SEMESTER IV

Course Code	ECMC207
Course Title	Microwave Engineering
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn fundamentals of microwaves.
- To represent microwave network using scattering matrix.
- To impart knowledge on microwave waveguides and components.
- To study design consideration and principle of operation of microwave tubes.
- To study various microwave semiconductor devices and their applications.

COURSE CONTENTS

Unit I: Introduction to Microwaves
History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves, Mathematical model of Microwave Transmission, Microwave Propagation (Friis Free space propagation model), Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Unit II: Microwave Waveguides and Components
Analysis of Parallel plane waveguides, Rectangular waveguides and Circular waveguides, Rectangular cavity resonator, Microwave Hybrid circuits, Waveguide Tees, Magic tees, Rat-race circuits, Directional coupler, Circulators and Isolators, Wilkinson power divider.

Unit III: Microwave Network Analysis
Equivalent voltages and currents, concept of impedance, impedance and admittance matrices of microwave junctions, scattering matrix representation of microwave networks, ABCD parameters, excitation techniques for waveguides.

Unit IV: Microwave Tubes & Semiconductor Devices
Design considerations and current status of microwave tubes, principle of operation of multi-cavity and reflex klystron, magnetron and traveling wave tube, Applications of Microwave tubes, Operation and circuit applications of Gunn diode, IMPATT diode, PIN Diode, and Schottky barrier diode, HEMT and their applications.

Unit V: Basics of Antennas
Introduction to antennas, Radiation mechanism and Current distribution of single wire, two wire, and dipole, Types of antennas and their applications, Isotropic radiators, Fundamental antenna parameters.

LIST OF EXPERIMENTS

1. To study I-V characteristics of Gunn diode.
2. To study the output power and frequency as a function of voltage characteristic of Gunn diode.
3. To study square wave modulation through Pin diode.
4. To study the characteristics of Reflex Klystron Tube.
5. Measurement of Directional Coupler parameters.
6. To study characteristics of Isolator and Circulator.
7. To study characteristics of Waveguide Tees.
8. Measurement of Frequency and Wavelength.
9. Measurement of Impedance.
10. Antenna Measurements.
11. Low, medium and high VSWR measurements.
12. To study the variable attenuator.
13. To study voice communication using Microwave test bench.
14. To study the square law behavior of microwave crystal detector.
15. To design Microstrip patch antenna using CST microwave studio.
16. To design Vivaldi antenna using CST microwave studio.
17. To design Anti-Podal Vivaldi antenna using CST microwave studio.
18. To design a Frequency selective surface for X-band using CST microwave studio.

Total Periods: 40 + 24 = 64

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the fundamentals of microwave engineering and outline the losses associated with microwave transmission.	K2
CO2	Analyze the operating principles of various microwave devices and recognize their usability in microwave network analysis.	K4
CO3	Analyze the basic mechanism behind the wave propagation in waveguides.	K4
CO4	Identify the effect of microwaves on different parts of human body and study operating principles of microwave tubes.	K3
CO5	Assess the methods used for generation and amplification of microwave power.	K5

TEXT BOOKS

1. Liao. S. Y., "Microwave Device and Circuits", 3rd Edition, Pearson Education, 2000.
2. Pozar, D. M., "Microwave Engineering", 4th Edition, Wiley, 2013.
3. Balanis, C. A., "Antenna Theory and Applications", 4th Edition, Wiley, 2021.

REFERENCE BOOKS

1. Collin, R. E., "Foundations for Microwave Engineering", 2nd Edition, Wiley, 2007.
2. Das, A. and Das, S. K., "Microwave Engineering", 3rd Edition, McGraw Hill Education, 2017.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	2	3	2	-	-	-	3	3	-	3	-	-	-
Score	15	11	4	15	10	2	3	3	5	15	-	15	6	-	8
COM	3	3	2	3	2	2	3	3	3	3	0	3	3	0	2

Course Code	ECMC208
Course Title	Analog Communication
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To understand the concepts of analog modulation and demodulation techniques with the performance of AM, FM and PM schemes.
- To know the design characteristics of Amplitude modulation transmitter and receiver systems.
- To understand the Frequency modulation transmitter and receiver systems.
- To introduce the concepts of various pulse modulation techniques and their demodulation.
- To study the different types of noises in communication systems.

COURSE CONTENTS

Unit I: Modulation Techniques
Various frequency bands used for communication, Types of Communication and need of modulation. Introduction to AM, FM, PM, frequency spectrum of AM Waves, Representation of AM, Power relation in AM waves, Need and description of SSB, Suppression of carrier, Suppression of unwanted side-bands, Independent sideband system, Vestigial sideband system, Mathematical representation of FM, Frequency spectrum of AM waves, wideband and narrow band FM, Phase Modulation.

Unit II: AM Transmitters and Receivers
AM Transmitters: Generation of AM, low level and high level modulation, AM transmitter block diagram, collector class C modulator, Base Modulator, DSB-SC modulator. Generator of SSB, balanced modulator circuit, filter method, phase shift method, third method, Phase cancellation method. AM Receivers: Tuned radio frequency (TRF) receiver. Super heterodyne receiver, RF section and characteristics, mixers, frequency changing and tracking, IF rejection and IF amplifiers. Detection and automatic gain control (AGC), AM receiver characteristics, Demodulation of SSB, product demodulator, Diode detection technique of SSB.

Unit III: FM Transmitters and Receivers
FM Transmitters: Generation of FM, FM Modulation methods: Direct methods (Variable capacitor Modulator, Varactor Diode Modulator, FET Reactance Modulator, Transistor Reactance Modulator, AFC in reactance modulator), Disadvantages of direct method, Indirect modulators (RC-phase shift modulators, Armstrong FM systems). FM Receivers: Limiters, single and double-tuned demodulators (balanced slope detector, Foster-Seeley or Phase Discriminator, ratio Detector, FM Detector using PLL), Pre-emphasis and De-emphasis, Block diagram of FM

Receivers, RF Amplifiers, FM Receiver characteristics, Phase modulator and demodulator circuits.

Unit IV: Pulse Modulation Techniques
Pulse amplitude modulation and demodulation, Pulse width modulation and demodulation, Pulse position modulation and demodulation, Sampling theorem, Time Division Multiplexing, Frequency Division Multiplexing.

Unit V: Noise
Thermal Noise, Shot noise, Partition noise, Flicker noise, Gaussian Noise, Noise in Bipolar Junction Transistors (BJTs), FET noise. Equivalent input noise, Signal to Noise Ratio (SNR), Noise Temperature, Noise equivalent Bandwidth, Noise Figure. Experimental determination of Noise Figure, Pulse Response and its elimination.

LIST OF EXPERIMENTS

1. To study Amplitude Modulation/demodulation using a transistor, depth of modulation, and observe the diagonal peak clipping effect of AM.
2. Frequency Modulation using Voltage Controlled Oscillator.
3. Generation of DSB-SC, SSB, and VSB.
4. Study of Phase Lock Loop (PLL) and detection of FM Signal using PLL.
5. Study functioning of Super-heterodyne AM Receiver, and study the limiter circuit and IF filter frequency response, study of the effect of image frequency.
6. Study functioning of Super-heterodyne FM Receiver
7. Measurement of Sensitivity, Selectivity, and Fidelity of radio receivers.
8. Study of PAM, PPM, and PPM.

Total Periods: 40 + 24 = 64

COURSE OUTCOMES

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

CO	Description	Level
CO1	Analyze and compare different types of modulation and demodulation schemes for their efficiency and bandwidth.	K2
CO2	Attain in-depth knowledge of different Transmitters and Receivers design of amplitude modulation	K3
CO3	Attain in-depth knowledge of different Transmitters and Receivers design of frequency modulation.	K3
CO4	Compare different pulse modulation and multiplexing techniques	K3
CO5	Apply concepts of noises in designing of communication systems.	K2

TEXT BOOKS

1. Haykin S., “Communications Systems”, John Wiley and Sons, 2001.
2. B. P. Lathi, “Modern Digital and Analog Communication Systems,” 4th Edition, Oxford, 2011.

REFERENCE BOOKS

1. Tomasi, W., “Advanced Electronic Communications systems” 6th Edition, Pearson Publishers, 2015.
2. Taub H. and Schilling D.L., ”Prnciples of Communication Systems”, Tata McGraw Hill, 2001.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	3	2	-	-	-	-	3	-	3	-	-	2
CO2	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
CO3	3	3	-	3	2	-	-	-	-	3	-	3	3	-	2
CO4	3	2	2	3	2	2	3	3	2	3	-	3	-	-	2
CO5	3	2	-	3	2	-	-	-	-	3	-	3	3	-	2
Score	15	11	2	15	10	2	3	3	2	15	-	15	9	-	10
COM	3	3	2	3	2	2	3	3	2	3	0	3	3	0	2

Course Code	ECMC209
Course Title	Microprocessor and Microcontroller
Number of Credits (L-T-P-C)	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To understand microprocessor evolution, architecture, and applications, focusing on Intel 8085.
- To learn the development of assembly language programming of 8085.
- To learn essential data transfer methods for microprocessor-based systems.
- To learn the Interfacing of 8085 microprocessor with various peripherals.
- To understand the fundamentals of 16-bit microprocessor architecture.

COURSE CONTENT

Unit I: Introduction to Microprocessors and MicroComputers
History and Evolution, Types of microprocessors, Microcomputer programming languages, Microcomputer architecture, Intel 8085 Microprocessor, Pin Diagram, Architecture Diagram, Addressing Modes, Instruction Format, Types of Instructions, Instruction Set of 8085.

Unit II: Assembly Language Programming, Timing Diagram
Assembly Language Programming in 8085, Macros, Labels and Directives, Microprocessor timings, Micro Instructions, Instruction Cycle, Machine Cycle, T-states, state transition Diagrams, Timing diagrams for different machine cycles. INTERRUPTS: Interrupts in 8085, Issues in implementing interrupts, Multiple Interrupts and priorities, Interrupt handling in 8085, enabling, disabling, and masking of interrupts.

Unit III: Data Transfer Techniques
Data transfer techniques, Introduction to PPI 8255, Programmable Interval Timer/Counter 8253, Programmable Interrupt Controller (8259), DMA Controller (8257), USART (8251).

Unit IV: Microprocessor Interfacing Techniques
Interfacing Traffic Light Interface, Stepper Motor, 4 Digit 7 Segment LED, Elevator, Musical Tone Generator and 8 Channel 12Bit ADC with Multiplexor and A/D converters, D/A converters.

Unit V: Introduction to 8051 Microcontroller
Architecture of 8051, Special Function Registers (SFRs), Pin Diagram, Addressing modes, Instruction set, Assembly language programming, Programming 8051 timers, Serial Port Programming.

LIST OF EXPERIMENTS

1. WAP using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers.
2. WAP using 8085 Microprocessor for addition and subtraction of two BCD number.
3. WAP to perform multiplication and division of two 8 bit numbers using 8085.
4. WAP to find the largest and smallest number in an array of data using 8085 instruction set.
5. WAP to write a program to arrange an array of data in ascending and descending order.
6. WAP to initiate 8251 and to check the transmission and reception of character.
7. WAP to interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
8. Parallel communication between two microprocessors kits using 8255.
9. Serial communications between two microprocessors kits using 8251.
10. To interface DAC with 8085 to demonstrate the generation of square, saw tooth and triangular Wave.
11. Program for sorting an array for 8086.
12. Program to find the factorial of a given number.
13. Programs for searching a number or character in a string for 8086.
14. Programs for string manipulation for 8086.

Total Periods: 40 + 24 = 64

COURSE OUTCOMES

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

CO	Description	Level
CO1	To familiarise with the fundamental concepts of microprocessors and its applications	K2
CO2	Apply programming techniques in developing the assembly language program for microprocessor applications.	K2
CO3	Demonstrate an understanding of various data transfer techniques in microprocessor systems.	K4
CO4	Develop practical skills for interfacing microprocessors with various real-world devices.	K4
CO5	Demonstrate a foundational understanding of 16-bit microprocessor architecture	K2

TEXT BOOKS

1. TRamesh S Gaonkar“Microprocessor Architecture- Programming and Applications with 8085/8080A”, Penram International Publishing (India) Pvt. Ltd, 5th Edition.
2. B. Ram “Introduction of Microprocessors and Microcomputers”, Dhanpat Rai Publisher (P) Ltd, 4th Edition.
3. K Bhurchandi, A. K. Ray, “Advanced Microprocessor and Peripherals”, Tata McGraw-Hill Publishing Company, 3rd Edition (2012).

REFERENCE BOOKS

1. RodnayZaks and Austin Lesea “Microprocessor Interfacing Technique”, BPB Publication, 1st Indian Edition (1988).
2. PJames L Antonakes“An introduction to Intel family of Microprocessors”, Pearson Education, 3rd Edition.
3. Charles M Gilmore, “Microprocessor; Principles and Applications”, McGraw Hill, 2nd Edition.
4. Brey, B. B., “Intel Microprocessors”, 8th Edition, Pearson Education, 2013.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	-		-	2	-
CO5	3	3	3	3	3	3	-	-	-	-	-	-	-	2	-
Score	15	13	15	10	09	03	-	-	-	-	-	-	-	4	-
COM	3	3	3	2	-	2	3	3	-	-	-	-	-	2	-

Course Code	ECMC210
Course Title	Linear Integrated Circuits
L T P C	3-0-2-4
Course Type	MC

COURSE OBJECTIVES

- To learn the fundamentals of BJT Amplifiers.
- To learn the fundamentals of multistage and differential amplifiers.
- To learn general operational amplifiers and linear applications of Op-Amp.
- To impart knowledge on active filters and oscillators.
- To study special IC applications using Op-Amp.

COURSE CONTENTS

Unit I: BJT Amplifiers and Frequency Response of Amplifiers
Introduction of Biasing of BJT, BJT Amplifier using re, π and Hybrid-π Model; Common Emitter, Common Collector, and Common base, Requirement of Frequency Response, Low and High Frequency Response of BJT Amplifiers.

Unit II: Multistage and Differential Amplifiers
Multistage Amplifiers, Types of multistage couplings. Feedback Amplifier; Concept of feedback, Analysis of various configurations of feedback in amplifiers; Current mirror and current sources, Current sources as active loads, BJT Differential amplifier with active loads.

Unit III: General Linear Applications of OP-AMP
Introduction to operational amplifiers, the ideal Op-Amp, Ideal Voltage Transfer curve, Open-loop Op-Amp configurations, Characteristics of practical Op-Amp; The peaking amplifier, Summing, Scaling and Averaging amplifiers, Voltage Follower, Differential input and Differential output amplifier, V-to-I with Floating load and Grounded load, I-to-V converters, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier.

Unit IV: Active Filters and Oscillators Using OP-AMP
Active filters, First-order and second order Butterworth filters; Low pass and High pass, Band pass filters, Band-reject filters, All-pass filter, Oscillators; Principles, Types, Phase shift oscillator, Wein Bridge oscillator, Basic Comparator, Schmitt Trigger, Zero-crossing detector, Astable Multivibrator and Monostable Multivibrator (using op-amp).

Unit V: Special Function IC Applications
The 555 Timer; as a monostable multivibrator, as a astable multivibrator, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators, IC 723 general purpose regulator,

Monolithic switching regulator, Frequency to Voltage and Voltage to Frequency converters, Phase-Locked loops.

LIST OF EXPERIMENTS

1. Design and testing of inverting and non-inverting operational amplifiers.
2. To verify the function of an operational amplifier as an adder and subtractor.
3. To demonstrate the integrator and differentiator circuits using Op-amp.
4. Design and testing Instrumentation amplifier.
5. Design and testing active low-pass, high-pass, band-pass and band-stop filters.
6. Design and testing of astable and mono-stable multi-vibrators using Op-amp.
7. Design and testing Schmitt Trigger and Comparator using Op-amp.
8. Design, Build and Test a Square wave and triangular wave generators using op-amp.
9. To study the operation of IC 565 as PLL.
10. Study of Multiplier IC.
11. To study the output characteristics of half-wave and full-wave rectifier using op-amp.
12. Above experiments are to be Simulated using SPICE.

Total Periods: 40 + 24 = 64

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain the working of BJT Amplifiers and study its frequency response.	K2
CO2	Infer the DC and AC characteristics of multistage amplifiers and explain their effect on the output.	K2
CO3	Explain the working of general-purpose OP-AMP and design the general linear applications of an OP-AMP.	K6
CO4	Examine the functionality of various active filters and oscillators.	K4
CO5	Design application specific ICs such as Voltage regulators, PLL and determine their applications in modern day communication systems.	K6

TEXT BOOKS

1. Gayakwad, R. A., "OP-AMP and Linear Integrated Circuits", 4th Edition, Pearson Education, 2015.
2. Franco, S., "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, McGraw-Hill education, 2016.

REFERENCE BOOKS

1. Choudhary, D. R. and Jain, S. B., "Linear Integrated Circuits", 5th Edition, New Age International, 2018.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	3	-	3	-	-	-
CO2	3	3	-	-	2	-	-	-	-	3	-	3	-	-	2
CO3	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
CO4	3	2	2	3	2	-	-	-	-	3	-	3	-	-	2
CO5	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3
Score	15	13	8	9	10	-	-	-	6	15	-	15	6	4	10
COM	3	3	3	3	3	-	-	-	3	3	-	3	3	2	3

Course Code	ECMC211
Course Title	Control Systems
L T P C	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To acquire the knowledge of the dynamic modelling of the systems and their representations.
- To analyse the time domain behaviour of the control systems.
- To analyse the open and closed loop stability.
- To analyse the frequency domain behaviours and design control systems using different classical control theory.
- To understand the concept of state variable analysis.

COURSE CONTENTS

Unit I: Basic Concepts
Historical review, Definitions, Classification, Relative merits and demerits of open and closed loop systems, Linear and non-linear systems, Transfer function, Mathematical modelling of electrical, Mechanical and thermal systems, Analogies, Block diagrams and signal flow graphs, Control System Components.

Unit II: Time Domain Analysis
Importance of time response in transient and steady state analysis, typical test input signals, transient response of the first order and second order system, time response specifications, dominant closed loop poles of higher order systems, steady state error and error coefficients, PID Control-Analytical design for P, PI, PID control systems.

Unit III: Stability
Concepts of absolute and relative stability, pole zero location, Routh Hurwitz criteria. Relative Stability-Root Locus Concept-Guidelines for sketching root locus- Nyquist stability criterion.

Unit IV: Frequency Domain Analysis and Compensator Design
Closed loop frequency Response-Performance specification in frequency domain- Frequency response of standard second order system- Bode Plot — Polar Plot- Nyquist Plots. Design of compensators using Bode plots, lead compensation, lag compensation, lag-lead compensation.

Unit V: State Variable Analysis
Concept of State, State variables & state models, State space representation of linear continuous time systems, State models for linear continuous time systems, State variables and linear discrete time systems, Solution of state equations, Concept of controllability & observability

Total Periods: 40

COURSE OUTCOMES

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

CO	Description	Level
CO1	Explain and distinguish between open and closed control systems.	K2
CO2	Compute the transfer function of the mathematical model of a given physical system.	K3
CO3	Distinguish the various type of control system hardware and their functionality.	K2
CO4	Analyze and measure the response and stability of the closed and open loop systems.	K5
CO5	Design various kinds of controllers and compensators and then compare their performance.	K6

TEXT BOOKS

1. Nagrath, I. J. and Gopal, M., "Control System Engineering," 7th Edition, New Age International, 2021.
2. Nise, Norman S., "Control Systems Engineering" 8th Edition, John Wiley& Sons, 2019.

REFERENCE BOOKS

1. Warwick, K., "An Introduction to Control Systems", 2nd Edition, World Scientific Publishing, 1996.
2. Åström, K. J. and Murray, R.M. "Feedback systems. An Introduction for Scientists and Engineers". 2008.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	–	–	–	–	–	–	–	–	3	–	–
CO2	2	2	2	3	2	–	–	–	–	–	–	–	3	–	3
CO3	2	2	2	3	–	–	–	–	–	–	–	–	3	–	–
CO4	2	3	3	3	2	–	–	–	3	3	–	2	3	–	3
CO5	2	3	3	3	2	–	–	–	3	3	–	3	3	–	3
Score	10	12	12	13	6	–	–	–	6	6	–	5	15	–	9
COM	2	3	3	3	2	–	–	–	3	3	–	3	3	–	3

Course Code	ECMC212
Course Title	Digital Signal Processing
L T P C	3-1-0-4
Course Type	MC

COURSE OBJECTIVES

- To study the basics of Signal representation and discrete systems.
- To understand the analytical tools such as Fourier transforms, Discrete Fourier transforms and Fast Fourier Transforms required for digital signal processing.
- To understand the digital filters for digital signal processing.
- To design and realize various IIR and FIR.

COURSE CONTENTS

Unit I: Introduction to Signals and Signal Processing
Signal and its classification, basic elements of digital signal processing, advantages of digital signal processing over analog processing, correlation of signals.

Unit II: Frequency Analysis of Discrete Time Signals
Discrete Fourier Transform: frequency domain sampling of DTFT, DFT as linear transformation, properties of DFT, circular convolution, discrete time signal analysis using DFT, introduction to FFT: minimum complexity space for DFT, decimation in time and decimation in frequency methods to compute FFT algorithm, Goertzel algorithm.

Unit III: Realization of LTI Discrete Time Systems
Introduction to recursive and non-recursive systems, structural look of LTI systems, recursive and non-recursive realization of FIR systems, basic FIR digital filter structures: direct and cascade form structures, lattice structures, linear phase FIR systems, IIR digital filter structures: direct and cascade form, parallel and lattice structures.

Unit IV: FIR Digital Filter Design
Introduction, General considerations: causality and Paley-Wiener theorem, characteristics of frequency selective filters, design of linear phase FIR filters using windowed Fourier series and frequency sampling method.

Unit V: IIR Digital Filter Design
Introduction, design of IIR filters from analog filters, IIR filter design via approximation of derivatives, impulse invariance, bilinear transformation and matched z-transformation.

Total Periods: 40

COURSE OUTCOMES

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

CO	Description	Level
CO1	Summarize the fundamentals of different signals and basic operations of Signal processing.	K2
CO2	Understand the handling of discrete/digital signals using MATLAB.	K2
CO3	Analyse the spectral components of discrete signals.	K4
CO4	Implement FIR/IIR systems using efficient structures.	K3
CO5	Design FIR/IIR systems for given specifications.	K3

TEXT BOOKS

1. Proakis, J. G. and Manolakis, D. G., "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson education, 2014.

2. Mitra, S. K., "Digital Signal Processing: A computer-based approach", 4th Edition, McGraw Hill Education, 2013.

REFERENCE BOOKS

1. Tan, L. and Jiang, J., "Digital Signal Processing: Fundamentals and Applications", 2nd edition, Academic Press, 2013.

2. Oppenheim, A. V. and Schafer, R. W., "Discrete-Time Signal Processing", 3rd edition, Pearson Education, 2014.

3. Andreas Antoniou (2006), "Digital Signal Processing", Tata McGraw Hill, New Delhi.

4. Ifeachor and Jervis, "Digital Signal Processing", Pearson Education India.

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	-	-	-	-	-	-	-	-	3	-	-
CO2	2	2	2	3	2	-	-	-	-	-	-	-	3	-	3
CO3	2	2	2	3	-	-	-	-	-	-	-	-	3	-	-
CO4	2	3	3	3	2	-	-	-	3	3	-	2	3	-	3
CO5	2	3	3	3	2	-	-	-	3	3	-	3	3	-	3
Score	10	12	12	13	6	-	-	-	6	6	-	5	15	-	9
COM	2	3	3	3	2	-	-	-	3	3	-	3	3	-	3

Course Code	ECMC213
Course Title	Product Development Lab
Number of Credits (L-T-P-C)	0-0-2-1
Course Type	MC

COURSE OBJECTIVES

- To introduce students to PCB design tools and techniques.
- To familiarize students with the process of converting a schematic design into a physical prototype.
- To enhance students' understanding of CAD tools and their role in prototyping.
- To enable students to integrate and test basic electronic components using prototyping techniques.
- To develop the practical skills on designing the real-world circuits.

COURSE CONTENT

Module I: Introduction to PCB Design
Overview of PCB design, types of PCBs, applications, materials used, and design considerations. Introduction to PCB design software.

Module 2: Schematic Design
Exploration of the PCB design software: Symbols and footprints, component library management. Design and simulation of basic circuits.

Module 3: Layout Design
PCB stack-up, routing strategies, grounding techniques, component placement, and design rules. Designing single-layer and double-layer PCBs, performing ERC (Electrical Rule Check) and DRC (Design Rule Check).

Module 4: PCB Fabrication and Assembly
PCB manufacturing process, CAM files (Gerber files), via types, solder mask, silkscreen, soldering techniques, and safety. Generating Gerber files, preparing PCB for fabrication, printing and etching PCB prototypes, Hand soldering components, placing and soldering surface mount components, and assembling the PCB

Module 5: Testing and Troubleshooting
Testing procedures for continuity, voltage, and functionality; debugging and troubleshooting techniques. Functional testing of the PCB; identifying and correcting issues

COURSE OUTCOMES

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

CO	Description	Level
CO1	Understand and utilize PCB design software to create schematics and PCB layouts	K1
CO2	Design a PCB using CAD tools and prepare necessary documentation.	K4
CO3	Fabricate a PCB prototype by implementing design-for-manufacturing principles.	K5
CO4	Assemble and solder components on a PCB and perform functional testing.	K3
CO5	Identify and troubleshoot design and assembly errors effectively	K2

TEXT BOOKS

1. Khandpur, Raghbir Singh. ”Printed Circuit Boards Design, Fabrication, and Assembly.” (2006).
2. Mitzner, Kraig. Complete PCB design using OrCAD Capture and PCB editor. Newnes, 2009.

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1. Wilson, Peter. The circuit designer’s companion. Newnes, 2017.
2. Eppinger, Steven D., and Karl Ulrich. ”Product design and development.” (1995).

CO to PO/PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	-	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	2	-	-	-	-	-	-	-	-	-	2
CO3	-	2	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	1	3	2	-	-	-	2	-	-	-	-	-	-	-
CO5	1	2	2	1	-	-	-	-	1	-	-	1	-	-	-
score	5	11	8	3	3	-	-	-	3	-	-	2	-	-	2
COM	2	3	2	2	2	-	-	-	1	-	-	1	-	-	2