lectures/MOOCs/papers

1. https://nptel.ac.in/courses/106106091
2. https://nptel.ac.in/courses/106105183
3. https://archive.nptel.ac.in/courses/106/105/10610508/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ECE62.1		2												
22ECE62.2	2			2										
22ECE62.3		2		2	1								2	
22ECE62.4	2				1									
22ECE62.5		2			1									
22ECE62.6				2									2	

1: Low 2: Medium 3: High

Microwave and Antennas			
Course Code	**22ECE63**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

- Describe fundamental principles of electric and magnetic fields.
- Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem.
- Apply transmission line theory to analyze and solve problems related to microwave systems.
- Describe the working of microwave passive devices such as coaxial connectors, adapters, attenuators, and phase shifters.
- Compare the directivity, gain, and effective height of different antenna types.

Module-1 Introduction to Electric and Magnetic Fields (8 hours)

Electric Field: Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Gauss's law, Divergence, Maxwell's First equation (Electrostatics) (Text 1: Chapter 2,3)

Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Magnetic flux and Magnetic flux density (Text 1: Chapter 8)

Module-2 Maxwell's Equations and Plane Wave Propagation (8 hours)

Maxwell's Equations: Maxwell's equations in point form, and integral form, Maxwell's equations for different media. (Text 1: Chapter 10)

Uniform Plane Wave: Plane wave, Uniform plane wave, Derivation of plane wave equations from Maxwell's equations, Solution of wave equation for perfect dielectric, Relation between E and H, Wave propagation in free space, Poynting's theorem and wave power.(Conceptual Framework) (Text 1: Chapter 12)

Module-3 Transmission Lines (8 hours)

Microwave Transmission Lines: Microwave Frequencies, Microwave devices, Microwave Systems, Transmission Line equations and solutions, Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio. (Text 2: Chapter 0 & Chapter 3)

Module-4 Microwave Devices and Antenna Basics (8 hours)

Microwave Passive Devices: Coaxial Connectors and Adapters, Attenuators, Phase Shifters, Waveguide Tees, Magic tees. (Text 3:Chapter 6)

Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones. (Text 4: Chapter 2)

Module-5 Antenna Types and its Design Considerations

Antenna Types: Introduction to Dipole Antenna**,** Horn Antennas,The Helix geometry, Helix modes, Practical Design considerations for the mono-filar axialmode Helical Antenna, Yagi-Uda array, Parabolic reflector. (Text 4: Chapter 6,7,8,9)

Course Outcomes: At the end of the course the student will be able :

22ECE63.1	Calculate electric and magnetic field intensities, and derive field distributions for various charge and current configurations using the principles of electrostatics and magnetostatics.
22ECE63.2	Apply Maxwell's equations to study wave propagation in different media and derive key relations between electric and magnetic fields in free space.
22ECE63.3	Analyze microwave transmission line and determine reflection coefficient, standing wave ratio, and impedance matching for efficient energy transfer in

	microwave systems.
22ECE63.4	Analyze the performance of microwave passive devices such as attenuators, phase shifters, and waveguide tees, and understand their role in practical microwave applications.
22ECE63.5	Analyze key antenna concepts, including radiation patterns, gain, and directivity, to understand their impact on communication performance.
22ECE63.6	Comprehend different antenna types and their design parameters for diverse applications.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Engineering Electromagnetics	W.H. Hayt and J.A. Buck	Tata McGraw-Hill	7th Edition, 2006
2	Microwave Devices and Circuits	Samuel Y Liao	Pearson Education	3rd Edition, 2007
3	Microwave Engineering	Annapurna Das, Sisir K Das	TMH Publication	3rd Edition, 2010
4	Antennas and Wave Propagation	John D. Krauss, Ronald J Marhefka, Ahmad S Khan	McGraw Hill Education	4th Edition, 2013
Reference Books				
1	Elements of Electromagnetics	Matthew N.O., Sadiku	Oxford university press	4th Edition, 2007
2	Microwave Engineering	David M Pozar	John Wiley India Pvt Ltd	3rd Edition, 2008
3	Antennas and Wave Propagation	Harish and Sachidananda	Oxford University Press	1st Edition 2007

Additional Resources: Web links/NPTEL Courses

- https://nptel.ac.in/courses/117101056
- https://nptel.ac.in/courses/115101005
- https://nptel.ac.in/courses/108101112
- https://onlinecourses.nptel.ac.in/noc20_ee91/preview

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE63.1	2	3		1								1		
22ECE63.2	3	3		1								1		
22ECE63.3	2		2	2	1							1	1	
22ECE63.4	2			2								1	1	
22ECE63.5	1			2	1							1	1	
22ECE63.6	1											1	1	

1: Low 2: Medium 3: High

Information Theory and Coding			
Course Code	**22ECE641**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the concept of entropy, Rate of information, and order of the source about dependent and independent sources.
- Study various source encoding algorithms.
- Model discrete and continuous communication channels.
- Study various error control coding algorithms.

Module-1 Introduction to Information Theory (8 hours)

Introduction to Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Mark off Sources

Textbook 1: 4.1, 4.2

Module-2 Source Coding (8 hours)

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm. Shannon Fano Encoding Algorithm. Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI, Huffman codes

Textbook 1: 4.3, 4.3.1

Reference Book 4: 2.15

Textbook 2: 2.2

Module-3 Information Channels (8 hours)

Information Channels: Communication Channels, Discrete Communication Channels Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies.

Textbook 1: 4.4, 4.5, 4.51, 4.5.2

Self-Study Portion:

Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel,

Textbook 2: 2.5, 2.6

Binary Erasure Channel, Muroga,s Theorem

Reference Book 4: 2.27, 2.28

Module-4 Error Control Coding (8 hours)

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction.

Textbook 1: 9.1, 9.2,9.3,9.3.1,9.3.2,9.3.3

Introduction to advanced coding techniques: Low-Density Parity Check Codes (LDPC), Polar codes. **(https://archive.nptel.ac.in/courses/117/106/108106137/)**

Module-5 Convolution Codes (8 hours)

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm)

Textbook 2: 8.5.8.6,8.7,8.8,8.9

Introduction to advanced coding techniques: Turbo Codes.

(https://onlinecourses.nptel.ac.in/noc22_ee108/preview)

Course Outcomes: At the end of the course the student will be able to:	
22ECE641.1	Describe the fundamental parameters relevant to information theory.
22ECE641.2	Apply source coding and decoding techniques to solve engineering problems.
22ECE641.3	Categorize different types of channels and channel models.
22ECE641.4	Apply various error detection and correction techniques to address communication engineering problems.
22ECE641.5	Generate and represent cyclic codes and understand their operation.
22ECE641.6	Develop and analyse the encoding and decoding process of convolutional codes.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital and analog communication systems	K. Sam Shanmugam	John Wiley & Sons	2nd Edition, 2006
2	Digital communication,	Simon Haykin	John Wiley & Sons	2nd Edition, 2008 reprint
Reference Books				
1	ITC and Cryptography	Ranjan Bose	TMH	2nd Edition 2007
2	Principles of digital communication	J. Das, S. K. Mullick, P. K. Chatterjee	Wiley	2nd Edition, 2008
3	Digital Communications Fundamentals and Applications,	Bernard Sklar	Pearson Education	2nd Edition 2016
4	Information Theory and Coding	HariBhat, Ganesh Rao	Cengage India Private Limited	1st Edition 2017
5	Error Correction Coding	Todd K Moon	Wiley Std.	2nd Edition, 2006

Web links and video Lecturers

- https://nptelvideos.com/course.php?id=555 (NPTEL)
- https://www.coursera.org/learn/information-theory (Coursera)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE641.1	1													
22ECE641.2	2	2	2	1										
22ECE641.3	2	2		1								1		
22ECE641.4	1		2									1		
22ECE641.5	1	1			1									
22ECE641.6	1				1									

1: Low 2: Medium 3: High

Verification of Digital Systems			
Course Code	**22ECE642**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to:

- To outline the fundamental principles of design verification and its importance in the development of digital systems.
- To evaluate the various verification tools and their roles in the verification process.
- To develop skills in test bench organization and design, including clock generation, stimulus generation, and response assessment.
- To explain decision diagrams, equivalence checking techniques, and symbolic simulation for efficient verification.

Module-1 (8 hours)

An invitation to design verification: What is design verification? The basic verification principle section, Verification methodology section, Simulation-based verification versus formal verification section, Limitations of formal verification section, A quick overview of Verilog scheduling and execution Semantics.

What is verification: What is test bench, The importance of verification, What is being verified?, Functional verification approaches, Testing verses verification, Design and verification reuse, The cost of Verification.

Textbook 1: Chapter 1
Textbook 2: Chapter 1

Module-2 (8 hours)

Coding for verification: Functional correctness, Timing correctness, Simulation performance, Portability and maintainability, Synthesizability, Debug ability, and general tool compatibility, Cycle-based simulation, Hardware simulation/emulation, Two-state and four-state simulation.

Textbook 1: Chapter 2

Module-3 (8 hours)

Verification tools: Linting tools, Simulators, Verification intellectual property, Waveform viewers, Code coverage, Functional Coverage, Verification languages.

The verification plan: The role of verification plan, Levels of verification, Verification strategies, From specification to features, Directed test bench approach, Coverage driven random – based approach.

Textbook 2: Chapter 2
Textbook 2: Chapter 3

Module-4 (8 hours)

Test bench organization and design: Anatomy of a test bench and a test environment, Initialization mechanism, Clock generation and synchronization, Stimulus generation, Response assessment, Verification utility, Test bench-to-design interface, Common practical techniques and methodologies.

Textbook 1: Chapter 4

Module-5 (8 hours)

Test scenarios, assertions, and coverage: Hierarchical verification, Test plan Pseudorandom test generator, Assertions, System Verilog assertion, Verification coverage.

Decision diagrams, Equivalence checking, and Symbolic simulation: Binary decision diagrams, Decision diagram variants, Decision diagram-based equivalence checking, Boolean satisfiability, Symbolic simulation.

Textbook 1: Chapter 5
Textbook 1: Chapter 8

Course Outcomes: At the end of the course the student will be able to:	
22ECE642.1	Demonstrate the principles and importance of design verification in the development lifecycle of digital systems.
22ECE642.2	Summarize the importance of verification in ensuring the reliability, functionality, and correctness of digital system designs.
22ECE642.3	Develop proficiency in coding for verification, ensuring functional correctness, timing correctness, and efficient simulation performance of digital systems.
22ECE642.4	Outline a variety of verification tools and to create comprehensive verification plans, considering different levels of verification.
22ECE642.5	Demonstrate competence in designing and organizing test benches.
22ECE642.6	Discuss decision diagrams, equivalence checking techniques, and symbolic simulation, and apply them to verify digital designs efficiently.

Web links and Video Lectures (e-Resources):
http://www.nptel.ac.in/courses/106103016/#

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Hardware Design Verification: Simulation and Formal Method-Based Approaches	William K. Lam	Pearson Prentice Hall	1st Edition 2005
2	Writing Testbenches: Functional Verification of HDL Models	Janick Bergeron	Springer-Verlag New York Inc	2nd Edition 2003
Reference Books				
1	System Verilog for verification: A Guide to Learning the Testbench Language Features	Chris Spear	Springer-Verlag New York Inc	3rd Edition 2012
2	Getting started with UVM, A beginner's guide,	Venessa R. Cooper	Verilab	1st Edition 2013

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE642.1				2						2				
22ECE642.2		2		2										
22ECE642.3		2		3	3			2		2				
22ECE642.4		2		2	3					2				
22ECE642.5		2			3									
22ECE642.6		2		2										

1: Low 2: Medium 3: High

Biomedical Signal Processing			
Course Code	**22ECE643**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Illustrate the origin and properties of biological signals.
- Describe the basic signal processing techniques in analysing biological signals.
- Apply signal processing techniques for estimating characteristics of ECG signal.
- Apply signal processing methods to analyse the properties of EEG signal.

Module-1 Introduction to Biomedical Signals (8 hours)

Introduction to Biomedical Signals: The nature of biomedical Signals, Examples of biomedical signals, Objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, Computer-aided diagnosis.

Textbook1:1.1-1.5

Module-2 Signal Averaging and Data Compression Techniques (8 hours)

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.

Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding.

Textbook 2:9.1,9.2, 9.3, 9.4, 9.5, 10.1, 10.2, 10.3, 10.4

Module-3 Filtering for Removal of Artifacts (8 hours)

Problem Statement: Random noise, Structured noise, and Physiological interference.

Illustration of the Problem with Case-studies: Noise in event related potentials, High frequency noise in the ECG, Motion artifacts in the ECG, Power-line interference in ECG signals, Maternal interference in the fetal ECG.

Applications: Removal of Artifacts in the ECG, Maternal-Fetal ECG.

Textbook 1: 3.1, 3.1.1, 3.2, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.8, 3.9

Module-4 ECG QRS Detection and Analysis (8 hours)

Power Spectrum of ECG, Band pass filtering techniques, Differentiation techniques, Template matching technique, A QRS detection algorithm.

ECG interpretation, ST-segment analyser, Portable arrhythmia monitor, Simulation of ECG signals using MATLAB.

Textbook 2: Chapter 12.1, 12.2, 12.3, 12.4, 12.5, 13.1, 13.2,13.3

Module-5 EEG Signal Analysis (8 hours)

EEG rhythms, waves and transients, Correlation Analysis of EEG channels, Detection of EEG rhythms, Template matching for EEG spike - and - wave detection, Cross - spectral techniques, Coherence analysis of EEG channels, The matched filter: Detection of EEG spike-and wave complexes. Application: Adaptive segmentation of EEG signals, Simulation of EEG signals using MATLAB.

Textbook 1: 4.2.4, 4.4, 4.4.1, 4.4.2, 4.5, 4.5.1, 4.6, 4.6.1, 8.7

Course Outcomes: At the end of the course the student will be able to:	
22ECE643.1	Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
22ECE643.2	Apply the basic signal processing techniques in analysing biomedical signals.
22ECE643.3	Discuss different types of noise interference and removal techniques in ECG signals.

22ECE643.4	Discuss the detection of events in ECG and apply it in the detection of QRS.
22ECE643.5	Explain the ECG signal acquisition and signal processing methods for extraction of QRS cycle.
22ECE643.6	Apply different algorithms for the detection of EEG spike, wave and transients and analyze extracted features.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Biomedical Signal Analysis: A Case Study Approach	Rangaraj M. Rangayyan	John Wiley & Sons	1st Edition, 2011
2	Biomedical Digital Signal Processing	Willis J. Tompkins	Prentice Hall India	1st Edition, 2011
Reference Books				
1	Biomedical Signal Processing: Principles and Techniques	D C Reddy	McGraw-Hill Education Pvt Limited	1st Edition, 2005

Web links and Video Lectures (e-Resources):

NPTEL Video on Biomedical Signal Processing by Prof.Sudipta Mukhopyay by IIT Kharagpur: https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-ee17/

MIT Courseware on Biomedical Signal and Image Processing: https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE643.1	2	0	0	0	0	0	0	0	1	1	0	0	0	0
22ECE643.2	2	1	0	0	0	0	0	0	0	1	0	0	0	0
22ECE643.3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
22ECE643.4	2	0	0	1	1	0	0	0	0	1	0	0	0	0
22ECE643.5	2	0	1	1	1	0	0	0	0	1	0	0	0	0
22ECE643.6	2	0	1	1	1	0	0	0	0	1	0	0	0	0

1: Low 2: Medium 3: High

Neural Networks and Deep Learning			
Course Code	**22ECE644**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

1. Develop a solid understanding of the fundamental concepts and principles of deep learning.
2. Learn the theoretical foundations of deep learning networks.
3. Study the basic principles, architecture, and functioning of neural networks.
4. Explore various neural network architectures.

Module-1 Neural Networks (8 hours)

Prerequisite: Machine learning Basics.

An Introduction to Neural Networks: Introduction, The basic architecture of neural networks, Training a neural network with back propagation, Practical Issues in neural network training.
Textbook 1:1.1-1.4

Module-2 Deep Feed forward Networks (8 hours)

Deep Feed forward Networks: Example: Learning XOR, Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms
Textbook 2: 6.1-6.5

Module-3 Convolutional Networks (8 hours)

Convolutional Networks: The Convolution, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The neuroscientific basis for convolutional networks
Textbook 2: 9.1-9.10

Module-4 Sequence Modelling: Recurrent and Recursive Nets (8 hours)

Sequence Modelling: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Network
Textbook 2: 10.1-10.6

Module-5 Applications (8 hours)

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing,
Textbook 2: 12:12.1-12.5

Course Outcomes: At the end of the course the student will be able:	
22ECE644.1	Demonstrate the basic principles of neural networks, including architecture, training methodologies and the practical challenges.
22ECE644.2	Interpret the concepts and techniques related to deep feed forward networks, and apply them to solve problems.
22ECE644.3	Design and implement convolutional neural networks for image recognition tasks.
22ECE644.4	Develop skills in convolutional networks to tackle complex image processing tasks.
22ECE644.5	Illustrate sequence modelling techniques to model and analyse sequential data.
22ECE644.6	Apply knowledge of deep learning fundamentals to solve real-world problems

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer	1st Edition 2018
2	Deep Learning	Ian Goodfellow and Yoshua Bengio and Aaron Courville	MIT Press	1st Edition 2016
Reference Books				
1	Simon S. Haykin	Neural Networks and Learning Machines	Pearson	3rd Edition 2009
2	Deep Learning for Computer Vision	Rajalingappaa Shanmugamani	Packt	1st Edition 2018

Additional Resources: Web links/NPTEL Courses

- Deep Learning: https://archive.nptel.ac.in/courses/106/106/106106184/
- Artificial Neural Networks: https://nptel.ac.in/courses/117105084

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE644.1	1	1												
22ECE644.2	1	1												
22ECE644.3	2		1		3									
22ECE644.4	2		1		3									
22ECE644.5	1			2										
22ECE644.6				2	3				1	1		1		

1: Low 2: Medium 3: High

Fundamentals of Electronics Engineering			
Course Code	22ECE651	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain the fundamental characteristics and classifications of resistors, capacitors, and inductors.
- Analyze the performance of half-wave and full-wave rectifiers.
- Explain the construction, operation, and characteristics of JFETs and MOSFETs.
- Design and apply op-amp configurations in various applications.
- Explain the photoelectric effect and working principles of photoelectric devices.

Module-1 Introduction to Passive Circuit Elements (8 hours)

Resistors: Resistor types, Power rating, Variable resistors, resistor color code.

Inductor: Inductance of an Inductor, mutual inductance, Inductors in series and parallel combination, Q-factor of a coil.

Capacitors, capacitance, factors controlling capacitance, Types of capacitors, capacitors in series, capacitors in parallel, energy stored in a capacitor.

Textbook 1: 5.1, 5.2, 5.3, 5.9, 5.11, 5.14, 5.19, 5.21, 5.23, 5.26, 5.34, 5.35, 5.37, 5.38, 5.39, 5.45, 5.47, 5.49

Module-2 Semiconductor Diodes and Applications (8 hours)

P-n junction, p-n junction with no external voltage, forward biased p-n junction, reverse biased p-n junction, V-I characteristics of the diode, reverse breakdown, Ideal diode, diode current equation.

Textbook 2:2, 2,2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.10

Rectifiers: Half-wave and Full-wave rectifiers, Average and rms value of full-wave rectifier output, Ripple factor and Efficiency of a rectifier.

Textbook 2: 3.7, 3.8, 3.9, 3.10, 3.11

Module-3 Introduction to FET and MOSFET (8 hours)

Junction FET (JFET): Basic construction, Theory of operation, JFET Drain characteristics, Transfer characteristics, Advantages of FET's.

Textbook 1: 26.2, 26.4, 26.5, 26.6, 26.12

MOSFET: Depletion MOSFET, construction, working, symbol, Static characteristics of MOSFET.

Textbook 1: 26.13, 26.14, 26.15, 26.16

MOSFET: Enhancement MOSFET, construction, working, symbol, Drain and Transfer characteristics, FET as a switch, and FET Applications.

Textbook 1: 26.17, 26.18, 26.19, 26.20

Module-4 Op-amps and its Basic Applications (8 hours)

Introduction, operational amplifier, characteristics of Ideal op-amp, equivalent circuit, op-amp parameters.

Textbook 2: 5.1, 5.2, 5.2.1, 5.2.2, 5.2.3

Basic op-amp circuits: Inverting amplifier, non-inverting amplifier, voltage follower, summing amplifier, subtractor, Integrator, Differentiator.

Textbook 2: 5.3, 5.3.1, 5.3.2, 5.4, 5.4.1, 5.4.2, 5.4.4, 5.4.5, 5.4.6

Module-5 Photoelectric devices (8 hours)

Photo emissivity, photoelectric theory, applications of photo devices, photoconductivity, multiple junction photodiodes, photovoltaic effect, p-i-n photo detector and avalanche photodiode.

Textbook 3: 17.1,17.2,17.5,17.7,17.9,17.10,17.11,17.12

Course Outcomes: At the end of the course the student will be able to:	
22ECE651.1	Identify and classify various types of resistors, capacitors, and inductors.
22ECE651.2	Analyse the behaviour of inductors and capacitors in series and parallel configurations.
22ECE651.3	Design an optimized rectifier circuit with improved efficiency and reduced ripple factor
22ECE651.4	Describe the basic construction and operation of JFETs and MOSFETs.
22ECE651.5	Design and implement op-amp circuits for practical applications.
22ECE651.6	Illustrate the practical applications of various photo devices.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Basic Electronics Solid State	B.L Theraja	S Chand & Company Ltd.	5th Edition 2004
2	Basic Electronics	K A Navas & T A Suhail	Rajath Publishers	1st Edition 2016
3	Electronic Devices and Circuits	Jacob Millman Halkins Satyabrata JIT	Tata McGraw Hill	2nd Edition 2007
Reference Books				
1	Op-Amps and Linear Integrated Circuits	Ramakanth A Gayakward	Pearson Education	4th Edition 2002
2	Microelectronic Circuits	Adel S. Sedra Kenneth C. Smith	Oxford International Student Edition	6th Edition 2015

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/122106025
- https://www.edutry.com/Course/b-e-computer-engineering/28077/Videos
- https://ocw.mit.edu/courses/8-04-quantum-physics-i-spring-2016/resources/thephotoelectric- effect

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE651.1	3	2	2	-	1	-	-	-	-	-	-	-	-	-
22ECE651.2	3	3	3	2	1	-	-	-	-	-	-	-	-	-
22ECE651.3	3	2	3	1	2	-	-	-	-	-	-	-	-	-
22ECE651.4	3	3	3	2	2	-	-	-	-	-	-	-	-	-
22ECE651.5	2	1	1	1	2	-	-	-	-	-	-	-	-	-
22ECE651.6	3	2	2	1	-	2	-	-	-	-	-	-	-	-

1: Low 2: Medium 3: High

Sensors and Signal Conditioning			
Course Code	**22ECE652**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Provide the fundamental knowledge of basic sensors.
- Acquire knowledge about types of sensors used in modern digital systems.
- Get acquainted about material properties required to make sensors.
- Understand the operations of Signal Conditioning and Data Acquisition System.

Module-1 Introduction to Sensors and Restive Sensors (8 hours)

General concepts and terminology, sensor classification, primary sensors, material for sensors, micro sensor technology, Thermistors, Magneto resistors, Light dependent resistors, Resistive hygrometers, Resistive gas sensors.

Text Book 1: 1.1, 1.2, 1.7, 1.8, 1.9, 2.4, 2.5, 2.6, 2.7, 2.8

Module-2 Self Generating Sensors (8 hours)

Thermoelectric sensors, Piezoelectric sensors, Pyro electric sensors, Photovoltaic sensors.

Text Book 1: 6.1, 6.2, 6.3, 6.4

Module-3 Digital and Intelligent Sensors (8 hours)

Resonant sensors, Sensor based on quartz resonators, SAW sensors, Vibrating wire strain gages, Vibrating cylinder sensors, Digital flow meters.

Text Book 1: 8.2, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5

Module-4 Signal Conditioning (8 hours)

Introduction, Operational Amplifier, Basic Instrumentation Amplifier, Instrumentation Amplifier, Applications of Instrumentation Amplifiers (Specific Bridge)

Text Book 2: 14.1, 14.2, 14.3,14.4

Module-5 Data Acquisition System (8 hours)

Introduction, Objective of a DAS, Signal Conditioning of the Inputs, Single Channel Data Acquisition System, Multi-Channel DAS, Computer Based DAS, Data Loggers.

Data Transmission, Introduction, Data Transmission Systems, Advantages and Disadvantages of Digital Transmission Over Analog.

Text Book 2: 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.8, 18.1, 18.2, 18.3

Course Outcomes: At the end of the course the student will be able to:	
22ECE652.1	Distinguish various types of resistive sensors and their construction.
22ECE652.2	Illustrate various types of self-generating sensors and their construction.
22ECE652.3	Interpret the modern and intelligent sensors.
22ECE652.4	Discuss the working of Operational Amplifier based signal conditioning systems.
22ECE652.5	Outline the working of data transmission systems and distinguish between analog and digital transmission.
22ECE652.6	Illustrate the use of appropriate circuits for signal conditioning of DAS.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Sensors and Signal Conditioning	Ramon Pallás Areny, John G. Webster	John Wiley and Sons	2nd Edition 2000
2	Electronic Instrumentation	H. S. Kalsi	Tata McGraw Hill Education Pvt. Ltd.	3rd Edition 2010
Reference Books				
1	Sensors and Transducers	D. Patranabis	PHI Learning Pvt Ltd	2nd Edition 2013
2	Electrical & Electronic Measurements & Instrumentation	A. K. Sawhney	Dhanpat Rai & Co. Pvt. Ltd	17th Edition 2004

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108105064

https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4sH-zvbNVSE6IpEio

https://www.youtube.com/watch?v=NuQqDFkhIlU&list=PLC7B26029C4E955FA

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE652.1	2	2	1			2	2		2	2				
22ECE652.2	2	2	1			2	2		2	2				
22ECE652.3	2	2	1			2	2		2	2				
22ECE652.4	2	2	1	1										
22ECE652.5	2	2	1	1										
22ECE652.6	2	2	1	1										

1: Low 2: Medium 3: High

Microcontroller			
Course Code	**22ECE653**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers.
- Familiarize the basic architecture of 8051 microcontroller.
- Program 8051microcontroller using Assembly Level Language and C.
- Understand the interrupt system of 8051 and the use of interrupts.
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Interface 8051 to external memory and I/O devices using its I/O ports.

Module-1 8051 Microcontroller (8 hours)

8051 Microcontroller: Microprocessor Vs. Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.
Textbook 2: 1.1 to 1.3, 3.1 to 3.3

Module-2 8051 Instruction Set (8 hours)

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, and Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.
Textbook 2: Chapter 5, Chapter 6, Chapter 7

Module-3 8051 Jump and Call Instructions (8 hours)

8051 Jump and Call instructions: Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples on subroutine and involving loops.
Textbook 2: 8.1 to 8.4

Module-4 8051 Timers and Serial Port (8 hours)

8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051.
Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9-Pin RS232 signals, Simple Serial Port programming in Assembly to transmit a message and to receive data serially.
Textbook 1: 9.1, 9.2, 10.1 to 10.3

Module-5 8051 Interrupts (8 hours)

8051 Interrupts. Programming Time Interrupts, 8051 Assembly language programming to generate an external interrupt using a switch, 8051 Assembly language programming to generate a square waveform on a port pin using a Timer interrupt, Programming external Hardware Interrupt.
Textbook 1:11.1, 11.2, 11.3

Course Outcomes: At the end of the course the student will be able to:	
22ECE653.1	Outline the detailed hardware architecture of the 8051 Microcontroller.
22ECE653.2	Identify the addressing modes and instruction set of 8051 microcontrollers.
22ECE653.3	Describe the various modes of the 8051 Timers.
22ECE653.4	Illustrate the data transfer information through Input/ output ports.

22ECE653.5	Analyse the interrupts for various applications of 8051 microcontroller.
22ECE653.6	Demonstrate the programming skills in assembly language of 8051 microcontroller.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	The 8051 Microcontroller and Embedded Systems – using assembly and C	Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D McKinlay	Pearson	2nd Edition, 2008
2	The 8051 Microcontroller	Kenneth J Ayala	Thomson/Cengage Learning	3rd Edition, 2007
Reference Books				
1	The 8051 Microcontroller Based Embedded Systems	Manish K Patel	McGraw Hill	1st Edition, 2014
2	Microcontrollers: Architecture, Programming, Interfacing and System Design	Raj Kamal	Pearson	1st Edition 2005

Web links and Video Lectures (e-Resources):

NPTEL :: Electrical Engineering - NOC:Microprocessors And Microcontrollers

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE653.1		2	2											
22ECE653.2			2		2							2		
22ECE653.3		2	2											
22ECE653.4	2		2									2		
22ECE653.5			2	2								2		
22ECE653.6	2		2		2							2		

1: Low 2: Medium 3: High

Automotive Electronics			
Course Code	**22ECE654**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Gain knowledge of Ignition, Transmission, and Brakes System in Automobile.
- Understand the concepts of electronic engine control.
- Understand the basic concepts and various Operation using Sensor and Actuators used in Automobile.
- Diagnosis the problem related types of Data Acquisition System.
- Understand the basic of Vehicle Cruise control Systems.

Module-1 Automotive Fundamentals (8 hours)

Four Stroke Cycle, Engine Control, Ignition System, Spark plug, Spark pulse generation, Ignition Timing, Drive Train, Transmission, Suspension, Brakes, Steering System.

Textbook 1: Selected topics of Chapter 1

Module-2 Basics of Electronic Engine Control (8 hours)

Motivation for Electronic Engine Control, Concept of an Electronic Engine Control System, Definition of general terms, Definition of Engine performance terms, Engine Mapping, Electronic Fuel Control System, Engine Control Sequence, Open/loop control, Closed-loop operation, Electronic Ignition.

Textbook 1: Selected topics of Chapter 5

Module-3 Sensors and Actuators (8 hours)

Automotive Control System applications of Sensors and Actuators: Air flow rate sensor, Engine Crankshaft Angular Position (CKP) Sensors, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, and Throttle angle Sensor, Temperature Sensors, Exhaust Gas Oxygen Sensor, Knock Sensors. Automotive Engine Control Actuators: Fuel Injection, Exhaust Gas Recirculation (EGR), Ignition System, Variable Valve Timing (VVT), Electric motors for Hybrid/Electric Vehicles .

Textbook 1: Selected topics of Chapter 6

Module-4 Automotive Instrumentation (8 hours)

Modern Automotive Instrumentation, Input and Output signal conversion, Sampling, Measurement of various parameters (Fuel quantity, Coolant temperature, Oil pressure, Vehicle speed), Display devices (LED, LCD, Transmissive LCD, VFD, CRT, CAN network, Telematics.

Textbook 1: Selected topics of Chapter 9

Module-5 Vehicle Motion Control (8 hours)

Introduction, Typical Cruise Control System, Speed Response Curves, Digital Cruise Control, Throttle Actuator, Cruise Control Electronics, Stepper Motor-Based Actuator, Vacuum-Operated Actuator, Advanced Cruise Control, Antilock Braking System, Tire-Slip Controller, Electronic Suspension System, Electronic Suspension Control System, Electronic Steering Control.

Textbook 1:Selected topics of Chapter 8

Course Outcomes: At the end of the course the student will be able to:	
22ECE654.1	Conceptualize the Engine Parameters and a critical awareness of current problems within the automotive electronics domain using Various Measurement Technology.
22ECE654.2	Analyse Electronic Engine Control principles, evaluate system components, interpret fuel and ignition processes in diverse operational scenarios.

22ECE654.3	Apply the fundamental Concepts of automotive electronics on various Engine parts, Sensor, Actuator, Communication and Measurement System.
22ECE654.4	Describe the various instrumentation involved in a basic automobile.
22ECE654.5	Illustrate the driving assistance and other concepts involved in a vehicle motion control.
22ECE654.6	Outline the modern electronic controls involved in a hybrid vehicles.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Understanding Automotive Electronics	Willliam B. Ribbens	SAMS/Elsevier Publishing	6th Edition 2002
Reference Books				
1	Electric and Hybrid Vehicles: Design fundamentals	Iqbal Husain	CRC Press	3rd Edition 2021
2	Bosch Automotive Electrics and Automotive Electronics	Robert Bosch GmbH	Springer Vieweg	5th Edition 2014

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/107/106/107106088/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22ECE654.1	2													
22ECE654.2	2	1												
22ECE654.3	2													
22ECE654.4	2								2	2				
22ECE654.5	2	1												
22ECE654.6	2													

1: Low 2: Medium 3: High

Major Project Phase I			
Course Code	**22ECE66**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:4)	SEE	-
Total Hours	48 hours	Credits	02

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Report Submission

- **Report**: The project report should include an abstract, introduction, literature review, methodology, completed portion of the project work with the available results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the project report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. **Mentorship and Feedback**

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 100 marks)**
1. Project Synopsis Evaluation	Beginning of the 6th Semester	20 marks
2. Project Progress Evaluation	Middle of the 6th Semester	30 marks
3. Project Report Evaluation (Phase I)	End of the 6th Semester	50 marks
Marks given for the Project Report shall be the same for all project team members, However, marks may differ for presentations and viva-voce depending upon the individual student performance.		
Semester End Examinations (SEE)		
4. There is No SEE component for Major Project Phase I.		

Course Outcomes: At the end of the course the student will be able to :	
22ECE66.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
22ECE66.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
22ECE66.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
22ECE66.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
22ECE66.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.

22ECE66.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
22ECE66.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
22ECE66.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
22ECE66.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
22ECE66.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
22ECE66.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
22ECE66.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**22CIV67**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:0	SEE	2 Hours
Total Hours	15 hours	Credits	01

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology (3 hours)

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic, and Lake. Biodiversity: Types, Value; Hot spots; Threats and Conservation of Biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources (3 hours)

Advances in Energy Systems (Merits, Demerits, Global Status, and Applications): Hydrogen, Solar, OTEC, Tidal, and Wind.
Natural Resource Management (Concept and case studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health (3 hours)

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution, and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns (3 hours)

Global Environmental Concerns (Concept, policies, and case studies): Groundwater depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problems in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management (3 hours)

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications):
G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Fieldwork: A visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; thought to be Followed by an understanding of the process and its brief documentation (Optional).

Course Outcomes: At the end of the course the student will be able to:	
22CIV67.1	Identify the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
22CIV67.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
22CIV67.3	Demonstrate ecology knowledge of a complex relationship between a biotic and abiotic component.
22CIV67.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
22CIV67.5	Address problems related to waste management and public health aspects
22CIV67.6	List the Standards and latest tools to mitigate pollution.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Environmental studies	Benny Joseph	Tata McGraw-Hill	Edition 3, 2018
2	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	Edition 3, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	Dhanpat Rai Publishing Co. (P) Ltd	2017
2	Text book of Environmental Studies for Undergraduate Courses	Bharucha Erach	Universities Press	Edition 2, 2017
3	Environmental Studies	Ranjit R. J Daniels, Jagdish Krishnaswamy	John Wiley & Sons Inc.	2010
4	Perspective in Environmental Studies	Anubha Kaushik, C P Kaushik	New Age International Pvt. Ltd	Edition 3, 2009

Web links and Video Lectures (e-Resources):

1. Coursera Course: Introduction to Environmental Science Specialization - https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
2. NPTEL: Environmental Studies - https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
3. Directory of Open Access Books (DOAB) - Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : http://link.springer.com/openurl?genre=book&isbn=978-4-431- 54339-8
4. Lec 31: Environmental Management Systems (EMS) - https://youtu.be/BYqLRGawoH0
5. ISO 14001:2015 Training - Environmental Management - https://youtu.be/2f4pBIvXkBs

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22CIV67.1	-	-	-	-	-	1	3	-	-	-	-	-	-	-
22CIV67.2	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.3	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.4	-	-	-	-	-	-	3	-	-	-	-	-	-	-
22CIV67.5	-	-	-	-	-	2	3	1	-	-	-	-	-	-
22CIV67.6	-	-	-	-	1	-	-	2	-	-	-	-	-	-

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**22IIP68**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	Exam Hours	3 Hours
Total Hours	20 Hrs	Credits	01

Course Learning Objectives:

1. Learn how to use online databases and search tools for conducting patent searches.
2. Develop skills in analyzing patent documents and identifying relevant prior art.
3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
4. Understand the principles of technology gap analysis and patentability search.
5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.
Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.
Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.
Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process
Activity: Prepare a Patent Draft for the Proposed Capstone Project.

Course Outcomes: At the end of the course, the student will be able to:	
22IIP68.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
22IIP68.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
22IIP68.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.
22IIP68.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
22IIP68.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
22IIP68.6	Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent

	applications, to solve real-world problems and challenges in the field of intellectual property rights.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books/Sources				
1	Intellectual Property-A Primer for Academia (For Module 1)	Rupinder Tewari Mamtha Bhardway	Publication Bureau, Panjab University Chandigarh India	2021
2	Patent Landscape Reports (For Module 2)	WIPO - World Intellectual Property Organization https://www.wipo.int/patentscope/en/programs/patent_landscapes		
3	Guidelines for Preparing Patent Landscape Reports (For Module 2)	Anthony Trippe, Patinformatics, LLC	World Intellectual Property Organization (WIPO)	2015
4	Patent Searching - Tools and Techniques (For Module 3)	David Hunt	John Wiley & Sons Inc	First edition 2007
5	The Complete Patent Book_ Everything You Need to Obtain Your Patent (For Module 4)	James L. Rogers	Sphinx Publishing	First Edition 2003

Additional Resources:

1. WIPO Patent Drafting Manual - Second Edition 2023, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf
2. Patent Drafting for Beginners - https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed
3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India - https://www.ipindia.gov.in/
4. Copyright Office, Government of India - https://copyright.gov.in/
5. United States Patent and Trademark Office - https://www.uspto.gov/
6. Espacenet – patent search - https://worldwide.espacenet.com/
7. The Lens - Free & Open Patent and Scholarly Search - https://www.lens.org/
8. WIPO PATENTSCOPE - https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

Course Outcomes (Cos)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
22IIP68.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
22IIP68.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
22IIP68.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
22IIP68.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
22IIP68.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
22IIP68.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi

Accredited by NAAC with A+ Grade

B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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