Electronics & Communication Engineering: **Implemented from Batch 2023 Total Required Credits: Minimum=160 (I + II Semester =42)**

Semester	Course-1	Course-2	Course-3	Course-4	Course-5	Course-6	Course-7	Course-8	Course-9	Course-10	Course-11	Total Credits
III	Electronics-I	Network Analysis	Signals and Systems	Electronic Engineering Materials	Philosophy for Engineers: Society, Culture and Ethics	Mathematics III	Electronics-I Lab.	Circuit Analysis Lab	Signals & Systems Lab			
	3	3	3	3	3	3	1	1	1			21
	ECT201	ECT202	ECT203	ECT208	HST009	MAT203	ECL204	ECL205	ECL209			
IV	Electronics-II	Digital Elect.& Logic Design	Communication-I	Applied EMF& Waves	Control Systems	Mathematics IV	Electronics-II Lab.	DELDLab	Communication-I Lab.			
	3	3	3	3	3	3	1	1	1			21
	ECT250	ECT251	ECT252	ECT253	ECT259	MAT213	ECL254	ECL255	ECL256			
V	Microprocessor	Electronic Devices	Communication - II	Antenna and Wave Propagation	Mathematics-V	Elective I	Microprocessor Lab.	Communication – II Lab				
	3	3	3	3	3	3	1	1				20
	ECT301	ECT302	ECT303	ECT304	MAT301	ECT0xx	ECL305	ECL306				
VI	Digital Signal Processing	VLSI Design	Computer Organization & Architecture	Data Communication	Elective III	Institute Elective-I	Seminar	VLSI Design Lab	Digital Signal Processing Lab	Industrial Training		
	3	3	3	3	3	3	1	1	1	1		22
	ECT350	ECT351	ECT352	ECT353	ECT0xx	ECT9xx	ECS355	ECL356	ECL357	ECI358		
VII	Microwave Engineering	Wireless Communication	Electronic M&I	Industrial Organization & Management	Project pre-work	Institute Elective II	Microwave Engineering Lab.	EDA Tools I				
	3	3	3	3	2	3	1	1				19
	ECT401	ECT402	ECT403	HST010	ECP404	ECT9xx	ECL405	ECL407				
VIII	Project Major	Elective VI	Elective-VII	Elective-VIII								
	6	3	3	3								15
	ECP450	ECT0xx	ECT0xx	ECT0xx								
												160

Electronics & Communication Engineering: **Implemented from Batch 2023 Total Required Credits: Honours=180 (I + II Semester =42)**

Semester	Course-1	Course-2	Course-3	Course-4	Course-5	Course-6	Course-7	Course-8	Course-9	Course-10	Course-11	Total Credits
III	Electronics-I	Network Analysis	Signals and Systems	Electronic Engineering Materials	Philosophy for Engineers: Society, Culture and Ethics	Mathematics III	Electronics-I Lab.	Circuit Analysis Lab	Signals & Systems Lab			
	3	3	3	3	3	3	1	1	1			21
	ECT201	ECT202	ECT203	ECT208	HST009	MAT203	ECL204	ECL205	ECL209			
IV	Electronics-II	Digital Elect.& Logic Design	Communication-I	Applied EMF& Waves	Control Systems	Mathematics IV	Electronics-II Lab.	DELDLab	Communication-I Lab.			
	3	3	3	3	3	3	1	1	1			21
	ECT250	ECT251	ECT252	ECT253	ECT259	MAT213	ECL254	ECL255	ECL256			
V	Microprocessor	Electronic Devices	Communication - II	Antenna and Wave Propagation	Mathematics-V	Elective I	Elective II	Microprocessor Lab.	Communication – II Lab			
	3	3	3	3	3	3	3	1	1			23
	ECT301	ECT302	ECT303	ECT304	MAT301	ECT0xx	ECT0xx	ECL305	ECL306			
VI	Digital Signal Processing	VLSI Design	Computer Organization & Architecture	Data Communication	Elective III	Elective IV	Institute Elective-I	Seminar	VLSI Design Lab	Digital Signal Processing Lab.	Industrial Training	
	3	3	3	3	3	3	3	1	1	1	1	25
	ECT350	ECT351	ECT352	ECT353	ECT0xx	ECT0xx	ECT9xx	ECS355	ECL356	ECL357	ECI358	
VII	Microwave Engineering	Wireless Communication	Electronic M&I	Industrial Organization & Management	Project pre-work	Elective V	Institute Elective II	Microwave Engineering Lab.	EDA Tools I	Elective lab	Python Programming	
	3	3	3	3	2	3	3	1	1	1	2	25
	ECT401	ECT402	ECT403	HST010	ECP404	ECT0xx	ECT9xx	ECL405	ECL407	ECL0xx	ECT406	
VIII	Project Major	Elective VI	Elective-VII	Elective-VIII	Elective-IX	Elective-X	Elective XI Research Seminar/ Laboratory					
	6	3	3	3	3	3	2					23
	ECP450	ECT0xx	ECT0xx	ECT0xx	ECT0xx	ECT0xx	ECP0xx					
												180

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3rd Semester B Tech ECE

Syllabus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Electronics-I	ECT201	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: Familiarize with the basic semiconductor devices and to know about the working and performance of semiconductor devices like diodes, BJTs and FETs. To understand semiconductor devices application.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Define the basic semiconductors devices properties.	I
CO2	Understanding the behavior and demonstrate the application of P-N diodes at circuit level.	II
CO3	Analyze and examine the behavior of BJT and explain its application as a switch and amplifiers.	III, IV
CO4	Analyze and examine the behavior of FET and explain its application as a switch and amplifiers.	III, IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Semiconductors Physics and P-N Junction Diode:** Intrinsic and extrinsic semiconductors, transport mechanism of charge carriers, electric properties, Hall Effect, Current components in P-N junction, Characteristics-piece wise linear approximation, Temperature dependence, Diode capacitance, and switching times, diode circuits: half wave, full wave rectifiers, filters and regulator, clipping and clamping circuits, voltage multiplier circuits, Schottky Diode, Photo Diode, Tunnel diodes, LED, etc.	12
Module 2	**Introduction to BJT:** Operation and characteristics, Ebers- Moll model, CE, CB, and CC configuration and its input-output characteristics, DC load line, Biasing and Stability of BJT, Transistor as a switch, h-parameter model, hybrid π model.	12
Module 3	**BJT as Amplifier:** Analysis and design of transistor amplifier circuits, Analysis and design of transistor amplifier circuits at high frequencies, Multistage amplifiers.	10
Module 4	**FET:** Types of FETs (JFET and MOSFET), operation and characteristics of JFET, Biasing and Stability of FET, FET as a switch, FET amplifiers.	8

Recommended Books:

S.No.	**Title**	**Author**
1	Fundamentals of Microelectronics	Behzad Razavi
2	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis, Meyar
3	Electronic Devices and Circuits	Millman, Halkias, and Satyabrata Jit
4	Analog Electronics	Maheshwari and Anand
5	Electronic Devices & Circuits	Allan Mottershed
6	Microelectronics	Sedra & Smith

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Network Analysis	ECT202	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: To introduce students with the basic concepts of Electric Circuit theory and familiarize them how to analyze the circuits to get transits as well as steady-state response of the system with emphasis on analysis in frequency domain using various techniques.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understanding of and explain different circuit concepts.	II, V
CO2	Analysis of network functions in frequency domain.	IV
CO3	Analysis of two-port networks.	IV
CO4	Evaluate and design filter design.	V, VI

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Development of circuit concepts:** Network Elements and Sources, Synthesis of different waveforms, Topological and Graphical description of Networks, Dual networks, Formulation of Network equations, Natural Response and Forced Response, Transient and Steady State Analysis, Laplace Transform Technique, Response of RLC Networks for different signals.	12
Module 2	**Network Ports and Functions:** Concept of Complex Frequency, Natural frequency and Neper frequency, One-port and Two-port networks, Network (Driving point and Transfer) functions for one-port and two-port networks, T, π and ladder representations, Image impedance and Characteristics Impedance of networks, Poles and Zeros of networks, Restriction on pole and zero locations.	12
Module 3	**Two port parameters:** Impedance, Admittance, Transmission, Inverse Transmission, Hybrid and Inverse Hybrid parameters, Interrelationship between parameter sets; Parallel, Series, and Cascode connection of two-port Networks.	10
Module 4	**Filters**: Filter fundamentals – pass band and stop band filter classification and characteristics, Behavior of characteristic impedance over pass band and stop band, constant k & m derived filters, Filter design.	8

Recommended Books:

S. No.	**Title**	**Author**
1	Network Analysis	M. E. Van Valkenberg
2	Network Analysis and Synthesis	F. F. Kuo
3	Network Analysis and Synthesis	K. M. Soni
4	Network and Systems	Roy Choudhury
5	Principles of Electrical Engineering	Del Toro
6	Circuits & Networks: Analysis & Synthesis, McGraw Hill.	A. Sudhakar & S.S. Palli

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Signals and Systems	ECT203	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The course will focus on exploring the basic concepts of signal processing by formulating signals as mathematical functions and then characterizing systems based on these functions. By the end of this course a student will be able to understand mathematical description and representation of continuous and discrete-time signals and systems in both time domain and frequency domain. Based on these characterizations the students will be able to determine different system properties, thereby providing a better understanding of the system behavior under different operating conditions.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Formulate signals as mathematical functions and have a good understanding of the basic operations that can be performed on signals.	I, II
CO2	Represent and classify systems as processes for which cause and effect relations exist between the inputs and outputs.	II
CO3	Characterize systems in both time and frequency domains.	II, III
CO4	Analyze systems for different properties and provide alternate but equivalent descriptions of these properties in time and frequency domains.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Signals & Systems:** Mathematical description of Signals & System, Classification of Signals, Basic operations on Signals, Elementary Signals, Properties of Systems, Some example System.	12
Module 2	**Linear Time Invariant (LTI) Systems:** Characterization of continuous and discrete-time LTI systems using Convolution, Properties of LTI systems in terms of impulse response. Differential and difference equation representation of systems.	10
Module 3	**Frequency domain characterization of Continuous-time LTI systems:** Continuous-time Fourier series and Fourier Transform, Laplace Transform and its graphical interpretation, System properties in S-domain.	10
Module 4	**Frequency domain characterization of Discrete-time LTI systems:** Discrete-time Fourier series and Fourier Transform, Z-Transform and its graphical interpretation, System properties in Z-domain.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Signals and Systems	Simon Haykin
2	Signal Analysis	Atahnasios Papoulis
3	Schaum's outline series on Signals and Systems	Hwei P. HSU
4	Analog and Digital Signal and Systems	R. K. Rao
5	Signal Analysis	Ronald L. Allen and Duncan W. Mills

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Electronics Engineering Materials	ECT208	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: To familiarize with the basic principles related to the physics of materials relevant to electrical, electronic, magnetic and optical properties.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand and analyze the correlation of material properties with crystal structure, composition and nature of bonding.	II, IV
CO2	Study and analyze the growth of semiconductor materials and semiconductor properties.	IV
CO3	Analyze and evaluate electronic, magnetic, dielectric and optical properties of materials and their applications.	IV, V
CO4	Study of the state-of-the-art new materials for electronic applications.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Crystal Structure:** Crystalline state, Bravais lattices, Miller indices, reciprocal lattice, common crystal structures, interference phenomenon, Bragg's diffraction, crystal imperfections.	8
Module 2	**Crystal Growth:** Single crystal growth techniques, zone refining technique (specifically for semiconductors).	6
Module 3	**Semiconductor materials:** Their properties and applications, Binary, Ternary and Quaternary semiconductors, Physical parameters of semiconductors.	6
Module 4	**Magnetism:** Magnetic properties of materials, diamagnetism, para-magnetism, and ferromagnetism, Blackwell, domain dimensions, anti-ferromagnetism, and ferromagnetism, ferrites, Magnetic Materials: Fe, Si, Ni, Co, Hard magnetic materials.	7
Module 5	**Dielectric materials:** Electric & optical properties, polarization in static and alternating field, piezoelectricity, polarizability and dielectric constant, optical transition in solids, absorption and emission of radiation. Ferroelectric materials.	7
Module 6	**Emerging materials:** Materials for resistors, capacitors and inductors, properties and application of organic materials. Low Temperature and High Temperature Materials. Superconductivity and Superconductors. Introduction to material characterization techniques.	8

Recommended Books:

S. No.	**Title**	**Author**
1	Introduction to Solid State physics	Kittle
2	Solid state Physics	Dekker
3	Physical Met. Principles	Reedhill
4	Material Science and Engineering	Raghavan
5	Electronic Processes in Materials	Azaroff

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Philosophy for Engineers: Society, Culture and Ethics	HST009	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The course aims to explore the ethical, cultural, and societal dimensions of engineering.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify the workings of social structures and distinguish the levels of social frameworks by applying critical perspectives developed during the course.	III
CO2	Analyze the importance and role of culture and social institutions in human life and interpret the relationship between human and the socio-cultural structures.	VI
CO3	Assess the various perspectives and trends in the field of epistemology and relate as well as apply the deep knowledge in the professional purposes.	V
CO4	Elaborate overall professional ethical consciousness, seek solutions to engineering problems motivated by ethical judgment.	VI

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Sociological concepts.** • Concepts in Sociology: Society, Culture, Socialization, Social Control, Social Change, Social Groups and Institutions, Social Construction. • Foundation of Society: Social Structure and Sub Structure. • Power and Authority. • Social Control: Its Types and Means	11
Module 2	**Culture and Socialisation** • Culture: Definition and Nature; Types- Material and Non- Material. • Meaning of Culture; Man in Society; Society in Man. • Culture and Personality. • Socialization: Its importance, Process and Stages. • Institutions for socialization.	10
Module 3	**Introduction to Philosophy** • Definition of Philosophy; its nature and scope • Branches of Philosophy – Metaphysics, Epistemology, Ethics, Logic, Aesthetics • Greek Philosophy: Plato and Aristotle • Schools of Thought in Western Philosophy: Rationalism, Empiricism, Positivism, Existentialism	10
Module 4	**Philosophy of Ethics (Contact Hours: 10)** • Introduction to Ethics: Classical and Modern Perspectives (Aristotle and Kant) • Descriptive Ethics: Anthropology and Psychology	11

	• Normative Ethics: Philosophy and Religion • Engineering Ethics: Engineering as a Profession, Aim of Engineering, Responsibility of Engineers; Basic Values—Honesty, Integrity, Reliability, Safety and Liability	

Recommended Books:

S. No.	Title	Author
1	Introductory Sociology, Macmillan, 1998.	Jayaram, N.
2	History of Western Philosophy, Oxford University Press, USA, 2004.	Russell, B.
3	Introduction to Philosophy, Andrews UK Limited, Luton, 2012	Fullerton, G.S.
4	The Big Questions: A Short Introduction to Philosophy, Wadsworth Publishing Company, 2013.	Higgins, Kathleen M. and Robert C. Solomon.
5	Sociology: Themes and Perspectives, OUP, New Delhi,1998.	Haralambos, M.
6	A Companion to Applied Ethics, John Wiley & Sons, New York, 2008	R.G. Frey and Christopher Heath Wellman (ed)

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Mathematics-III	MAT203	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: A student should have basic knowledge of calculus.

Objectives: To understand various transformation techniques and their use to solve boundary value problems, and various linear differential equations.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Evaluate Laplace and Inverse Laplace transforms of various functions.	V
CO2	Apply Laplace transform for solving ordinary differential equations.	III
CO3	Apply the concepts of Fourier to various engineering problems.	III
CO4	Evaluate Z-transforms and Inverse Z-transforms of various functions and apply these concepts to solve difference equations.	III, V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Laplace Transforms:** Laplace transform, Condition for the existence of Laplace transform, Laplace transform of some elementary functions, Properties of Laplace transform, Differentiation and Integration of Laplace transform. Laplace transforms of periodic functions and other special functions, Unit Impulse function, Dirac-delta function and its Laplace transform.	10
Module 2	**Application of Laplace transforms:** Heaviside's expansion theorem, Inverse Laplace transform, Initial and Final value theorems, Convolution theorem and properties of Convolution, Evaluation of definite integrals by Laplace transforms. Use of Laplace transforms in the solution of ordinary linear differential equation with constant and variable coefficients.	10
Module 3	**Fourier Transforms:** Definition of Fourier transform, Fourier Integral Theorem, Properties of Fourier transform, Fourier sine and cosine, Convolution Theorem, Parseval's Identity for Fourier transform, Solution of Integral equations, Evaluation of definite integrals using Fourier transform, Applications of Fourier transforms to Ordinary and Partial differential equations.	12
Module 4	**Z-Tranforms:** Definition of Z-transform, Linearity property, Z-transform of elementary functions, Shifting theorems, Initial and Final value theorems, Convolution theorem, Inversion of Z-Transforms, Use of Z-transforms in solving difference equations.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Integral Transforms and their Applications, 2ndEdition, CRC press, (2007)	L. Debnath and D. Bhatta
2	Schaum's Outlines Laplace Transforms, Tata Mc-Graw Hill Edition, (2005)	M. R. Spiegel
3	Advanced Engineering Mathematics, 3rd Edition, Narosa Pub. House, (2008)	R.K Jain and S.R.K Iyengar

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Electronics-I Lab	ECL204	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Electronics-I.

Objectives: To acquire knowledge and become familiar with the different characterization techniques to analyse, synthesize basic electronic networks to get desired output.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Select and explain the working of different electronic equipment used in Electronics laboratories.	I, II
CO2	Experimental measures on different types of electronic circuit and analyse their operation under different operating conditions.	IV, V
CO3	Classify relevant information to supplement the Electronics I course.	II
CO4	Examine the characterization of diodes, BJT, and FETs.	III

Details of the Syllabus:

Exp. No.	**Particulars**
1	Study of CRO-Measurement of voltage frequency and phase of a given waveform.
2	To obtain V-I characteristics of PN Junction diodes.
3	To assemble a half wave and a full wave rectifier and to study their performance.
4	To study Clipping and Clamping circuits with some examples.
5	Comparison of Zener diode and Avalanche diode characteristics and to use Zener diode as a voltage regulator.
6	To obtain transistor characteristics in the following configurations. a) Common base b) Common emitter.
7	To assemble a CE amplifier and observe its performance.
8	To obtain frequency response of a RC coupled CE amplifier.
9	To assemble an emitter follower circuits and observe its performance.
10	To obtain JFET characteristics and to observe the performance of a source follower.
11	JFET as a voltage variable resistor.
12	Transfer and output characteristics of MOSFET.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Circuit Analysis Lab	ECL205	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Principles of electrical engineering and network analysis.

Objectives: To enable students to assemble series and parallel circuits using basic electrical components like Resistance, Inductance and Capacitance. To enable students to apply different circuit concepts based on network theorems for circuit simplification and analysis.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Apply the knowledge of basic network analysis in solving and verifying various network laws and theorems.	III, V
CO2	Understand, design and analyze RL and RC circuits.	II, IV, VI
CO3	Assemble resonant circuits and observe their frequency response.	IV, VI
CO4	Analysis and design of two-port network and filters.	IV, VI

Details of the Syllabus:

Exp. No.	**Particulars**
1	Study of CRO - Measurement of Voltage frequency and Phase of a given waveform.
2	Verification of Basic network theorems – I.
3	Verification of Basic network theorems – II.
4	Measurements on two-port parameters.
5	To study the series resonance.
6	To study the parallel resonance.
7	To measure the impedance and bandwidth of a parallel tuned circuit and obtain its quality factor.
8	To measure the impedance of symmetrical T and π networks.
9	Analysis and design of filters – I.
10	Analysis and design of filters – II.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (3rd Semester)	Signals and Systems Lab	ECL209	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Signals & Systems.

Objectives: Understand and represent continuous and discrete-time signals and systems in both time and frequency domains. Analyze system properties and understand system behaviour under various conditions.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Become familiar with the Octave environment.	I, II
CO2	Understand and synthesize basic signals and sequences.	II, V
CO3	Perform basic operations on signals.	III
CO4	Frequency domain representation of signals.	IV

Details of the Syllabus:

Exp. No.	**Particulars**
1	Introduction to Octave.
2	Basic plotting of signals/sequences. a) Write an Octave program to plot the following Continuous and discrete-time signals. 1. Step Function 2. Impulse Function 3. Exponential Function 4. Ramp Function 5. Sine Function
3	Basic signal operations. a) Write an octave program to perform time-scaling, time-shifting, and time-reversal on a given signal.
4	Convolution of given signals. a) Write an Octave program to obtain linear convolution of the given sequences.
5	Autocorrelation and Cross-correlation. a) Write an Octave program to compute the autocorrelation of a sequence x(n) and verify the property. b) Write an Octave program to compute the cross-correlation of sequences x(n) and y(n) and verify the property.
6	Fourier Series. a) To calculate Fourier Series coefficients associated with Square Wave.
7	Calculating transforms using Octave. a) Calculate and plot Fourier Transform of a given signal. b) Calculate and plot Z-transform of a given sequence.
8	Impulse response of a given system. a) Write an Octave program to find the impulse response of a system from its difference equation. b) Compute and plot the response of a given system to a given input.
9	Sampling of Continuous-time signal.

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4th Semester B Tech ECE

Syllabus

Department of Electronics and Communication Engineering
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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Electronics-II	ECT250	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electronics-I.

Objectives: To make students aware about the effects of feedback in electronic amplifiers, to analyze the amplifiers under different feedback configurations, to design different sinusoidal oscillators, to understand operational amplifier basics and its application in electronics, to design various wave shaping circuits, to understand power amplifiers and design power supplies.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Develop the concept of feedback for different feedback topologies.	III
CO2	Examine the basics of op-amps, its linear and non-linear applications.	IV
CO3	Analysis and design of sinusoidal oscillators and multi vibrators.	IV, VI
CO4	Define and explain the basic concept of power amplifiers and IC regulated power supplies.	I, II

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Feedback Basics:** Types of Feedback, Negative feedback, Effect of negative feedback on the performance of amplifiers: Gain, Bandwidth, Gain Bandwidth Product, Input/Output Impedance, etc., Types of feedback amplifiers, current shunt, current series, voltage shunt, and voltage series feedback. Analysis of feedback amplifier circuits.	9
Module 2	**Operational Amplifiers:** Operational amplifiers stages, Differential amplifier, CMRR, Cascade amplifier, Ideal and practical op-amp characteristics and properties, Frequency response, Inverting and Non-inverting op-amp configuration, Op-amp applications as: inverting and non-inverting amplifiers, difference amplifier, summer, differentiator and integrator, rectifiers, and comparators, Active Filters, Analog Computation.	13
Module 3	**Sinusoidal Oscillators:** Basic operations, Positive feedback, analysis of general oscillator circuit, Barkhausen's criteria, various types of oscillator circuits and their analysis, RC phase shift oscillator, LC oscillator, crystal oscillator, Bi-stable, Monostable and astable multivibrator circuits, and their analysis. Waveform generators, triangular and square wave generators.	11
Module 4	**Power Amplifiers and Power Supplies:** Classification of power amplifiers, Class A, Class B, Class AB, and Class C power amplifiers, Performance comparison of Power Amplifiers, Power supplies and IC regulators.	9

Recommended Books:

S. No.	**Title**	**Author**
1	Fundamentals of Microelectronics	Behzad Razavi
2	Analysis and Design of Analog Integrated Circuits	Gray, Hurst, Lewis, Meyar
3	Electronic Devices and Circuits	Millman, Halkias, and SatyabrataJit
4	Analog Electronics	Maheshwari and Anand

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Digital Electronics & Logic Design	ECT251	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The course will focus on introducing the concepts of logic design and how those concepts can be applied to come up with methodologies that allow the design of digital circuits. The course takes a concrete bottom-up approach starting from the basic number theory and Boolean laws and then building incrementally the design process through logic gates, flip-flops, registers etc. This should allow the student to develop a solid understanding of the basic design process in the digital paradigm. By the end of this course a student will have a more relevant view of the modern digital design field, and a better understanding of how the modern computers and other digital devices function.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the concepts of logic design and being able to apply those concepts to formulate design problems as Boolean functions.	I, II, III
CO2	Analyze the functionality of the formulated design problems at the gate level to avoid any hazards, thereby ensuring a complete timing closure of the intended circuit.	IV
CO3	Choose a proper circuit realization for a given problem and analyzing and evaluating the resultant performance in terms of some basic parameters.	IV, V, VI
CO4	Create alternate circuit realizations for a given problem by exploiting the inherent redundancies and analyzing different target elements and platforms.	IV, V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Number System & Boolean Algebra:** Binary Number system, Conversion of bases, Complements, Weighted and Non-weighted codes, Binary Arithmetic, Boolean Laws and Logic Gates, Boolean functions- Canonical and Standard forms, Simplification of Boolean Functions, Gate Implementations, Hazards and Glitches, Hazard detection and Hazard free implementations.	12
Module 2	**Combinational Logic Design:** Design procedure, Adders and Subtractors, Encoders and Decoders, Multiplexers/De-multiplexers and their use in combinational logic design, Digital Comparators, Timing response in Combinational networks.	10
Module 3	**Sequential Logic Design:** Latches and Flip-flops, Finite State Machines and Controllers, FSM based design- Counters, Sequence detectors, Signal generators, Moore and Mealy machines, Timing in state machines, Registers	10
Module 4	**Digital Logic families:** RTL, DCTL, DTL, TTL, ECL, CMOS logic families.	6
Module 5	**Programmable Logic devices:** PLAs, PALs, CPLDs, FPGAs.	4

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Recommended Books:

S. No.	Title	Author
1	Digital Principles and Applications	Donald P. Leach, Albert Paul Malvino and Goutam Saha
2	Digital Logic and Computer Design	M. Morris Mano
3	Modern Digital Electronics	R.P. Jain
4	Digital Design	Frank Vahid
5	Contemporary Logic Design	Randy H. Katz and Gaetano Borriello
6	A First Course in Digital System Design: An Integrated approach	John P. Uyemura

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Communication systems -I	ECT252	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Signals and systems.

Objectives: To analyze different analog modulation and demodulation schemes, understand the operation of AM and FM radio receivers, understand the random process and conduct noise analysis on AM and FM systems.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the basic principles of communication system and Fourier analysis of standard signals.	II
CO2	Analyze various Analog modulation and demodulation schemes.	IV
CO3	Understand the concept of random process and formulate the concept of autocorrelation, stationarity and Gaussian noise.	IV
CO4	Evaluate the performance of various reception techniques in presence of White Gaussian Noise.	V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Amplitude Modulation**: Need for Modulation, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations, Frequency discriminator, Demodulation of AM, Diode detector, Super heterodyne receiver.	10
Module 2	**Introduction to Angle Modulation:** Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Spectral characteristics of angle modulated signals, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase-Locked Loop: Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems, FM Receiver and Transmitter.	12
Module 3	**Introduction to Random Process:** Random Process, Mean Function, Autocorrelation function, Stationary Process, Wide Sense Stationary Process, Additive white Gaussian Noise (AWGN), Power Spectral Density of AWGN (Basic Definition), Random process through LTI (Linear Time Invariant) System.	10
Module 4	**Noise Analysis:** Signal-to-Noise Ratio, Noise Figure, Performance of DSB-SB, DSB-FC, SSB, PM & FM Systems in presence of noise, Pre-emphasis and De-emphasis, Threshold effect in AM & FM Demodulation.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Communication systems	Simons Haykin
2	Modern Analog and Digital Communication Systems	B P Lathi
3	Communication Systems Engineering, Prentice Hall 2002	John G. Proakis, Masoud Salehi

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P Credits**
2nd Year (4th Semester)	Applied Electromagnetic Fields and Waves	ECT253	2-1-0
Evaluation Policy	**Mid Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: To understand electrostatic and magnetostatic fields, apply laws to solve problems, distinguish between static and time-varying fields, analyze Maxwell's Equations, solve communication engineering problems, and derive basic Transmission Line Equations.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand basic concepts and principles of electromagnetic fields and coordinate systems.	I, II
CO2	Assimilate the practical significance of theory in developing a clear perspective of engineering applications.	II, III
CO3	Analyze the applications of EM waves in different Media.	IV
CO4	Understand and evaluate the transmission line	II, V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Review of Coordinate Systems and Basics of Electromagnetics:** Introduction, Cartesian Coordinates, Circular Cylindrical Coordinates, Spherical Coordinates, The Electromagnetic Model, Brief History and Importance of Electromagnetics, Fundamental Postulates of Electrostatics in free space: Coulomb's law, Gauss's Law, Fundamental Postulates of Magnetostatics in free space: The Biot-Savart law and its applications, Ampere's Circuit Law, Boundary-value problems in spherical coordinates, Interconversion of Coordinate systems.	10
Module 2	**Electromagnetic Waves and Applications:** Boundary conditions of Maxwell's Equations, Time-Varying Fields and Maxwell's Equations, Faraday's Law of Electromagnetic Induction, Maxwell's Equations in Integral Form and Differential Operator Form, Emergence of Wave Phenomenon, Triumph of Maxwell's Equations. Electromagnetic Boundary Conditions: Interface between two lossless linear media, Interface between a dielectric and perfect conductor Wave Equations and their solutions.	12
Module 3	**Electromagnetic Wave Propagation:** Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, Waves in layered media: Phase and Group Velocity. Wave Polarization, Power Flow in Electromagnetic fields: The Poynting Vector, Complex Poynting's Theorem and Lossless Conditions, Reflection of a Plane Wave at Normal Incidence, Reflection of a Plane Wave at Oblique Incidence: Perpendicular and Parallel Polarization.	12
Module 4	**Introduction to Transmission Lines:** Calculation of Reflection and Transmission Coefficients, Calculation of Electromagnetic Power Density, Concept of Standing Waves, Phasor Vector, Transverse Electromagnetic wave along a parallel plate, TEM mode, Analysis of Standing Wave Transmission Line Analogy of Normal Incidence.	8

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Recommended Books:

S. No.	Title	Author
1	Electromagnetic Waves & radiating systems, PHI	Jordan E and Balman K
2	Field and Wave Electromagnetics, Addison Wesley	David K Cheng
3	Elements of Electromagnetics, Oxford University Press	Sadiku, Matthew N. O
4	Fields and Waves in Communication Electronics, Wiley	Simon R, J. R. Whinnery, T.V Duzer

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Control Systems	ECT259	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The objective of the course is to introduce the students to modeling, analysis and design of control systems which are an integral part of modern society and have widespread application in science, engineering, and industry.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Determine and analyze the time response of first and second order systems to various standard test inputs.	IV, VI
CO2	Investigate, evaluate and analyze the stability of control systems, compare and contrast absolute and relative stability.	IV, V
CO3	Study and design of PID controllers, lead-lag Compensators and modeling of dynamic systems in state space.	II, VI
CO4	Determine and analyze the time response of first and second order systems to various standard test inputs.	IV, VI

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to continuous control systems:** Definition of a control system, open-loop, closed-loop (automatic and manual) control.	5
Module 2	**Mathematical modeling:** Transfer functions, block diagrams, signal flow graphs.	6
Module 3	**First and second order system:** Example of first and second order systems, responses of these systems to step, ramp, parabolic and sinusoidal inputs, transient, steady state and error analysis.	8
Module 4	**Stability studies:** Definition of stability, stability and pole locations, stability and Routh Table, stability and frequency response bode plot, polar plot, root locus.	12
Module 5	**Study of PID controllers, lead-lag Compensators** Proportional, Integral, Derivative (P.I.D) control. Compensator design Lead–lag compensators, Modeling of dynamic systems in state space (Introduction).	11

Recommended Books:

S. No.	**Title**	**Authors**
1	Modern Control Engineering	K. Ogatta
2	Automatic Control Systems	B. C. Kuo
3	Control System Engineering	Norman S Nise
4	Control Systems	M Gopal
5	Design of Feedback Control Systems	Stefani
6	Feedback control of dynamic systems	Franklin and Powel
7	Control systems	A. Anand Kumar

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Mathematics IV	MAT213	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic knowledge of calculus.

Objectives: To understand Probability theory with applications to engineering problems such as the reliability of circuits and systems to statistical methods for hypothesis testing, decision making under uncertainty, and parameter estimation.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Be acquainted with basic concepts of probability	I, II
CO2	Be acquainted with basic concepts of random variables, probability distribution.	II
CO3	Be acquainted with concepts like correlation coefficient, Transformation of random variables, Regression Analysis and their applications.	II
CO4	Compute point estimation of parameters, explain sampling distributions, and understand the central limit theorem.	V
CO5	Construct confidence intervals on parameters for a single sample, and perform hypothesis testing.	V, VI

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Basics of probability:** Basic definitions of probability, conditional probability with standard results, Bays theorem with examples	6
Module 2	**Random variables:** Discrete and Continuous Random variables, Distribution functions, Expectation and Variance of Probability distribution, and Moment Generating function, Moments and properties. Discrete distributions: Binomial, Poisson and Geometric distributions and their applications. Continuous distribution: Uniform, Exponential and Normal distributions, Normal approximation to Binomial distribution and their applications.	11
Module 3	**Two-Dimensional Random Variables:** Bivariate Random Variables, Joint Distribution Functions (Discrete and Continuous), Marginal and Conditional Distributions, Covariance and Correlation Coefficient, Transformation of random variables. Regression Analysis, Linear and Nonlinear Regression, Multiple regression, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves.	13
Module 4	**Sampling Theory:** Population and Sample, Statistical inference, Sampling with and without replacement, Random samples, Population parameters, Sample statics, Sampling distributions, Sample mean, Sampling distribution of means, Sample variances, Sampling distribution of variances, Case where population variances is unknown, Unbiased estimates and efficient estimates, point estimate and Interval Estimates, Confidence Interval estimates of population parameters.	12

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Recommended Books:

S. No.	Title	Authors
1	Introductory Statistics	Neil A. Weiss
2	Probability and Statistics for Engineers	Johnson, Miller and Freund
3	A First Course in Probability	S. Ross, A
4	Advanced Engineering Mathematics	R. K. Jain and S. R. K. Iyengar
5	An Introduction to Probability and Mathematical Statistics	V.K. Rohatgi and A. K. Md. Ehsanes

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Electronics-II Lab	ECL254	0-0-1
Evaluation Policy	**Internal Assessment**	**Final Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Electronics I, Electronics II, and Electronics I Lab.

Objectives: To acquire knowledge and become familiar with the different characterization techniques to analyze electronic feedback networks, operational amplifiers, and power amplifiers.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify relevant information to supplement the Electronics II course.	III
CO2	Experimental estimation of negative and positive feedback circuits.	V
CO3	Experimental demonstration and utilization of OP-AMP and 555 timer chip for different applications.	II, III
CO4	Experimental analysis of different topologies of Power Amplifiers.	IV

Details of the Syllabus:

Exp. No.	**Particulars**
1	Feedback a. To assemble current series feedback amplifier and study its performance. b. To assemble a voltage shunt feedback amplifier and study its performance.
2	To assemble an RC phase shift oscillator.
3	To assemble a differential amplifier and obtain its CMRR.
4	Study characteristics of OP-AMP as inverting and non-inverting amplifier.
5	Study applications of OP-AMP as integrator and differentiator.
6	To measure the following parameters of a typical OP-AMP. a. I/P Impedance. b. O/P Impedance. c. Slew rate. d. CMRR.
7	Obtain frequency response of an OP-AMP & hence find its bandwidth.
8	Study performance of multivibrator circuits using 555 chip in following modes: a. Bistable. b. Astable. c. Monostable.
9	Study of 555 chip as a timer circuit.
10	To assemble a Schmitt trigger Circuit and to obtain its characteristics and to use it as squaring circuit.
11	To assemble a Class A Power amplifier and to determine its power gain.
12	To study the performance of a voltage regulator IC Chip.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Digital Electronics & Logic Design Lab	ECL255	0-0-1
Evaluation Policy	**Internal Assessment**	**Final Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Prerequisite: Digital Electronics & Logic Design.

Objectives: To acquire knowledge and become familiar with the different characterization techniques to analyze, and synthesize the digital logic, combinational and sequential circuits.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify relevant information to supplement the Digital Electronics & logic Design course.	I, II
CO2	Develop competence in Combinational Logic Problem identification and solution.	III
CO3	Develop design capability in the field of combinatorial logic using gates and blocks.	III
CO4	Analysis and design of synchronous and asynchronous sequential circuits.	IV, VI

Details of the Syllabus:

Exp. No.	**Particulars**
1	To verify the truth table of following logic gates: AND, OR, NOT, NAND, NOR, XOR and XNOR.
2	To implement XOR and XNOR using universal logic gates.
3	a. To verify DeMorgans law using logic gates. b. To implement typical Boolean expressions and check their equality.
4	To design and realize: - a. Half adder and verify its truth table. b. Full adder and verify its truth table.
5	To design and realize: - a. Half subtractor and verify its truth table. b. Full subtractor and verify its truth table.
6	To design a multiplexer/demultiplexer using two input NAND gates.
7	To design a 4-bit binary to decimal converter.
8	To design a 4-bit binary to gray code converter.
9	To design a modulo-10 counter.
10	Given a frequency *f* obtain the waveforms with frequencies *f*/2, *f*/5 & *f*/10.
11	Design and realize the following flip-flops using logic gates. a. RS flip-flop. b. JK flip-flop. c. D flip-flop. d. T flip-flop.
12	Use PLL as: a. Frequency multiplier. b. Frequency demodulator.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
2nd Year (4th Semester)	Communication systems-I Lab	ECL256	0-0-1
Evaluation Policy	**Internal Assessment**	**Final Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Communication Systems-I.

Objectives: Familiarize the students with analog communication systems. Integration of communication systems theory with experimental and simulation techniques.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Test and understand working of different electronic equipment used in communication systems.	VI
CO2	Choose testing and experimental procedures on different types of communication circuits and systems; and analyze their operation under different operating conditions.	VI
CO3	Analyze and simulate error performance of various digital modulation schemes in the presence of noise.	IV
CO4	Analyze and design of communication receivers under different noise conditions.	IV

Details of the Syllabus:

Exp. No.	**Particulars**
1	To study the generation of standard signals.
2	To study the spectrum Analysis of standard signals.
3	To study the generation and detection of AM signals.
4	To study the generation of DSBSC amplitude modulated signals.
5	To study the detection of DSBSC amplitude modulated signals.
6	To study the generation of frequency modulated signals.
7	To study the detection of frequency modulated signals.
8	To measure sensitivity, selectivity, and fidelity of a radio receiver.
9	To measure the noise figure of AM and FM System.
10	To study zero crossing and PLL receivers of FM signals.
11	To simulate various analog modulation schemes in MATLAB.

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5th Semester B Tech ECE

Syllabus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd year (5th Semester)	Microprocessor	ECT301	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Knowledge of Digital Electronics and C fundamentals.

Objectives: Understand the basic structure and operations of microcomputers, including the architecture of the 8085 microprocessor and programming it using Assembly Level Language. Gain familiarity with the system bus structure and its operations and interfacing 16-bit microprocessors with memory and peripheral chips for system design. Additionally, familiarize yourself with the basic architecture of the 8086 microprocessors.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Write programs to run on 8085 microprocessor-based systems.	III
CO2	Design system using memory chips and peripheral chips for 16-bit 8085 microprocessor.	IV
CO3	Understand and devise techniques for faster execution of instructions, improve the speed of operations, and enhance the performance of microprocessors.	II
CO4	Distinguish between RISC and CISC processors.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Microcomputer Structure and Operations:** Basic Microcomputer Elements, Typical Microcomputer Structure, CPU, Memory System, Input Output.	10
Module 2	**Microprocessors and Memory:** Typical 8, 16, and 32-bit Microprocessors, 8085, Microprocessor Specification, Memory Technologies.	8
Module 3	**Assembly Language Programming:** Programming Model of 8085, Registers, Fetch, Execute Operation of CPU, Instruction Set, Addressing Modes, Basic Operations, Microprocessor Arithmetic.	14
Module 4	**Microprocessors Interfacing:** Interfacing concepts, Parallel Input Output, Memory Interfacing, Direct Memory Access, The Serial Subsystems, Programmable Peripheral Interface.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing.	Ramesh Gaonkar
2	Microprocessors and Interfacing, McGraw-Hill.	Douglas V Hall

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P Credits**
3rd year (5th Semester)	Electronic Devices	ECT302	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Knowledge of basic electronics.

Objectives: To understand free electron theory, band theory of electronic conduction, semiconductor physics and optical devices.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Defining free electron theory and band theory of electronic conduction.	I
CO2	Demonstration of semiconductor physics, mechanism of charge carrier generation, transport and recombination phenomenon.	II
CO3	Develop understanding of construction, basics of operation and performance analysis of the devices like PN-junction diodes, BJT, MOSFETs.	III
CO4	Inspect physics of optical devices and mechanisms like stimulated emission, photo-detection, and photoconduction.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Solid state physics:** Free electron theory, Schrodinger equation and its solution, Band theory of solids, Kronig Penny model, Bloch wave, Brillion zones, Crystal lattice, Energy discontinuity, Effective mass, Electron and Hole conduction, Density of states.	10
Module 2	**Basic Semiconductor Physics:** Revision of classical distribution functions, Fermi Dirac distribution and its properties, Fermi energy and contact potential, electronic conductivity and mean free time. Intrinsic and Extrinsic semiconductors, Donor and Acceptor states, Free carrier concentration and Fermi level derivations in Thermal equilibrium; Mobility and Scattering phenomenon, Generation, Recombination, Drift, and Diffusion mechanisms, Transport equation.	10
Module 3	**Semiconductor devices:** PN junction diode and its transport mechanism under non-equilibrium conditions, Breakdown in PN junction, Schottky Junctions, Bipolar Junction Transistor (BJT); Mechanism, Transport equations, characteristics, and equivalent circuit of BJT; Introduction to MIS, JFET and MOSFET structures.	12
Module 4	**Optical Devices:** Photo-conductive and Photo-detective devices, Luminescence and energy band gap; spontaneous and stimulated emission, PN junction laser, Solar cell.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Electronic Processes & Materials	Azaroff & Brophy
2	Fundamentals of Solid-State Devices & Circuits	Barlev
3	Solid State Electronic Devices	Ben G. Streetman
4	Fundamentals of Semiconductor Theory	S. Wang
5	Semiconductor Physics and Devices	Donald A. Neamen

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P Credits**
3rd year (5th Semester)	Communication Systems-II	ECT303	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Communication system-I.

Objectives: The objective of this course is to understand the concepts of digital communication starting from sampling theorem to digital modulation techniques, with emphasis on bit error rate evaluation and channel capacity in the presence of noise.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand how analog signal are converted to digital ones via sampling, quantization and various pulse coded modulation techniques.	II
CO2	Analyze signals as vectors in vector space and understand various digital modulation schemes, their modulator and demodulators.	III
CO3	Evaluate error performance of various digital modulation schemes in the presence of noise.	III
CO4	Understand the fundamentals of information theory to characterize concept of channel capacity of noisy systems.	V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Analog-to-Digital Conversion**: Sampling Theorem, Anti-Aliasing Filters, Pulse Amplitude Modulation (PAM), Quantization, Non-Uniform Quantization, Pulse Coded Modulation (PCM), Delta Modulation.	10
Module 2	**Digital Modulation Techniques:** Geometric representation of signals**,** Vector representation of continuous AWGN channel**,** Phase Shift Keying (PSK), Frequency Shift Keying (FSK), M-Quadrature Amplitude Modulation (M-QAM), Signal Space diagram of various modulation schemes.	12
Module 3	**Noise in Digital Communication Systems:** Bit Error Rate (BER), Q-Function, Optimum Detection of BPSK, QPSK, M-PSK, M-QAM, in presence of Additive White Gaussian Noise (AWGN)**.**	10
Module 4	**Information Theory:** Introduction to Entropy, joint Entropy, and Conditional Entropy, Relative entropy and Mutual Information. Capacity of an AWGN channel.	10

Recommended Books:

S. No.	**Title**	**Author**
1	An Introduction to Analog and Digital Communications, Wiley India Pvt. Limited, 2009	Simon Haykin, Michael Moher
2	Communication Systems Engineering, Prentice Hall 2002	John G. Proakis, Masoud Salehi
3	Modern Digital and Analog Communication Systems, Oxford University Press.	B. P. Lathi, Zhi Ding
4	Elements of Information Theory, Wiley.	Thomson Cover

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P Credits**
3rd Year (5th Semester)	Antenna & Wave Propagation	ECT304	2-1-0
Evaluation Policy	**Mid Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisite: Basic concepts of Electromagnetic theory.

Objectives: To understand the propagation of waves in guided and unguided media and the basic theory behind the antenna theory.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Comprehend the Propagation of Waves through Transmission lines.	I
CO2	Understand the Propagation of waves through unguided media, particularly the free space and atmosphere.	II
CO3	Understand the antenna basics and theory behind EM radiations.	II
CO4	Have an understanding of different types of antennas and their operations.	II

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Transmission Lines:** Transmission Line equations and solutions, Characteristic impedance and propagation constant, Reflection, and transmission coefficients, SWR, Open and short circuit their use as circuit elements at UHF, Line impedance and admittance, Smith Chart, Impedance Matching.	8
Module 2	**Waveguides and Cavity Resonators:** Transverse Electric and Transverse magnetic Waves, Wave propagation through rectangular and circular waveguides, Power transmission and attenuation in waveguides, Electromagnetic Resonators, Rectangular & Circular cavities.	8
Module 3	**Strip Lines:** Propagation Constant, Characteristic impedance, and attenuation characteristics of strip lines and microstrips.	6
Module 4	**Propagation of Waves:** Waves in free space, Attenuation, Absorption and polarization, effects of the environment, Ground wave propagation, sky wave propagation, space wave propagation, Tropo-spherical propagation, and Extraterrestrial propagation.	10
Module 5	**Radiation:** Retarded Potential and Electromagnetic field, Radiation from a short current element, Half wave dipole, Radiation Resistance, Effect of ground on radiating elements.	6
Module 6	**Antennas:** Basic Antenna parameters, Radiation pattern, Directivity and Antenna Gain, Bandwidth and beam width, Polarization, Folded dipole, and applications. Antenna arrays, Parabolic reflector, Properties and feed mechanism, Horn Antenna, Loop Antenna.	4

Recommended Books:

S. No.	**Title**	**Author**
1	Electromagnetic Waves & radiating systems, PHI.	Jordan E and Balman K
2	Antennas and Wave Propagation, McGraw-Hill.	John D. Kraus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P Credits**
3rd year (5th Semester)	Mathematics-V	MAT301	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basics of calculus.

Objectives: To study complex variables, their functions and theorems, special functions, and wavelet transform.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Demonstrate understanding of complex variables, including analytic functions and the Cauchy-Riemann equations.	II
CO2	Apply complex integration techniques and understand the significance of Cauchy's fundamental theorem.	III
CO3	Analyze complex functions using Taylor's expansions and determine zeroes, poles, residues, and contour integrals.	IV
CO4	Solve series and understand the properties and applications of special functions like Legendre's and Bessel's functions.	III

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Complex Variables:** Analytic functions, Cauchy Riemann equations, complex integration, Cauchy's fundamental theorem, Cauchy's integral theorem, Cauchy's inequality and Liouville's theorem on integral function, Taylor's and Laurent's expansions, Zeroes and poles of analytic functions, Residues, and contour integration.	18
Module 2	**Special Functions:** Solution of series, Legendre's functions, Rodrigues formula, generating functions for Legendre Polynomials, and recurrence formulae. Bessel's functions, Recurrence formulae, and Bessel's functions of integral order.	10
Module 3	**Wavelet Transform:** Continuous wavelet transforms, Basic properties of the wavelet transform, Discrete wavelet transform, Orthonormal wavelets, multi-resolution analysis, Construction of Orthonormal wavelets, Daubechies wavelets, and algorithms. Band limited wavelets, Balian low theorem.	14

Recommended Books:

S. No.	**Title**	**Author**
1	Complex Variables & Applications, McGraw-Hill Education	R. V. Churchill
2	Theory of Functions of Complex Variables, Oxford University Press	E. I. Copson

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd year (5th Semester)	Microprocessor Lab	ECL305	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisite: Microprocessor.

Objectives: To develop programming skills and understanding of microprocessor operations through practical exercises targeting arithmetic, logic, and interfacing operations.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the fundamentals of microprocessors.	II
CO2	Demonstrate proficiency in microprocessor programming for various control operations.	III
CO3	Apply knowledge of microprocessor interfacing techniques with peripherals.	III
CO4	Analyze and troubleshoot microprocessor-based systems.	IV

Details of the Syllabus:

Exp. No.	**Particulars**
1	i) To develop a program to add two double-byte numbers.
	ii) To develop a subroutine to add two floating-point quantities.
2	i) To develop a program to multiply two single-byte unsigned numbers, giving a 16-bit product.
	ii) To develop a subroutine that will multiply two positive floating-point numbers.
3	Write a program to evaluate P * Q + R * S where P, Q, R & S are 8-bit binary numbers.
4	Write a program to divide a 4-byte number by another 4-byte number.
5	To write a program to divide an 8-bit number by another 8-bit number up to a fractional quotient of 16-bit.
6	Write a program for adding the first N natural numbers and store the results in memory location X.
7	Write a program that decrements a hexadecimal number stored in register C. The program should halt when the program register reads zero.
8	Write a program to introduce a time delay of 100ms using this program as a subroutine to display numbers from 01H to OAH with the above-calculated time delay between every two numbers.
9	N hexadecimal numbers are stored at consecutive memory locations starting from X. Find the largest number and store it at location Y.
10	Interface a display circuit with the microprocessor directly with the bus or using I/O ports. Write a program by which the data stored in a RAM table is displayed.
11	Design and interface a circuit to read data from an A/D converter using the 8255A in the memory-mapped I/O.
12	Design and interface a circuit to convert digital data into an analog signal using the 8255A in the memory-mapped I/O.
13	To interface a keyboard with the microprocessor using the 8279 chip and transfer the output to the printer.
14	To design a circuit to interface a memory chip with a microprocessor with a given memory map.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (5th Semester)	Communication Systems-II Lab	ECL306	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisite: Communication Systems-II.

Objectives: To familiarize the students with the fundamental concepts on TDM, Pulse modulations, digital modulation techniques, source coding techniques and Error-control coding techniques.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Explain how analog signals are converted to digital ones via sampling, quantization and various pulse coded modulation techniques.	V
CO2	Analyze signals as vectors in vector space and understand various digital modulation schemes, their modulator and demodulators.	IV
CO3	Analyze and simulate error performance of various digital modulation schemes in the presence of noise.	IV
CO4	List the recent trends in the field of Digital Communication.	IV

Details of the Syllabus:

Exp. No.	**Particulars**
1	To study the sampling theorem and to plot waveforms for different sampling rates.
2	To analyze a Pulse amplitude modulation (PAM), Pulse width modulation (PWM) and Pulse position modulation (PPM) modulation system and interpret the modulated anddemodulated waveforms.
3	To study the demodulation of PAM, PWM and PPM.
4	To analyze a PCM system and interpret the modulated and demodulated waveforms.
5	To analyze a Delta modulation system and interpret the modulated and demodulated waveforms.
6	To analyze Amplitude Shift Keying (ASK) modulation system and interpret the modulated and demodulated waveforms.
7	To analyze Frequency Shift Keying (FSK) modulation system and interpret the modulated and demodulated waveforms.
8	To analyze a Binary Phase Shift Keying (BPSK) modulation system and interpret the modulated and demodulated waveforms
9	To demonstrate Time Division Multiplexing and de-multiplexing process.
10	To simulate various PAM, PWM and PPM schemes in MATLAB
11	To simulate various ASK, FSK and PPM schemes in MATLAB

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6^{th} Semester B Tech ECE

Syllabus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd year (6th Semester)	Digital Signal Processing	ECT350	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Signals and Systems.

Objectives: The course will focus on introducing some basic concepts concerning discrete-time signals and how these concepts can be applied to come up with the characterization of discrete-time systems in time and frequency domains. The course starts with the basic mathematical description of discrete-time sequences and systems and builds incrementally towards the analysis and design of Linear Time-invariant systems. By the end of this course a student will have a more relevant view of signal processing in the digital domain, and a better understanding of characterization and properties of LTI systems in both time and frequency related domains.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the basic sequence operations and their role in complex DSP algorithms like Convolution, FIR, IIR and FFT.	I, II, III
CO2	Analyze the properties of Linear Time-invariant systems through characterizations based on Impulse response and Z-transform.	IV
CO3	Create non-recursive and recursive structures for discrete LTI systems and evaluate their performance in terms of some basic parameters.	V, VI
CO4	Design and analyze digital filters for processing of discrete time signals.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Discrete-Time Signals and Systems:** Mathematical formulation, Basic sequence operations, System properties, Linear Shift-Invariant systems, Convolution, Linear Constant-Coefficient Difference equation, Frequency-Domain representation of Discrete-time systems.	8
Module 2	**Z-Transform:** Definition, Properties, Inverse Z-Transform, Characterization of LTI systems using Z-transform, System function.	8
Module 3	**Digital Filter Structures:** FIR filter structures- Direct form, Transposed form, Cascaded form, Lattice form, Parallel FIR structures using Polyphase decomposition and FFA, IIR filter structures- Direct form-I, Direct form-II, Cascade form, Interleaved IIR filters.	12
Module 4	**Discrete Fourier Transform:** Definition and Properties, Fast Fourier Transform (FFT), Decimation in Time (DIT) and Decimation in Frequency (DIF) Radix-2 FFT.	8
Module 5	**Digital Filter Design Techniques:** Linear phase FIR filters, FIR filter design using windows, IIR filter design from analog filters.	6

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Recommended Books:

S. No.	Title	Author
1	Digital Signal Processing	Alan V. Oppenheim and Ronald W. Schafer
2	Digital Signal Processing: Principles, Algorithms & Application	J.C. Proakis & M.G. Manolakis
3	Schaum's Outlines Digital Signal Processing	Monson H. Hayes
4	Digital Signal Processing	A. Nagoor Kani

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Year (semester)	**Course title**	**Course code**	**L-T-P-credits**
3rd year (6th semester)	VLSI Design	ECT351	2-1-0
Evaluation policy	**Mid-term**	**Internal assessment**	**End-term**
	26 marks	24 marks	50 marks

Pre-requisites: Electronics-I and Electronics II.

Objectives: To understand MOSFET mechanism as a building block of digital circuits, technology to manufacture them and operation of various logic families.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand and define the basic physics of MOSFET and its operation as a switch and inverter.	I, II
CO2	Explain the fabrication processes for MOS devices and develop the layout concept.	II, III
CO3	Applying the basic MOS knowledge to examine various MOS logic.	III, IV
CO4	Create various types of digital circuits using various MOS logic.	VI

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**MOSFET and CMOS:** Structure and Operation of MOS Transistor, MOSFET Current-Voltage Characteristics, Threshold Voltage and Transconductance, MOSFET Capacitances, Non-ideal I-V effects and MOSFET Scaling; MOSFET as a switch. **CMOS inverters:** Static Voltage Transfer Characteristic, Effect of load capacitance, Fall Time, Rise Time, Delay Time, Noise Margins, Power Dissipation, Power delay Product, Leakage current, Sizing considerations.	14
Module 2	**CMOS Processing Technology and Layout:** Fabrication: Wafer Processing, Oxidation, Epitaxy, Deposition, Ion-Implantation & Diffusion, The Silicon gate Process, n-well, p-well and Twin-Tub Process. Fabrication flow of a simple CMOS inverter. **Layout:** Floor planning, Stick diagram, MOSIS scalable CMOS design rules, Micron Design rules, Simple Layout Examples	08
Module 3	**MOS Circuit Families:** Static CMOS, Ratioed circuits, Cascode Voltage Switch Logic, Pseudo-nMOS, Pass Transistor (Transmission Gates), Dynamic, Domino, NORA (n-p) CMOS, Zipper CMOS, Clocked CMOS, Bi-CMOS, Comparison of different logic circuit families. Implementation of NAND gate and NOR gate in different logic families and their performance comparison, Fan-in, and Fan-out for NAND and NOR gate	10
Module 4	**Implementation:** Multiplexers, Conventional CMOS latches, Conventional CMOS Flip-Flops, Adder, Subtractor, Multiplier, Overview of standard cell based design.	10

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Recommended Books:

S. No.	Title	Author
1	CMOS Digital Integrated Circuits: Analysis and Design	Sung-Mo Kang & Y. Leblebici
2	CMOS VLSI Design: A Systems Perspective	N. Weste & K.Eshraghian
3	CMOS VLSI Design: A Circuits & Systems Perspective	N. Weste, D. Harris & A. Bannerjee
4	Digital Integrated Circuits: A Design Perspective	Rabaey
5	CMOS Circuit Design, Layout and Simulation	R. Jacob Baker

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6th Semester)	Computer Organization and Architecture	ECT352	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic concepts in digital circuit design, familiarity with a programming language like C.

Objectives: The purpose of this course is to have a thorough understanding of the basic structure and operation of a digital computer. Put in very simple terms, the course will enable students as to how a computer works. Students will learn the basic operations involved in the execution of an instruction, interrupts and their usage to implement I/O control and data transfers and identify the different architectural design issues that can affect the performance of a computer such as RISC architecture, instruction set design, and addressing modes.

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

CO No.	**Course Outcome**	**Bloom's Taxonomy Level**
CO1	Explain the internal organization of the computer and its instructions.	II
CO2	Analyze fixed and floating-point algorithms and apply micro program instructions.	IV
CO3	Explain the memory organization and pipelining.	V
CO4	Examine the design of Control Unit and memory hierarchy.	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Function and structure of a computer:** Functional components of a computer, Interconnection of components, Performance of a computer, measuring CPU performance and choice of benchmarks.	08
Module 2	**Representation of Instructions:** Machine instructions, Operands, addressing: Machine instructions, Operands, addressing modes, Instruction formats, Instruction sets, Instruction set architectures - CISC and RISC architectures.	10
Module 3	**Processing Unit:** Organization of a processor - Registers, ALU and Control unit, Data path in a CPU, Instruction cycle, Organization of a control unit Operations of a control unit, Hardwired control unit, Microprogrammed control unit.	10
Module 4	**Memory Subsystem:** Semiconductor memories, Memory cells - SRAM and DRAM cells, Internal Organization of a memory chip, Organization of a memory unit, Error correction memories, Interleaved memories, Cache memory unit - Concept of cache memory, Mapping methods, Organization of a cache memory unit, Fetch and write mechanisms, Memory management unit - Concept of virtual memory, Hardware support for memory management. Overview of pipelining and pipelining scheduling.	14

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Recommended Books:

S. No.	Title	Author
1	Computer Organization and Design the Hardware /Software Interface	D. A. Patterson and J.L. Hennessy
2	Computer Organization and Architecture - Designing for Performance	W. Stallings.
3	Computer System Architecture	Morris Mano.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6th Semester)	Data Communication	ECT353	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic knowledge of communication systems, logic circuits, and their applications in digital systems.

Objectives:

1. To introduce the fundamental various types of computer networks.
2. To study the various techniques of data communication, encoding, and protocols.
3. To understand network topologies, routing, and switching techniques.
4. To explore the TCP/IP and OSI models with merits and demerits. To analyze UDP and TCP Models

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand fundamental principles of computer communication in data networks and the internet.	II
CO2	Understand and remember the conventional computer system interfacing standards, media access methods and peer to peer data link communication protocols.	I, II
CO3	Explore and create the addressing methods and understand the various IP protocols, subnetting, and super netting.	VI
CO4	Easily develop the concepts of TCP\IP and qos.	III

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Data Communication and Networking:** Brief Introduction to OSI Model, Data Representation, Protocols and Protocol Architecture, Data Transmission, Shannon Capacity Transmission Media, MAN, WAN, LAN Characterization, Network Topologies and Design Issues, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks, Message switching.	12
Module 2	**Data Link Layer:** Introduction, Framing, and Overview of Error Detection and Correction, Introduction of Linear Block Coding, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols, Medium Access sub layer: ALOHA, CSMA/CD, LAN – Ethernet IEEE 802.3, IEEE 802.5 – IEEE 802.11, Random access, Controlled access, Channelization.	12
Module 3	The ipv4 and v6, Ip addressing, Logical Addressing, Internetworking, Tunnelling, Address mapping, ICMP, IGMP, Forwarding, Uni-Cast Routing Protocols, Multicast Routing Protocols, Mobile IP.	08
Module 4	Process to Process Delivery in Transport layer, UDP and TCP/IP Suite, Data Traffic, Congestion, Congestion Control, qos, Application Layer: Domain name space, DNS in internet, HTTP.	10

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Recommended books:

S.NO.	Title	Author
1	Data communications and computer networking	W. Stallings
2	Data communications and computer networking	Behrouz Forouzan
3	Computer networks, Prentice hall	Andrew S. Tanenbaum
4	Computer networking: a top-down approach featuring the internet.	James Kurose & Keith W. Ross

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6th Semester)	Seminar	ECS355	0-0-1
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
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Pre-requisites: None.

Objectives: To nurture skills in writing and communication of technical papers amongst the students so as to become effective engineering professionals.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Carry out up to date and effective literature study upon a selected topic.	IV
CO2	Report writing and submission under the guidance of a faculty member of the Department.	I
CO3	Enhancement in communication skills through seminar presentation.	III

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6th Semester)	VLSI design lab	ECL356	0-0-1
Evaluation Policy	**Internal Assessment**	**External Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: VLSI design.

Objectives: To familiarize the students with the practical aspects of MOS device such as its working, characteristics, application, layout using tool based software.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	To understand the MOS model parameters using simulation and analysis of the MOS characteristics.	II, IV
CO2	To understand CMOS based inverter using a tool and analysis of the related parameters.	II, IV
CO3	To get familiarized with the operation of ring oscillators and the multiplexers.	II
CO4	To be able to implement the layout of CMOS based inverter and CMOS based gates for detailed analysis of their performances.	III

Details of the Syllabus:

Exp. No.	**Particulars**
1	Familiarization with MOS model parameters in a circuit simulation software.
2	To plot the transfer characteristics and output characteristics of a MOSFET.
3	Simulation of CMOS inverter with different loads.
4	Simulation of CMOS inverter for different parameters K_n, K_p as a design variable.
5	Study of the switching characteristics of CMOS inverter and find out noise margins.
6	To design and plot the output characteristics of a 3-inverter ring oscillator.
7	Study of the switching characteristics of 2-input CMOS NAND/NOR gate.
8	Layout design of a CMOS inverter using a layout design tool.
9	Layout design of a 2-input CMOS NAND/NOR gate using a layout design tool and their comparison.
10	To design and plot the characteristics of a 4x1 digital multiplexer using pass transistor logic.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6thSemester)	Digital Signal Processing Lab	ECL357	0-0-1
Evaluation Policy	**Internal Assessment**	**Final assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: Digital Signal Processing.

Objectives: By the end of this course a student will have a more relevant view of signal processing in the digital domain, and a better understanding of characterization and properties of LTI systems in both time and frequency related domains.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Calculate and Plot DFT / IDFT of given DT signal.	III
CO2	Analyze the frequency response of discrete time systems.	IV
CO3	To implement Linear and Circular Convolution.	III
CO4	To design and implement FIR and IIR filters.	III, VI

Details of the Syllabus:

Exp. No.	**Particulars**
1	Simulate the following signals using Python/ Scilab/MATLAB. 1. Unit impulse signal. 2. Unit pulse signal. 3. Unit ramp signal. 4. Bipolar pulse. 5. Triangular signal.
2	Find DFT / IDFT of given DT signal.
3	Verify the Linear Convolution of two sequences.
4	Verify the Circular Convolution of two sequences.
5	Find frequency response of a given system.
6	Design and Implement FIR filters for given sequence – I.
7	Design and Implement FIR filters for given sequence – II.
8	Design and Implement IIR filters for given sequence – I.
9	Design and Implement IIR filters for given sequence – II.
10	Study of FIR filter design using window method.

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
3rd Year (6th Semester)	Industrial Training	ECI358	0-0-1
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
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Pre-requisites: None.

Objectives:

1. Students are required to be a part of industrial organization and understand the implementation of technology there.
2. The practical knowledge gained is to be presented in form of detailed report of work experience.
3. The course will be evaluated on basis of viva and report.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Acquaint themselves with the essential practical tasks emphasized in their Professional study.	II
CO2	Ability to identify, formulate & model problems & find engineering solutions based on a systems approach.	III
CO3	Learn professional ethics & economic aspects of industry.	IV
CO4	Learn industrial settings, gaining hands-on experience in designing & manufacturing.	V

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7th Semester B Tech ECE

Syllabus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4thYear (7th Semester)	Microwave Engineering	ECT401	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electromagnetic theory.

Objectives: To become familiarized with microwave frequency bands and their applications and understand the limitations and losses of conventional tubes at these frequencies. To develop the theory related to microwave transmission lines and determine the characteristics of rectangular waveguides, micro strip lines, waveguide components, and ferrite devices. To impart the knowledge of the Scattering Matrix, its formulation, and utility, and establish the S-Matrix for various types of microwave junctions. To be able to understand the working and construction of various Active microwave devices.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand microwave spectrum and bands and recent trends in microwave applications.	II
CO2	To analyze and distinguish between the different types of waveguides and cavities. To establish the properties of the Scattering Matrix, formulate the S-Matrix for various microwave junctions, and understand the utility of S-parameters in microwave component design.	IV, VI
CO3	Appraise the principle of operation of Transferred Electron Devices, and Avalanche Transit-Time Devices	V
CO4	To realize and evaluate the need for solid-state microwave sources.	V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction to Microwave Communication:** Need and Advantages of Microwaves, Microwave Spectrum and Bands, Applications of Microwaves. **Waveguides and Cavity Resonators**: Rectangular Waveguides: Solution of Wave Equations in Rectangular Coordinates, TE/TM mode analysis, Transverse Electric and Transverse Magnetic Waves, Impossibility of TEM Mode. Illustrative Problems Wave propagation through rectangular and circular waveguides, Power transmission and attenuation in waveguides, Electromagnetic Resonators, and Rectangular & Circular cavities.	14
Module 2	**Microwave Passive Devices:** Scattering Matrix (S Parameter) representation of multi-port networks, Tees, Directional Coupler, Circulator, and Isolator. **Microwave Active Devices:** Limitations of conventional vacuum tubes at microwave frequencies, Klystrons, Traveling wave tube, Magnetron, Microwave Detectors.	10
Module 3	**High-Frequency Devices:** Varactor diode, Tunnel diode, **Avalanche Transit-Time Devices:** IMPATT, TRAPATT, BARITT, **TEDs:** Gunn diode,	10
Module 4	**Microwave Amplifiers and Oscillators:** Brief Introduction to Microwave Transistors-Bipolar and Field Effect Transistor Characteristics.	8

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Recommended Books:

S. No.	Title	Author
1	The RF and Microwave Handbook	Mike Golio
2	Microwave Devices and Circuits	Samuel Y. Liao
3	Microwave Principles	Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss,
4	Microwave Engineering	David Pozar

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th year (7th Semester)	Wireless Communication	ECT402	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Communication System –II.

Objectives: To introduce basic cellular concepts and to develop an understanding of frequency reuse, cell splitting, shadowing, fading, GSM standards, mobility management, IS-95, GPRS, etc.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand the basic concepts of wireless communication and performance parameters	II
CO2	Formulate the large and small scale modelling of a wireless communication channel.	III
CO3	To analyze bit error rate and channel capacity evaluation of wireless communication system.	II
CO4	Analyze the performance of cellular communication systems with emphasis on next generation systems	IV

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	**Introduction:** Classification of wireless systems, Types of Services, Requirements for the services, Performance parameters in wireless communications, Multipath propagation, Spectrum Limitations, Noise and Interference limited systems.	10
Module 2	**Propagation Channels:** Radio Propagation Mechanisms (Qualitative treatment), Propagation effects with mobile radio, Channel Classification, Link Budget, Narrowband and Wideband models.	12
Module 3	**Performance Evaluation**: Diversity, Channel Capacity, Capacity of a fading channel-Water filling algorithm, BER performance Improvement with Diversity, Types of Diversity – Frequency, Time, Space.	10
Module 4	**Cellular Communication:** Introduction to Cellular Communications, Frequency reuse, Basic theory of cell layout, Cellular Processes - Call Setup, Handover etc., Evolution of mobile communication technologies (from 2G to 6G).	10

Recommended Books:

S. No.	**Title**	**Author**
1	Wireless Communications	Andreas F. Molisch
2	Fundamentals of Wireless Communications, (Cambridge Publishers)	David Tse, P. Viswanathan
3	Wireless Communication	Rappaport
4	Wireless Communication	Andrea Gold Smith

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (7th Semester)	Electronic Measurements & Instrumentation	ECT403	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: To introduce the instrumentation system, construction, operation of various transducers, sensors, function generators, frequency counters, digital instruments, data acquisition systems, interfacing of micro controllers and basic GPIB techniques.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	What are measurement standards and systems, understanding working principle of different measuring instruments.	I
CO2	Classification of transducers, working and applications, sensors and actuators used in measurements	II
CO3	Develop an understanding the working of wave generators and analyzers	III
CO4	Analyze digital measurements systems, data acquisition system and interfacing with microcontrollers	IV

Details of the Syllabus:

Module no.	**Particulars**	**Hours**
Module 1	**Measurement of Basic Parameters:** Instrumentation System and its classification, Performance parameters- error and sensitivity. Galvanometer and its principle, Moving Coil, Moving iron meters, Torque equation, extension range and effect of temperature, Watt meter. Bridge measurements: Measurement of Resistance, Capacitance, and Inductance.	10
Module 2	**Transducers, Sensors, and Actuators:** Classification, types: Resistive, Inductive, capacitive, Piezoelectric, Optical; Measurement of Physical, Physiological, and chemical quantities: (Temperature, pH, Flow, Pressure, Torque, Speed, Stress, Strain, etc,), Sensors for hostile environments, Actuators: Relays, Solenoids, Steppermotors.	12
Module 3	**Signal Generators and Analyzers:** Function generators, RF Signal Generator, Sweep Generator, Frequency synthesizer, Wave Analyzers for Audio and radio frequency waves. Measurement of harmonic distortion and Spectrum analysis.	10
Module 4	**Digital Instrumentation and Data Acquisition System:** Comparison of analog and digital techniques, Digital multimeter, ADC/DAC, Various Digital Voltmeters. Components of data acquisition system, Interfacing of transducers, Single Channel and Multi-channel system, Multiplexing, interfacing with micro controllers, IEEE 488 Bus.	10

Recommended Books:

S. No.	**Title**	**Author**
1	Electronic Measurements	W Cooper
2	Electrical & Electronic Measurements	A K Sawhney
3	A course in Electrical and Electronic Measurements and Instrumentation, 13/E, Kataria and Sons, 2009.	J.B Gupta

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (7th Semester)	Industrial Organization & Management	HST010	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The experimental setups are introduced to and performed by the students to enable them to give optimal performance in professional life.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Develop the ability to explain economic terms and concepts, Understand and explain the function of market, its types and determination of price under various competencies.	II
CO2	Demonstrate the ability to employ the economic way of thinking like application of marginal analysis, use of benefit/cost analysis, utility and demand forecasting techniques.	IV, VI
CO3	Practice the process of management's four functions: planning, organizing, directing and controlling to make an appropriate staffing decision which includes recruitment and selection design, implement and evaluate training programs.	V
CO4	Understand an organization's characteristics and how they might impact on management practices and analyze both qualitative and quantitative information to isolate issues and formulate best control methods.	V

Details of the Syllabus:

Module No.	**Particulars**	**Hours**
Module 1	Industry, meaning of Industrialization, Industrial revolution, Need problems and prospects of Industrial change in the developing countries. Industrial Evolution in India. Downfall of early industries, evolution of modern industry, effects of partition, industrial policy and progress after independence.	8
Module 2	Forms of Industrial Organization: a) Single Proprietorship b) Partnership c) Joint Stock companies d) Cooperatives and e) State Enterprises. Growth of Industry and Management Meaning of industrial management, functions and tools of management, growth of management concepts. Objectives of Industrial Management: Defining management objectives, managerial activity and objectives, tests of management of objectives, primary, secondary personal and social objectives of management.	10

Module 3	Management Organization: Various forms of organization of departmentalization line staff, functional and committee organization, formal and non formal organization. Management and Authority, Decision Making in Management. Leadership, Definition, Traits, inborn traits, acquired traits, analytical, etc.	12
Module 4	Marketing of Industrial Products and the Sales Manager. Personal Management: Recent changes in personal management function of personal departments, sections, training and placement other functions of personal department.	12

Recommended Books:

S.No.	**Title**	**Author**
1	Principles of Management	G. R. Terry
2	Industrial Organization &Management	Tara Chand
3	Business Organization &Management	M. C.Suckla

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (7th Semester)	Project pre-work	ECP404	0-0-2
Evaluation Policy	**Mid-term evaluation**	**End-term evaluation**	**Supervisor**
	To be awarded by the project evaluation committee.		To be awarded by the supervisor.
	20	40	40

Pre-requisites: None.

Objectives: This course enables the students to get first-hand experience acquainting with principles and applications of electronics and communication engineering by analysing as well as solving problems concerning industries, research etc.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Acquaint students with research methodology.	I
CO2	Enable students to correlate class mode learning to real industrial as well as research applications.	III
CO3	Understand the literature and previous studies concerning the problem.	II
CO4	Learn technical report writing and enhance the communications skills.	II

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (7th Semester)	Microwave Engineering Lab	ECL405	0-0-1
Evaluation Policy	**Internal Assessment**	**Final Assessment**	**Total**
	60 Marks	40 Marks	100 Marks

Pre-requisites: None

Objectives: The experimental setups are introduced to and performed by the students to enable them to give optimal performance in professional life.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Explain and Perform the Reflex klystron Characteristics using Microwave bench set.	II, III
CO2	Explain and Perform the Gunn diode Characteristics using Microwave bench setup.	II, III
CO3	Measure the Frequency, attenuation, VSWR, Impedance using Klystron Bench Setup.	III, IV
CO4	Analyze various characteristics of microwave junctions and design of microwave communication links.	IV, V, VI

Details of the Syllabus:

Exp. No.	**Particulars**
1	To determine the characteristic impedance of lumped constant delay line.
2	To study the voltage distribution along a lumped constant delay line in the cases when it is: (i) Open Circuited (ii) Short Circuited (iii) Terminated in Z_O and hence determine attenuation constant, phase constant, propagation constant, and wavelength.
3	To study the method of measuring VSWR at the input of the component under test or unknown load when (i) VSWR<10 and (ii) VSWR>10.
4	To set up an LOS link using microwave horn antennas and study the link performance under different obstructions.
5	To study the method of evaluation of an unknown load impedance by measuring VSWR and the position of voltage minimum.
6	i. To study the characteristic of wave propagation in a waveguide by studying standing wave pattern and hence to plot W.B.diagram. ii. To verify the relationship between guide wavelength and free space wavelength.
7	To study the method of measurement of VSWR at the input of the component under test (say pyramidal horn) and hence to determine its input impedance.
8	To measure the frequency of a microwave source.
9	To study Gunn oscillator as a source of microwave power and hence to study i. I-V Characteristics. ii. Power frequency characteristics.
10	To measure main line and auxiliary line VSWR of a directional coupler.
11	To study the properties of E and H-plane waveguide tee junctions and to determine isolations, coupling coefficients and input VSWR.

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Year (semester)	**Course title**	**Course code**	**L-T-P-credits**
4th year (7th Semester)	Electronic Design & Automation Tools I	ECL407	0-0-1
Evaluation policy	**Internal assessment**	**Final assessment**	**Total**
	60 marks	40 marks	100 marks

Pre-requisites: None.

Objectives: To study the design of various electronic circuits and systems using automatic simulation tools.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Develop the working knowledge of Vivado tool and any other electronic simulator available	II
CO2	Develop the VHDL code for implementing the digital circuits.	III
CO3	Implement combinational or sequential circuits	IV
CO4	Test the hardware (FPGA Boards) using the implemented code.	V

Details of the Syllabus:

Module No.	**Particulars**
Module 1	Spice
Module 2	Octave
Module 3	Any other electronic simulator available

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (7th Semester)	Python Programming	ECT406	0-0-2
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives:

1. To learn Syntax, Semantics and create Functions and to handle strings and files in Python.
2. To understand Lists, Dictionaries, and Regular Expressions in Python.
3. To implement OOP concepts in Python.
4. To build web services and introduction to Network and Database Programming in Python.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Understand Python syntax and semantics and be fluent in the use of Python flow control and functions.	II
CO2	Implement Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.	III
CO3	Interpret the concepts of Object-Oriented Programming as used in Python.	IV
CO4	Implement exemplary applications related to Network Programming, Web Services and Databases in Python.	V

Details of the Syllabus:

S. No.	**Particulars**
1	Implement a sequential search.
2	Create a calculator program.
3	Explore string functions.
4	Implement Selection Sort.
5	Implement Stack.
6	Read and write into a file.
7	Demonstrate usage of basic regular expression.
8	Demonstrate use of advanced regular expressions for data validation.
9	Demonstrate use of List.
10	Demonstrate use of Dictionaries.
11	Create Comma Separate Files (CSV), Load CSV files into internal Data Structure.
12	Write script to work like a SQL SELECT statement for internal Data Structure made in earlier exercise.

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8th Semester B Tech ECE

Syllabus

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Year (Semester)	**Course Title**	**Course Code**	**L-T-P-Credits**
4th Year (8th Semester)	Project Major	ECP450	0-0-6
Evaluation Policy	**Mid-term evaluation**	**End-term evaluation**	**Supervisor**
	To be awarded by the project evaluation committee.		To be awarded by the supervisor
	20	40	40

Pre-requisites: None.

Objectives: Students need to select a standard project related to electronics and communication. The project has to be workable to be demonstrated practically. Extensive literature review is to be carried out related to the project and same is to be submitted in form of a thesis. Related project will be completed with a power point presentation and viva.

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

CO No.	**Course Outcomes**	**Bloom's Taxonomy Level**
CO1	Identify methods & materials to carry experiments / develop code.	III
CO2	Reorganize the procedure with a concern for society, environment and ethics.	IV, V
CO3	Analyze and discuss the results to draw valid conclusions.	V
CO4	Prepare a report as per recommended format and defend the work.	III, V, VI
CO5	Explore the possibility of publishing paper in peer reviewed journal/conference proceedings.	V

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List of Electives in Groups

Subject Code	Subject Name
Electronics and Systems Group	
ECT001	Advanced Microcontrollers
ECT002	Analog CMOS design
ECT003	Biomedical Engineering
ECT004	Mechatronics
ECT005	Mixed Signal Design
ECT006	Molecular Electronics
ECT007	Nano-Technology
ECT008	Network Synthesis
ECT009	Non-Linear Integrated Circuit
ECT010	Opto Electronic Devices
ECT011	Solar PhotoVoltaics
ECT012	General Purpose Interface Bus Measurement Technique
ECT013	Quantum Devices and Computing
ECT014	Radio Frequency Design
ECT015	SCADA
ECT016	System Design
ECT017	VLSI Technology
ECT018	Embedded Systems
Communication Group	
ECT031	Error Control Codes
ECT032	Information Theory
ECT033	Millimeter Wave Communication

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ECT034	Optical Communication
ECT035	Radar Systems
ECT036	Smart grid communication
ECT037	Telemedicine
ECT038	TV Engineering
ECT039	5G/6G Communication
Computer Science and Engineering Group	
ECT061	Advance Microprocessors
ECT062	Artificial Intelligence and Machine Learning
ECT063	Computer and Network security
ECT064	Design and analysis of algorithms
ECT065	GIS and Remote Sensing
ECT066	Image Processing
ECT067	Multimedia Information Systems
ECT068	Python Programming
ECT069	Real Time Systems
ECT070	Software Engineering
ECT071	Visual Programming
Other Group	
EET081	Advanced Power Electronics
EET082	Electrical Machines
EET083	Power Electronics
EET084	Power Systems
MAT085	Discrete Mathematics
MAT086	Fuzzy logic and neural networks
MAT087	Numerical Analysis and Techniques

MAT088	Optimization Techniques
HST089	HR Management
HST090	IT in Management
HST091	Technology Management
ECT092	Technological Development and Ecology
Elective Labs	
ECL070	Image Processing
ECL071	Optical Communications
ECL072	VLSI Design
ECL073	Visual Programming
ECL074	General Purpose Interface Bus Measurement Technique

Note: Besides the above Elective Courses the students can take subjects offered at:

- M. Tech Level courses and B.Tech level courses from sister (CSE, EE and IT) Departments.

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Advanced Microcontrollers	ECT001	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Digital Electronics, Microprocessors.

Objectives: The course will enable the students to learn the architecture and programming of ARM microcontrollers in C and in Assembly language. The focus will be on building simple applications and interfacing various sensors with the ARM controller.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the Von Neumann architecture as used in the ARM microcontroller.	I, II
CO2	Understand the Instruction Set Architecture of the ARM microcontroller.	I, II
CO3	Develop assembly language and C-language codes to implement different functionalities.	III
CO4	Interface different sensors with the ARM microcontroller.	III, IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Basics of ARM Controllers:** The Acorn RISC Machine, ARM Core data flow model, Architectural inheritance, The ARM7TDMI model: General purpose registers, CPSR, SPSR, ARM memory map, data format, load and store architecture.	10
Module 2	**ARM7TDMI Assembly Language Instructions and Programming:** Different Types of Instructions, ARM Instruction Set, Addressing modes, Program Control Flow,	10
Module 3	**Interrupts and Exceptions:** Exception Handlers, Reset Handling, Aborts, Software Interrupt Instruction, Interrupt Latency, Thumb state, Thumb Programmers model, Interrupt processing. Interrupt Handling Schemes, Examples of Interrupt Handlers.	10
Module 4	**Embedded C Programming for ARM:**ARM Development Environment Embedded Software, Overview of C compiler and optimization, Basic C data types, C Looping structures, Register allocations, function calls, pointer aliasing, C programs for General purpose I/O, general purpose timer, PWM Modulator.	8
Module 5	**ARM Interfacing:** UART, I2C Interface, SPI Interface, ADC, DAC.	4

Recommended Books:

S. No.	Title	Author
1	ARM, System-On-Chip Architecture.	Steve Furber
2	ARM Assembly Language Programming & Architecture.	Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Shujen Chen

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Analog CMOS Design	ECT002	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: VLSI Design.

Objectives: As the course title suggests, the course will be specific to Analog CMOS circuit implementations. In particular, the course will focus on different configurations of CMOS analog amplifier and different differential amplifier topologies and their analysis. The course will also cover voltage references and current mirrors.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	To design and analyze Basic CMOS Amplifier configurations Analysis using small signal model; and large signal Analysis of Amplifiers	I
CO2	Able to analyze and design analog circuits such as Differential Amplifier, OP-AMP, Current mirrors, Biasing, Voltage references, Frequency Synthesizers	I, II
CO3	Ability to analyze high-frequency response of amplifiers and stability compensation for amplifiers.	IV,VI
CO4	Performance Analysis and Design of Multistage amplifiers	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to analog VLSI and mixed signal issues in CMOS technologies. Basic MOS models, SPICE Models and frequency dependent parameters.	10
Module 2	Basic NMOS/CMOS gain stage, CS, CG, CD configurations, cascade and cascode circuits. Frequency response, stability.	12
Module 3	Differential amplifier and OP-AMP design, Frequency response, stability. Current Sources and Voltage references, Frequency Synthesizers, Voltage Controlled Oscillators and Phased lock-loop.	13
Module 4	Multi stage Amplifiers and Noise issues in Amplifiers.	07

Recommended Books:

S. No.	Title	Author
1.	Design of Analog CMOS Integrated Circuits McGraw Hill	Behzad Razavi
2.	CMOS Analog Circuit Design, Oxford University Press	Allen and Holberg,
3.	CMOS Circuit Design, Layout, and Simulation, PHI	Baker, Li, and Boyce

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Year(Semester)	Course Title	Course Code	L-T-P-Credits
	Biomedical Engineering	ECT003	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: The aim of the course is to get the students acquainted with the fundamentals and principles of Biomedical Instrumentation, allied measurements and equipments.

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the basics of biomedical instrumentation and propagation of bio-signals	I , II
CO2	Analyse the governing principles of electrodes, transducers & amplifiers used in biomedical instrumentation, and electrode potential recording	III IV
CO3	Understand the different types of assist devices for humans	IV, V
CO4	Gain knowledge of different Imaging techniques as applied to medical science.	V

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to Biomedical Engineering and Instrumentation:** Biometrics, Human-instrument system and its Components, Bio–potentials and their origin, Resting potential, Action potential, typical wave form of action potential and its propagation , Recording of action potential.	07
Module 2	**Electrodes, Transducer and Amplifiers:** Introduction of Bio-Electrodes, Bio-Electrodes and their bio-interfacial properties, different types of electrodes, Transducers, Sensors, Diaphragms, Force sensors; Biological Amplifiers and Data acquisition	07
Module 3	**Bio (Electro) Potential Recording:** Heart, cardiovascular system, generation and propagation of cardio bio-signal, Signal characteristics, typical waveforms and lead systems of ECG,EEG,EMG signals, Block diagrams and recording techniques for acquisition of ECG, EEG, EMG signals	08
Module 4	**Devices for Assistance:** Direct and Indirect measurement of different bio-parameters, Invasive and Non-Invasive measurements, Cardiac pacemakers and their classification, Defibrillation, AC and DC Defibrillators, Diathermy etc	08
Module 5	Imaging Techniques: Introduction and Properties of X-rays, Production and Block Diagram of X-ray Machine; Ultrasound in medicine, Introduction of Computed tomography, A-mode, B-Mode, M-Mode, Doppler mode,, Introduction of MRI and Gamma camera etc.	12

Recommended Books:

S. No	Title	Author
1.	Handbook of Biomedical Instrumentation	R. S. Khandpur
2.	Medical Instrumentation: Application and Design	J. G. Webester
3.	Biomedical Instrumentation and Measurement	Leislie Cromwell
4.	Introduction to Biomedical Equipment Technology	Joseph J. Carrand John M.Brown

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Mechatronics	ECT004	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic Electrical Engineering, Control Theory, Programming language

Objectives: The objectives of a mechatronics subject typically revolve around providing students with a comprehensive understanding of the principles, methods, and applications of mechatronics, aiming to achieve the Integration of Disciplines: and Integration of Hardware and Software.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Explain the architecture of various mechatronic systems.	II
CO2	Identify and analyze the modern electrical and electronic components used in mechatronic systems.	I,IV
CO3	Select and integrate various sensors and actuators to meet a mechatronic product requirement.	V,VI
CO4	Determine and analyze the dynamic response of the zero, first and second order mechatronic systems. Program and analyze new mechatronic products using embedded systems.	IV,V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to mechatronics, mechatronic design approach, system interfacing, instrumentation and control systems microprocessor-based controllers and microelectronics, mechatronics; a new directions in nano-, micro-, and mini-scale.	8
Module 2	electromechanical systems design, physical system modelling, electromechanical systems structures and materials, modelling of mechanical systems for mechatronics application.	10
Module 3	Sensors and actuators, fundamentals of time and frequency, sensor and actuator characteristics, linear and rotational sensors, acceleration sensors, force measurement, torque and power measurement, flow measurement, temperature measurements, distance measuring and proximity sensors, light detection; image, and vision systems, integrated micro-sensors, actuators; electro-mechanical actuators, electrical machines, piezo electric actuators; hydraulic and pneumatic actuation systems.	14
Module 4	Micro transducers analysis, design and fabrication, role of controls in mechatronics, role of modeling in mechatronics design, response of dynamic systems, introduction to computer and logic systems, logic concepts and design system interfaces, communication and computer networks, fault analysis in mechatronic systems, logic system design, programmable logic controllers, software and data acquisition.	12

Recommended Books:

S. No.	Title	Author
1.	Mechatronics system design, Cengage learning	ShettyD.,Richard A.K.
2.	Mechatronics, PrenticeHall	Dan S.N

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Mixed Signal Design	ECT005	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Analog Circuit Design, Digital Circuit Design, Signal Processing.

Objectives: As the course title suggests, the course will develop a comprehensive understanding of mixed-signal systems, including the interaction between analog and digital components within integrated circuits and systems. Aims at Gain proficiency in designing both analog and digital circuits, including amplifiers, filters, data converters (ADCs and DACs), oscillators, digital logic gates, flip-flops, and other relevant building blocks.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand mixed-signal systems, including the principles of analog and digital electronics, their interactions, and the challenges associated with integrating both domains into a single system.	V,VI
CO2	Design both analog and digital circuits. This includes the ability to design basic analog circuits such as amplifiers, filters as well as digital circuits including ADC and DAC.	V,VI
CO3	To design Charge-pump circuits, Multipliers and Mixed-Signal layout.	III,V
CO4	Design of Interconnects, Phase locked loops, Delay locked loops.	III, IV,V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Analog and discrete-time signal processing, Analog integrated continuous-time and discrete- time (switched-capacitor) filters, Switched Capacitor Amplifiers	10
Module 2	Basics of Analog to digital converters (ADC), Basics of Digital to analog converters (DAC), Performance Parameters of Data Converters, ADC and DAC Architectures and Design.	14
Module 3	Charge-pump circuits and Multipliers., Mixed-Signal layout	11
Module 4	Interconnects, Phase locked loops, Delay locked loops.	07

Recommended Books:

S. No.	Title	Author
1.	CMOS Analog Circuit Design	P. E. Allen and D. R. Holberg
2.	Analysis and Design of Analog Integrated Circuits, Wiley.	P. Gray, P. Hurst, S. Lewis and Meyer
3.	Design of Analog CMOS Integrated Circuits, McGraw-Hill.	B. Razavi
4.	Analog MOS Integrated Circuits for Signal Processing,Wiley.	R. Gregorian and G. C. Temes

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Molecular Electronics	ECT006	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Organic Chemistry

Objectives: The course treats the emerging field of molecular electronics from basics. Organic semiconductors will be an important introductory part of this course. The theory and practice of fabricating discrete and integrated molecular electronic devices and their applications in diverse fields will be covered. Lessons from biological molecular behaviour for molecular electronics will be addressed.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the physics behind organic semiconductors	II
CO2	Transport properties in the molecular systems, Identify the molecules that can be used for different functions in molecular electronics	IV
CO3	Choose a proper method or combined several methods for fabricating and characterizing organic systems.	V
CO4	Exploit the behaviour of the biomolecules for molecular electronic	VI

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to organic electronic materials and their basic properties; Electronic Structure of Molecules and energy structure of organic electronics	9
Module 2	Electronic Properties; Optical properties: Energy levels, color changes, light emission and absorption; Charge transport Mobility, Doping and its Determination	10
Module 3	Techniques to grow / Fabricate Organic films / Materials. Organic electronic circuit components: conductors, resistors, capacitors, diodes, transistors.	10
Module 4	Organic electronics photovoltaics, Organic Memory, Characterization Techniques for organic Electronic materials, Applications in neuroscience and plant biology. An overview of current applications and commercialization: cost, implementation, environmental consideration, printed and flexible electronics	13

Recommended Books:

S. No.	Title	Author
1.	Electronics Processes in Organic Crystals and Polymers	Martin Pope & Charles L. Swenberg
2.	Polymer Electronics	Hsin – Fei Meng

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Network Synthesis	ECT008	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisite: None

Objectives: To introduce students to the basic concepts of Electric Circuit design theory and familiarize them with how to synthesize the circuits to get transits and the steady-state response of the proposed system, emphasizing synthesis in the frequency domain using different techniques.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Comprehensive understanding of synthesizing techniques for circuits and systems	II
CO2	Understanding of causality, stability, and realizability theory; Hurwitz polynomial; Positive real functions	II
CO3	Synthesis procedure for driving point and transfer immittance functions for RLC circuits	III
CO4	Synthesis and filter design, transient response, magnitude and frequency normalization, frequency transformation	III

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction and Laplace Transform:** Frequency domain representation of networks, Laplace transforms of shifted functions, transient & steady response, Time domain behaviors from poles and zeros, Convolution Theorem.	8
Module 2	**Network Synthesis and Impedance Functions:** Network functions, Impedance & Admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two-terminal pair network.	8
Module 3	**Poles, Zeros, and Network Synthesis Techniques:** Sinusoidal network in terms of poles & zeros, Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms.	8
Module 4	**Filters Synthesis and Characteristics:** Classification of filters, characteristics impedance, and propagation constant of the pure reactive network, Ladder network, T section, IT section, terminating half section, passbands, and stop bands, Design of constant-K, m-derived filters, Composite filters.	8

Recommended Books:

S. No.	Title	Author
1.	Network Synthesis, Wiley	Van Valkenburg
2.	Network Synthesis	IVS Iyer
3.	Network Analysis & Synthesis, Wiley	Franklin F. Kou

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Non-Linear Integrated Circuit	ECT009	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electronics-I and Electronics II.

Objectives: As the course title suggests, the course will be specific to non-linear circuit implementations. In particular, the course will focus on different types on non-linear operation and device. The course will also cover application of non-linear device and circuits.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understanding the basic concept of non-linearity and non-linear operations.	II
CO2	Understanding of basic non-linear function and application of non-linear device.	II,III
CO3	Study of non-linear circuits and its application.	III,IV
CO4	To develop the ability to critically evaluate new technologies and methodologies and their potential impact on circuit design and applications.	IV,V

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Basic Operation**: Linearity vs. Non-linearity, Nonlinear device and analog computing, Non-linear operation.	4
Module 2	**Non-linear Functions**: Function Fitting, Time Function Generation, Basic Triangular/ Square-Wave Generator, Operational Amplifier as Hysteretic Comparator, A Practical Oscillator Circuit, One-Shot, Sine-Wave Oscillator, A Practical 2-Phase Sine-Wave Oscillator, Sweep Circuits, Voltage-to-Frequency Conversion.	12
Module 3	**Understanding Nonlinear Circuits**: Logarithmic Circuits, Multipliers, Divider, Multifunction Devices: Powers and Roots, Root Mean-Square.	10
Module 4	**Application of Non-linear Circuits**: Log Circuit Application, Log Ratio Application, Antilog Application, Multiplying and Squaring	8
Module 5	**Transconductance Amplifier (OTA):** Internal structure and analysis, use of transconductance amplifier as variable resistance, inductance simulator, oscillator, filter, Schmitt trigger, and multiplier.	8

Recommended Books:

S. No	Title	Author
1.	Nonlinear Circuits Handbook, 1976	Analog Devices , Edited By Daniel H. Sheingold
2.	Linear and Nonlinear Circuits	Leon O. Chua, Charles A. Desoer, Ernest S. Kuh

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Year(Semester)	Course Title	Course Code	L-T-P-Credits
	Optoelectronic Devices	ECT010	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electromagnetic Fields and Waves, Electronic Devices

Objectives: The aim of this course is to provide students with an understanding of various semiconductor and non-semiconductor based optoelectronic devices (light emitters, detectors, modulators etc.)

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the basic working mechanism of the devices.	I , II
CO2	Analyze the governing equations to be able to perform calculations to characterize the performance of the devices .	III IV
CO3	Have the practical knowledge and an understanding of the trade-offs when using these devices in their respective applications	IV, V
CO4	Understand the integration of optoelectronic devices into practical systems and devices, including considerations such as packaging, thermal management, and compatibility with other components.	V

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Optical processes in semiconductor heterostructures:** Maxwell equations and boundary equations; recombination, absorption in semiconductors, matrix elements and oscillator strength for band-to-band transitions, absorption and emission spectra, Auger recombination.	10
Module 2	**Heterojunction and quantum well:** Theory of the heterostructure band alignment; transport properties; drift-diffusion equation; generation-recombination; abrupt structures and thermionic emission.	10
Module 3	**Propagation of light:** Light propagation in isotropic and anisotropic media; optical waveguide theory; dielectric optical waveguides, the effective index method, gains guidance and index guidance in semiconductor laser; losses and gains in waveguide.	10
Module 4	Generation of light: Semiconductor lasers; Fabry-Perot and distributed-feedback lasers and vertical-cavity surface-emitting lasers (VCSEL).	10
Module 5	Detection of light: Solid state detectors	4

Recommended Books:

S. No	Title	Author
1.	The Physics of Semiconductors with Applications to Optoelectronic Devices	K. F. Brennan,
2.	Semiconductor Optoelectronic Devices	Bhattacharya
3.	Optical semiconductor devices	Mitsuo Fukuda
4.	Advanced Optoelectronic Devices	Dragoman and Dragoman
5	Design of Integrated Circuits for Optical Communications	B. Razavi

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Year(Semester)	Course Title	Course Code	L-T-P-Credits
	Solar Photovoltaics	ECT011	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electronic Devices

Objectives: The aim of this course is to provide students with an understanding of various semiconductor and non-semiconductor based photovoltaic devices

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the basic working mechanism of the photovoltaic devices and their performance parameters	II
CO2	Gain the knowledge of Fabrication Techniques	II,III
CO3	Have the practical knowledge, understanding and interpretation of different Material, Electrical and Optical characterization techniques	II,IV
CO4	Gain the knowledge of state of the art photovoltaics: modelling, performance, and implementation	II,III,IV

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to Solar Photovoltaics and Solar cells**:Solar Resource, Solar Energy Conversion Technologies, Need of Solar PV, Prospects of PV technology. Generations, Light Absorption, Charge Excitation, Charge Drift/Diffusion, Charge Separation, Charge Collection, PN junction diodes: Dark IV, Illuminated IV, Device Performance parameters: Short Circuit Current, Open Circuit Voltage, Fill Factor, Efficiency, Series/ Shunt Resistance, Factors affecting the performance parameters, Detailed Balanced Limit.	08
Module 2	**Solar Cell Fabrication:**Vacuum Based Deposition Techniques: Chemical Vapor Deposition (CVD): PECVD, LPCVD, MOCVD, Physical Vapor Deposition (PVD): Sputtering, Electron Beam Evaporation, Vapor Transfer Deposition, Pulsed Laser Deposition, Atomic Layer Deposition, Molecular Beam Epitaxy. Solution Based Deposition Techniques: Electrodeposition, Spin Casting, Printing, Layer-by Layer Deposition, Colloidal Synthesis.	08
Module 3	**Solar Cell Characterization:** Solar Simulator, Quantum Efficiency Measurement, Secondary Ion Mass Spectroscopy, FESEM, Energy Dispersive X-Ray Spectroscopy, Photo-Luminescence (Basic and Time Resolved)	08
Module 4	**Commercial and Emerging Technologies in Solar cells**:Silicon PV Technology, Chalcopyrite/ Kesterite Solar Cells, Organic Photovoltaics, Dye Sensitized Solar Cells, Perovskite Solar cells, Transparent Photovoltaic Devices, Flexible PV Devices, Multijunction Devices, Concentrator Solar Cells.	08
Module 5	**Cutting-edge Themes and PV Modules Light manipulation in PV Devices**: Plasmonic Integration, Surface Texturing, Spectrum Splitting Techniques. Module Design, Interconnection effects, Temperature effects, Lifetime of PV modules, Module measurement.	06
Module 6	**PV Device Modelling:** Basics of Solar Cell Device Modelling, Thin-Film Solar Cell Device Modelling: Hands-on with an Open Source Tool, Modelling of PV Modules	04

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Recommended Books:

S. No	Title	Author
1.	The Physics of Semiconductors with Applications to Optoelectronic Devices	K. F. Brennan
2.	Semiconductor Optoelectronic Devices	Bhattacharya
3.	Optical semiconductor devices	Mitsuo Fukuda
4.	Advanced Optoelectronic Devices	Dragoman
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Year(Semester)	Course Title	Course Code	L-T-P-Credits
	General Purpose Interface Bus Measurement Technique	ECT012	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Measurement and Instrumentation, Programming Language

Objectives: The objectives of this course typically encompass a blend of theoretical understanding and practical skills aimed at enabling students to effectively utilize GPIB interfaces for measurement and instrumentation purposes.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understanding the basic concept IEEE 488 communication protocol.	I , II
CO2	Understanding and analysing the different specifications of GPIB interface bus.	III IV
CO3	Implementation of GPIB communication protocols.	IV, V
CO4	Design of Programming modules for different functionalities.	VI

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to IEEE 488: PC expansion architecture – Design consideration of PC expansion cards. Interfacing standards- General Purpose Instrumentation Bus(GPIB) – IEEE - 488 protocol	8
Module 2	Electrical and Mechanical Specifications: Hardware, Structure, Electrical and Mechanical specifications.	4
Module 3	System Controller, Addressing and Programming: Addressing and interconnection of equipment/ Instruments, Basic requirement of equipments, Device compatibility, Basic concepts of programming the IEEE 488 GPIB	10
Module 4	Handshaking and IEEE 488 Functions: Functions and Handshaking signals, and their use in programming, Formulation of algorithms for different measurement functionality.	12
Module 5	IEEE 488.2: Disadvantages of IEEE 488, IEEE 488-2 standard-GPIB, Data coding, formats, message protocol	8

Recommended Books:

S. No	Title	Author
1.	488.2-1992 - IEEE Standard Codes, Formats, Protocols, and Common Commands for Use With IEEE Std 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation.	Available at https://ieeexplore.ieee.org/document/213762
2.	Institute of Electrical and Electronics Engineers: General Purpose Instrumentation Bus Manual-488 (Professional and Technical Series)	Anthony J. Caristi

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Quantum Devices and Computing	ECT013	
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic Quantum Mechanics, Linear Algebra

Objectives: The course aims to provide undergraduate engineering students with a fundamental understanding of quantum devices and computing, preparing them for advanced studies or careers in quantum technology and related fields.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the principles of quantum mechanics and their applications in quantum computing and quantum devices	I
CO2	Gain knowledge of various quantum computing architectures and their underlying hardware components.	II
CO3	Develop proficiency in designing and analyzing basic quantum algorithms and circuits.	IV
CO4	Explore the principles and techniques of quantum error correction and their applications in achieving fault-tolerant quantum computation	III

Details of the syllabus:

Module No.	Contents	Hours
Module 1	**Introduction to Quantum Mechanics and Quantum Computing:** Introduction to quantum mechanics: Wave-particle duality, superposition, and entanglement, Basics of qubits: Quantum gates, Bloch sphere representation, Quantum algorithms: Overview of quantum algorithms such as Deutsch-Jozsa, Grover's, and Shor's algorithms, Quantum circuit design: Basic quantum circuits and their applications.	10
Module 2	**Quantum computing architectures**: Overview of different quantum computing platforms (superconducting qubits, trapped ions, etc.). Quantum hardware components: Superconducting qubits, trapped ions, quantum dots, and other emerging technologies.	12
Module 3	**Quantum error correction**: Introduction to quantum error correction codes such as the Shor code, surface codes, and concatenated codes,Principles and techniques for achieving fault-tolerant quantum computation, Implementation challenges and current research developments in quantum error correction, Quantum error mitigation techniques and their applications in noisy quantum systems.	10
Module 4	**Applications of Quantum Computing**: Introduction to quantum machine learning algorithms and their potential applications, Quantum Computing for Optimization, Quantum Cryptographt, Current challenges and future prospects in the field of quantum computing.	10

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Recommended Books:

S. No	Title	Author
1.	Quantum Computing: A Gentle Introduction	Eleanor Rieffel and Wolfgang Polak
2.	Quantum Computation and Quantum Information	Michael A. Nielsen and Isaac L. Chuang
3.	Dancing with Qubits	Robert S. Sutor

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Radio Frequency Design	ECT014	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Analog Electronics, Communication-I, Communication-II, Analog CMOS Design

Objectives: This course will develop electronic circuits for radio frequency applications, specific to CMOS integrated circuits. As the course title suggests, the course will be specific to CMOS integrated circuits, and specific to radio frequencies. In particular, the course will focus on circuits for radio front-ends for mobile phone handsets. The course will cover low noise amplifiers, mixers, power amplifiers, frequency synthesizers (and phase locked loops). The course will also cover several modern radio architectures.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	To design and analyze basic RF systems, architectures and passive RLC networks. To analyze the behavior of passive components at high frequencies.	II
CO2	Understanding the performance parameters and characteristics of noise parameters at high frequencies	IV
CO3	Design and Analysis of RF amplifiers, Mixers, VCO and PLLs. Understanding the Frequency analysis of Oscillators and Mixers	V
CO4	Design and Analysis of GSM, 3G and other communication technologies.	VI

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**RFIC System Overview:** Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology, Overview of RF Filter design and Transmission Lines, Smith Chart **Receiver Architecture**: Different types of Receiver architectures; Performance parameters	12
Module 2	**Noise:** Classification of Noise; Noise performance and limitations of devices, integrated parasitic elements at high frequencies.	6
Module 3	**Low Noise Amplifiers:** Low noise Amplifier design in different technologies and their performance **Mixers:** Design of Mixers at GHz frequency range, Various mixers- working and implementation, Spur Chart **Voltage-Controlled Oscillators and Phase-Locked-Loop:** Basic topologies VCO and definition of phase noise, Noise power and trade off, Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers	12
Module 4	**Power Amplifiers**: General considerations, linear and nonlinear PAs, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques	12

Recommended Books:

S. No.	Title	Author
1.	RF Microelectronics Prentice Hall of India	Behzad Razavi
2.	The Design of CMOS Radio Integrated Circuits, Cambridge University Press	Thomas H. Lee

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	SCADA Sytems and Applications	ECT015	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Control systems, Digital logic design.

Objectives: The course aims to introduce the fundamental principles and applications of SCADA systems. Students will learn how SCADA systems are utilized to supervise, control, and acquire data from industrial processes. The course will cover the underlying concepts of SCADA, its components, communication protocols, and real-world applications.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the basic concepts of SCADA systems and apply them to formulate solutions for industrial control and monitoring tasks.	II, III
CO2	Analyze the functionality of SCADA systems at various levels to ensure proper operation and timing closure of industrial processes.	IV
CO3	Choose appropriate SCADA system configurations for specific industrial applications and evaluate their performance based on key parameters such as reliability, scalability, and responsiveness.	III
CO4	Identify the security challenges inherent in SCADA systems. Acquire proficiency in deploying security measures. Develop expertise in implementing redundancy, fault tolerance, disaster recovery, and backup strategies.	II,III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to SCADA Systems:** Overview of SCADA, history of SCADA, Components of SCADA: RTUs (Remote Terminal Units), PLCs (Programmable Logic Controllers), HMIs (Human-Machine Interfaces), Communication networks, SCADA architectures: Centralized, Distributed, and Hybrid, Communication protocols in SCADA: Modbus, DNP3, OPC-UA.	13
Module 2	**SCADA System Design and Configuration:** Design considerations for SCADA systems, Configuration of SCADA software: Tag database, Alarms and Events, Trending, Historical Data Logging, Human-Machine Interface (HMI) design principles, SCADA system integration with other industrial control systems.	10
Module 3	**SCADA Applications and Case Studies:** Applications of SCADA in various industries: Power generation and distribution, water and wastewater management, oil and gas, manufacturing, and transportation. Case studies of real-world SCADA implementations. Role of SCADA in process optimization, fault detection, and predictive maintenance.	10
Module 4	**SCADA Security and Reliability:** Security challenges in SCADA systems:Cyber threats, Unauthorized access, Data integrity. Security measures: Authentication, Encryption, Intrusion detection. Redundancy	9

	and fault tolerance in SCADA systems. Disaster recovery and backup strategies.	

Recommended Books:

S. No.	Title	Author
1	SCADA supervisory control and data acquisition	Stuart A Boyer
2	Practical Modem SCADA Protocols	Gordan Clark & Deem Reynders
3	Handbook of SCADA / Control Systems Security	Robert Radvanovsky Jacob Brodsky

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	System Design	ECT016	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: To learn basic techniques for the interfacing between system components, meta-stability, and techniques for handling them; to study Layout strategies at IC and board level for local and global signals.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand the System partitioning techniques in different forms and Interfacing in linear and digital systems.	I
CO2	Design finite state machines, and implement state assignment strategies.	I, II
CO3	Carry out implementation of DSP algorithms, and comprehend signal integrity and high-speed behavior of interconnects.	VI
CO4	Get familiar with the Layout strategies at IC level.	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Basics of system hardware design. Hierarchical design using top-down and bottom-up methodology.	07
Module 2	System partitioning techniques, interfacing between system components. Handling multiple clock domains, Synchronous and asynchronous design styles. Interface between synchronous and asynchronous blocks. Meta-stability and techniques for handling it. Interfacing linear and digital systems, data conversion circuits.	12
Module 3	Design of finite state machines, state assignment strategies. Design and optimization of pipelined stages. Use of data flow graphs, Critical path analysis, retiming and scheduling strategies for performance enhancement. Implementation of DSP algorithms. Signal integrity and high-speed behavior of interconnects: ringing, cross talk and ground bounce.	13
Module 4	Layout strategies at IC and board level for local and global signals. Power supply decoupling.	10

Recommended Books:

S. No.	Title	Author
1.	System Analysis & Design	V K Jain
2.	Modern Systems Analysis and Design	Jeffrey A. Hoffer
3.	System Analysis & Design	Kenneth E. Kendall

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	VLSI Technology	ECT017	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: To introduce students to the basic concepts of VLSI technology. Profound understanding of the latest fabrication techniques, emphasizing the ultra-deep submicron technology and its issues and challenges.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Develop the concept of crystal growth and wafer preparation.	II
CO2	Develop knowledge of fabrication processes such as epitaxy, oxidation, lithium, and etching.	III
CO3	Study the methodology of doping in detail and the process of metallization.	IV
CO4	Apply the concept of fabrication processes for process simulation, integration, and understanding of different assembly and packing techniques.	III

Details of Syllabus:

Module No.	Particulars	Hours
Module 1	**Semiconductor Manufacturing Fundamentals:** Crystal Growth, Wafer Preparation, Epitaxy, and Oxidation; Electronic Grade Silicon; Czochralski crystal growing; Silicon Shaping; Vapor phase Epitaxy; Molecular Beam Epitaxy; Silicon on Insulators; Epitaxial Evaluation; Growth Mechanism and kinetics; Thin Oxides; Oxidation Techniques and Systems; Oxide properties; Redistribution of Dopants at interface; Oxidation of Poly Silicon; Oxidation induced Defects.	12
Module 2	**Lithography and Etching Techniques:** Optical Lithography, Electron Lithography, X-ray lithography, Ion Lithography, Plasma properties, Feature Size control, Anisotropic Etch mechanism, Plasma Etching techniques and equipment.	8
Module 3	**Deposition, Diffusion, and Ion Implantation:** Deposition process; Polysilicon; Plasma-assisted Deposition; Models of Diffusion in Solids; Flick's one-dimensional Diffusion Equation; Implant equipment; Annealing Shallow junction; High energy implantation; Physical vapor deposition; Patterning.	10
Module 4	**VLSI Process Integration and Simulation:** Ion implantation; Diffusion and oxidation; Epitaxy; Lithography; Etching and Deposition; NMOS, CMOS, MOS Memory, Bipolar IC Technology; Introduction to process simulation.	8
Module 5	**Assembly Techniques and Packaging:** Analytical Beams; Chemical methods; Package types; Banking design consideration; VLSI assembly technology; Package fabrication technology.	4

Recommended Books:

S. No.	Title	Author
1.	VLSI Technology, McGraw Hill	Sze
2.	Silicon VLSI Technology: Fundamentals, Practice, and Modeling, Pearson	Plummer

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Year (semester)	Course title	Course code	L-T-P-credits
	Embedded Systems	ECT018	2-1-0
Evaluation policy	**Mid-term**	**Internal assessment**	**End-term**
	26 marks	24 marks	50 marks

Pre-requisites: None.

Objectives:

1. The Course is designed to provide students with a comprehensive understanding of embedded systems, including their architecture, components, and applications.
2. The course aims to familiarize students with real-time operating systems (RTOS) principles, emphasizing the importance of deterministic behavior in embedded systems.
3. Additionally, students will develop practical skills in programming embedded systems using the C language, focusing on efficiency, resource management, and hardware interfacing.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Explain the fundamental concepts, components, and characteristics of embedded systems, demonstrating a holistic view of their design and implementation.	II
CO2	Design and implement embedded systems utilizing real-time operating systems, ensuring timely execution of tasks and efficient resource utilization.	III
CO3	Develop embedded software using the C programming language, demonstrating proficiency in writing efficient code, managing memory, and interfacing with hardware.	IV
CO4	Execute a capstone project, showcasing the ability to integrate knowledge and skills acquired throughout the course to solve real-world problems in embedded systems.	V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction:** Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design. Design Process. **Embedded System Architecture:** Instruction Set Architecture - CISC and RISC instruction set architecture, Basic Embedded Processor/Microcontroller Architecture, Memory System Architecture, I/O Sub-system, Co-processors and Hardware Accelerators, Processor Performance Enhancement, CPU Power Consumption.	14
Module 2	**Designing embedded computing platform:** Using CPU Bus, Memory Devices and their Characteristics – RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM. I/O Devices. Component Interfacing - Memory Interfacing, I/O Device Interfacing, Interfacing Protocols.	10
Module 3	**Programming Embedded Systems:** Program Design, Programming Languages - Desired Language Characteristics, Use of High-Level Languages, Programming and Run-time Environment, Basic Compilation Techniques, Analysis and Optimization of - Execution Time, Energy and Power, Program Size.	10
Module 4	**Operating System:** Basic Features of an Operating System, Kernel Features, Processes and Threads, Context Switching, Scheduling, Inter-process Communication, Real-time Memory Management, I/O, Evaluating and	08

	Optimizing Operating system performance, Power Optimization Strategies for Processes.	

Recommendedbooks:

S.NO.	Title	Author
1	Embedded Systems: Architecture, Programming and Design	Raj Kumar
2	Embedded System Design- A unifiedHardware/software Introduction	Frank Vahid, Tony Givargis
3	Programming Embedded Systems in C and C ++	Michael Barr, O'Reilly
4	Real-Time Concepts for Embedded Systems.	Q. Li and C. Yao

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Error Control Codes	ECT31	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Understanding of basic concepts in digital communication systems, Familiarity with probability theory and linear algebra.

Objectives: The course aims to provide students with a thorough understanding of error control coding techniques for modern wireless communication systems. It covers theoretical concepts and practical applications of various codes, enabling students to design and analyze coding schemes for reliable communication in next-generation wireless technologies.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Recognize and recall the principles and properties of various error control codes.	I
CO2	Explain the encoding and decoding techniques employed in error control codes and their applications in wireless communication systems.	II
CO3	Design and implement encoding and decoding algorithms for error control codes to solve communication problems.	III
CO4	Evaluate the performance and suitability of error control codes for different communication scenarios based on theoretical analysis and practical experimentation.	IV

Details of the Syllabus:

Module No.	Contents	Hours
Module 1	**Linear Block Codes and Cyclic Codes:** Introduction to Linear Block Codes and Cyclic Codes, Encoding and decoding algorithms, Error correction/detection capabilities, Practical applications in wireless communication systems	10
Module 2	**Convolutional Codes:** Basics of Convolutional Codes, Encoding and decoding techniques, Viterbi algorithm for decoding, Performance analysis and applications	12
Module 3	**Reed-Solomon Codes:** Introduction to Reed-Solomon Codes, Encoding and decoding algorithms, Error correction/detection capabilities, Applications in modern communication systems	10
Module 4	**Modern Error Control Codes for Wireless Communication:** Overview of modern codes like LDPC codes, Encoding and decoding techniques, Performance comparison with traditional codes, Applications in next-generation wireless communication systems	10

Recommended Books:

S. No.	Title	Author
1.	Error Control Coding	Shu Lin and Daniel J. Costello
2.	Modern Coding Theory	Tom Richardson and Rüdiger Urbanke
3.	Channel Coding: Theory, Algorithms, and Applications	John Proakis and Marcio M. de Oliveira

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Information Theory	ECT32	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Understanding of basic concepts in probability theory and discrete mathematics, Familiarity with digital communication systems is helpful but not required.

Objectives: To provide students with a comprehensive understanding of Information Theory principles and their applications in communication systems, data compression, and cryptography.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Recall fundamental concepts of Information Theory such as entropy, mutual information, and channel capacity.	I
CO2	Explain the theoretical foundations of Information Theory and its relevance in modern communication systems.	II
CO3	Apply Information Theory principles to analyze communication systems and optimize information transmission efficiency.	III
CO4	Analyze the performance of coding schemes and compression algorithms using Information Theory metrics, such as entropy and channel capacity.	IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to Information Theory: Notion of information, Entropy, mutual information, Properties of entropy and mutual information, Chebeschev's inequality, Law of Large Numbers, Asymptotic Equipartition Property.	10
Module 2	Data Compression: Concept of Typical Sets, Source Coding Theorem, Lossless and lossy compression techniques, Huffman coding and arithmetic coding, Lempel-Ziv algorithms for text compression.	12
Module 3	Communication Channels: Joint Typicallity Lemma, Channel capacity and the noisy channel coding theorem, Capacity of discrete memoryless channels,Capacity of Gaussian channels, Sphere Packing argument, Water-filling solution for Colored Gaussian Noise Channel.	10
Module 4	Advanced Topics in Information Theory: Source coding with side information (Slepian-Wolf coding), Multi-terminal channels and capacity regions, Cryptography and information theory, Information theory applications in modern communication systems.	10

Recommended Books:

S. No.	Title	Author
1.	Elements of Information Theory	Thomas M. Cover and Joy A. Thomas
2.	Information Theory and Reliable Communication	Robert G. Gallager
3.	Information Theory, Inference, and Learning Algorithms	David MacKay

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Millimetre Wave Communication	ECT033	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Digital Communication, Signal Processing, Electromagnetics

Objectives: To familiarise students with Millimetre wave communication technology which is a major part of future WLAN as well as cellular systems.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand significance of Millimetre Wave(mmWave) Communication for future mobile applications.	II
CO2	Know fundamentals of mmWave Propagation, devices and circuits	I
CO3	Understand various components of mmWave Communications system	II
CO4	Know antenna design at mmWave frequencies and mmWave MIMO and mmWave Standards	I, VI

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**INTRODUCTION :** Millimeter Wave (mmWave) Wireless, mmWave Implementation Challenges, Emerging Applications of mmWave Communications, propagation characteristics of mm waves: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Coverage and capacity in mmWave.	9
Module 2	**MM WAVE DEVICES, CIRCUITS AND COMM:** Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mmWave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm Wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.	10
Module 3	**MM WAVE COMMUNICATION SYSTEMS:** Modulations for mmWave communications, mmWave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, mmWave calibration, production and manufacture, Future considerations.	10
Module 4	**ANTENNAS FOR MM WAVE SYSTEMS, MM WAVE MIMO AND MM WAVE STANDARDIZATION:** Antenna beamwidth, polarization, mmWave antenna design considerations, mmWave antennas for 5G, On-chip and In package mm wave antennas, Techniques to improve gain of mmwave antennas, mm wave adaptive antenna arrays, Advanced beam steering and beam forming for mmWave applications. mmWave MIMO, Massive MIMO, Noise coupling in MIMO system, Multiple Antennas, Multiple Transceivers, Spatial, Temporal and Frequency diversity, Potential benefits of advanced diversity for mmWave communication, mmWave MIMO for 5G applications. Introduction, mmWave Spectrum Regulations, International Recommendations, IEEE 802.15.3c, IEEE 802.15.3 MAC, IEEE 802.15.3c mmWave PHY, Wireless HD, ECMA-387, IEEE 802.11ad, WiGig	13

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Recommended Books:

S. No.	Title	Author
1.	Millimeter Wave Communication Systems", Wiley-IEEE Press	K.C. Huang, Z. Wang
2.	Millimeter Wave Wireless Communication", Prentice Hall, 2014	Robert W. Heath, S. Rappaport,
3.	Millimeter - Wave Wireless Communication Systems: Theory and Applications, Hindawi Publishing Corporation	Chia-Chin Chong et al.
4.	Millimeter-Wave Integrated Circuits, Springer	Eoin Carey

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Optical Communication	ECT034	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Communication systems.

Objectives: To make the students aware about the basic theory and working of various sub-systems of optical fibre communication systems, their design and integration into a communication setup.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand basic concepts about Optical Fibers, Ray optics and overview of modes.	I,II
CO2	Understand basic knowledge about various degradation phenomenon including attenuation, scattering dispersion and bending in optical fibers.	I,II,V
CO3	Understand concepts related to various optical fiber sources including LED and LASERS and their coupling with optical fibers. To understand operation of various Fiber Optical Receivers including PIN and APD diodes.	IV,V
CO4	Understand point to point link considerations including link power budgets and rise time budgets. To understand operational principles of WDM, Soliton and analyze Noise effects on system performance including EDFA, Sonnet/ SDH networks.	II,III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**INTRODUCTION TOOPTICALFIBERS:** Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Ray Optics-Optical Fiber Modes and Configurations- Mode theory of Circular Waveguides-Overview of Modes-Key Modal concepts- Linearly Polarized Modes - Single Mode Fibers-Graded Index fiber structure.	10
Module 2	**SIGNAL DEGRADATION OPTICAL FIBERS**: Attenuation –Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides-Information Capacity determination-Group Delay- Material Dispersion, Waveguide Dispersion, Signal distortion in SM fibers-Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers-Mode Coupling -Design Optimization of SM fibers-RI profile and cut-off wavelength.	14
Module 3	**FIBER OPTICAL SOURCES AND COUPLING:** Direct and indirect Band gap materials-LED structures-Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition -Rate equations -External Quantum efficiency -Resonant frequencies-LaserDiodes,Temperatureeffects,IntroductiontoQuantumlaser,Fiberamplifiers-Power Launching and coupling, Lencing schemes, Fibre– to - Fibre joints, Fibre	11

	splicing.	
Module 4	**FIBER OPTICAL RECEIVERS**: PIN and APD diodes-Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise-Comparison of Photodetectors- Fundamental Receiver Operation- preamplifiers, Error Sources - Receiver Configuration -Probability of Error –Quantum Limit. **DIGITAL TRANSMISSION SYSTEM:** Point-to-Point links System considerations- Link Power budget–Rise-time budget-Noise Effects on System Performance- Operational Principles of WDM, Solitons-Erbium-doped Amplifiers. Basic on concepts of SONET/SDH Network.	07

Recommended Books:

S. No.	Title	Author
1.	Optical Fiber Communication	Gerd Keiser
2.	Optical Communication, Principles and Practice	J.Senior

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Radar Systems	ECT035	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: The course is aimed to expose students to radar techniques for target detection in presence of noise and clutter. The course will enable students to gain insight into the emerging applications of radar technology.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand the radar operation and its applications in practice.	I
CO2	Design a radar signal for a given problem.	I, II
CO3	Choose a suitable detection method for detecting a target in presence of noise and clutter.	VI
CO4	Understand the tracking methods in a radar system	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Introduction to Radar Systems: Radar Equation, Radar Cross section, Area and volume Targets	07
Module 2	Radar Signals: Radar Signal Types and their LTI response, Matched Filter Response for stationary and moving targets, Ambiguity function Pulse compression of Radar Signals. Basic Concept and compression techniques.	12
Module 3	Radar Detection: Basic Detection principles, Optimum decision rule, Detection criteria for different target models. Radar measurements: Range, Doppler frequency and angle measurement. Optimum Receiver Design, Radar Tracking	13
Module 4	Emerging Trends in Radar technology: 3D Radar, Active Scanned Arrays for RADARs, Broadband Multifunction Radar, Distributed Aperture Radar Systems, Use of Light Detection and Ranging(LIDAR) sensors in Radar systems.	10

Recommended Books:

S. No.	Title	Author
1.	Radar Principles	P.Z. Peebles
2.	Introduction to Radar Systems, (3/e)	Merrill I. Skolink

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Smart Grid Communications	ECT036	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electrical Machines, Power System

Objectives: The objective of this course is provide electronics & communications engineering students with a basic understanding of communication systems concepts and principles as applied to electric utility applications. One of the key enabling technologies for the emerging "smart power grid" is the advanced communication technology. Hence, it is becoming imperative for ECE students to have an understanding of the communication technologies and their use for the smart grid. This course serves as an interdisciplinary course to prepare students to be knowledgeable in these critical and relevant areas of communications, cyber security and their use for the smart grid. In this course, students are also prepared to get exposure of recent trends in smart grid technology including IoT, Artificial Intelligence/Machine Learning based solutions for smart grid communication..

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	To understand the overall objective of smart grid and its relevance to power distribution system	II, IV
CO2	To understand the smart grid communication network, data acquisition and control system	II
CO3	To understand the smart grid network architecture and its design and security issues	II, VI
CO4	To get exposure of recent trends in smart grid communication including IoT, Machine Learning and AI Based solutions	II, IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to Smart Grid:** Definition, Objectives and Domain of Smart Grid; Revision of Voltage, Current, Alternating Current Phasor representation, Power Generation, Transmission System, Distribution System and Faults in Power System	10
Module 2	**Communication Networking for Smart Grid:** Elements of Data Communication Networks; Protocols and Protocol Layers; Data Networking Technologies; Supervisory Control and Data Acquisition systems (SCADA); Networking with SCADA; Teleprotection	12
Module 3	**Smart Grid Network Architect and Design:** Architecture Framework, Wide Area Network, Field Area Network (FAN), Network Design Process, Network Traffic, Routing architecture, QoS in Smart grid network, Security in Smart Grid Network	12
Module 4	**Recent Trends in Smart Grid:** IoT based Smart Grid Communication, Machine Learning and Artificial Intelligence Based Solutions for Smart Grid, Other recent trends based on recent Journal papers	10

Recommended Books:

S. No.	Title	Author
1.	Communication networks for smart grids.	Budka, Kenneth C., Jayant G. Deshpande, and Marina Thottan.

2.	Smart grid: Communication-enabled intelligence for the electric power grid	Bush, Stephen F.
3.	Smart grid communications and networking	Hossain, Ekram, Zhu Han, and H. Vincent Poor, eds

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Telemedicine	ECT037	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: This course presents how telecommunications technology is used by health care professionals to evaluate, diagnose and treat patients at a distance.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understanding the Scope, Benefits and clinical applications of Telemedicine.	II
CO2	Understanding of data security & standards	II, III
CO3	Understanding of a tele-radiology system	II,IV
CO4	Understanding various applications of telemedicine in medical fields	II

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**History of Telemedicine:** Telemedicine: Definition and history, Block diagram, Scope, Benefits, Limitations and Clinical applications - Real-time and store-forward, Types of information: Audio, Video, Still Images, Text and data, and Fax - Types of Communication and Network: PSTN, POTS, ATN, and ISDN - Basic concepts of Communication and Network: Internet, and Wireless communications (GSM, Satellite and Micro- wave), Types of antennas depending on requirements.	12
Module 2	**Medical Data Security and Legal Issues:** Data Exchanges: Network configuration, Video conferencing- Data security and Standards: Encryption, Cryptography, Mechanisms and phases of encryption- Protocols and Standards -encryption, Ethical and legal aspects of Telemedicine, patient rights and consent form, aces to medical records, Intelectual property rights.	12
Module 3	**Tele-Radiology and Tele-Pathology:** Tele-radiology and its basic system components, Image acquisition system, Display system, Communication networks, Interpretation, Tele-pathology, Multimedia databases, color images of sufficient resolution, image compression methods, Interactive control of color and controlled sampling.	11
Module 4	**Other Medical Applications:** Tele-dermatology, Tele-psychiatry, Tele-cardiology, Tele-trauma, role of tele-education, evaluation in telemedicine, Tele-oncology, Tele-surgery, security and confidentiality tools.	9

Recommended Books:

S. No.	Title	Author
1.	Handbook of Telemedicine	Olga Ferrer-Roca, M.Sosa Ludicissa
2.	Essentials of Telemedicine and Telecare	Norris A.C

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	TV Engineering	ECT038	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Communication-I, Communication-II

Objectives: This course will develop the subject of TV Engineering from the basics. Starting from the analysis and theory of TV Pictures, Composite Video Signal, Receiver Picture Tube, we move on to the study of Monochrome Television Transmitter and Receiver systems. Aspects of Color TV systems theory will also be covered in detail.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	To analyse and synthesize TV Pictures, Composite Video Signal, Receiver Picture Tubes and Television Camera Tubes	IV, VI
CO2	To study the principles of Monochrome Television Transmitter and Receiver systems	I
CO3	Understand various Color Television systems with a greater emphasis on PAL system	II
CO4	To study the advanced topics in Television systems and Video Engineering	I

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**FUNDAMENTALS OF TELEVISION:** Geometry form and Aspect Ratio - Image Continuity - Number of scanning lines - Interlaced scanning - Picture resolution - Camera tubes- Image orthicon - vidicon-plumbicon-silicon diode array vidicon-solid state image scanners- monochrome picture tubes- composite video signal-video signal dimension- horizontal sync. Composition- vertical sync. Details – functions of vertical pulse train – scanning sequence details. Picture signal transmission – positive and negative modulation – VSB transmission sound signal transmission – standard channel bandwidth	12
Module 2	**MONOCHROME TELEVISION TRANSMITTER AND RECEIVER**: TV transmitter – TV signal propagation – Interference – TV transmission Antennas – Monochrome TV receiver – RF tuner – UHF, VHF tuner- Digital tuning techniques- AFT-IF subsystems - AGC – Noise cancellation- Video and sound inter carrier detection- vision IF subsystem- video amplifiers requirements and configurations - DC re- insertion - Video amplifier circuits- Sync separation – typical sync processing circuits- Deflection current waveform – Deflection Oscillators – Frame deflection circuits – requirements- Line Deflection circuits – EHT generation – Receiver Antennas	11
Module 3	**ESSENTIALS OF COLOUR TELEVISION:** Compatibility – colour perception- Three colour theory- luminance, hue and saturation-colour television cameras- values of luminance and colour difference signals- colour television display tubes- delta – gun-precision – in-line and Trinitron colour picture tubes- purity and convergence- purity and static and dynamic convergence adjustments- pincushion correction techniques- automatic degaussing circuit- grey scale tracking – colour signal transmission- bandwidth- modulation of colour difference signals – weighting factors- Formation of chrominance signal.	11

Module 4	**COLOUR TELEVISION SYSTEMS:** NTSC colour TV system- NTSC colour receiver- limitations of NTSC system – PAL colour TV system – cancellation of phase errors- PAL –D colour system- PAL coder – Pal-Decolour receiver- chromo signal amplifier- separation of U and V signals- colour burst separation – Burst phase Discriminator – ACC amplifier- Reference Oscillator- Ident and colour killer circuits- U and V demodulators- Colour signal matrixing – merits and demerits of the PAL system – SECAM system – merits and demerits of SECAM system.	12
Module 5	**ADVANCED TELEVISION SYSTEMS:** Satellite TV technology- Cable TV – VCR- Video Disc recording and playback- Tele Text broadcast receiver – digital television – Transmission and reception- projection Television – Flat panel display TV receiver – Sterio sound in TV – 3D TV – EDTV – Digital equipments for TV studios	10

Recommended Books:

S. No.	Title	Author
1.	Monochrome Television Practice, Principles, Technology and servicing	By R.R.Gulati
2.	Monochrome and colour Television	By R.R.Gulati
3.	Colour Television, Theory and Practice	By S.P.Bali

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Advanced Microprocessors	ECT061	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisite: None

Objectives: To familiarize students with different types of processors/Architectures and induce in them a sense of inquisitive thinking about design and implementation issues related to computer processors/architectures, taking MIPS architecture as an example.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand computer architectures, their significance, and differences.	II
CO2	Evaluate performance measures of processors.	VI
CO3	Design data paths for single-cycle MIPS-32 implementation and introduce multicycle implementation.	III
CO4	Enhance the performance of computer systems using pipelining and memory management.	IV

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	Familiarization and importance of CISC and RISC processors and their design issues. Hardware and Software interaction in Computers	8
Module 2	Performance of Computers. Understanding and evaluation of CPU performance. Factors used for enhancement of performance. Performance benchmarks	10
Module 3	Introduction to MIPS-32 and MIPS-64 processors and their instruction formats/addressing modes. Single Cycle Data Path implementation of MIPS-32 and introduction to multipath implementation.	8
Module 4	Performance enhancement of MIPS-32 using pipelining. Pipeline Hazards and the Resolution of Pipeline Hazards	8
Module 5	Memory hierarchy and use of memory hierarchy for improvement of computer performance. Importance of Virtual memory and implementation in the computer system.	8

Recommended Books:

S. No.	Title	Author
1.	Microprocessors and Interfacing – TMH	Douglas V Hall
2.	Microcomputer Systems: The 8086/8088 Family – PHI	Yu Cheng Liu and Glen A Gibson

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Artificial Intelligence & Machine Learning	ECT062	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Probability and Statistics, Calculus, Python Programming Language

Objectives: The objective of the course is to understand the fundamentals of computational intelligence, to know about the various knowledge representation methods, to understand the features of neural network and its implementation, to study about various data clustering methods. To gain knowledge in evolutionary computation and neuro – fuzzy systems.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Implement computational intelligence through applications.	VI
CO2	Understand knowledge representation methods and apply approximate reasoning.	II, III
CO3	Apply evolutionary algorithm to solve the optimization problem.	I
CO4	Able to Model Flexible Fuzzy Inference systems for dynamic nonlinear data sets.	VI

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to AI:** Philosophy of artificial intelligence, Course structure and policies. History of AI. Proposing and evaluating AI applications.	10
Module 2	**Search and Planning:** Fundamental and advanced search techniques Problem spaces and search, Heuristic search strategies, Search and optimization (gradient descent), Adversarial search, Planning, and scheduling (A*, local search, suboptimal heuristic search, search in AND/OR graphs), Constraint optimization	12
Module 3	**Knowledge Representation and Reasoning:** Logic and inference, Temporal reasoning, Knowledge representation and reasoning through propositional and first-order logic, modern game playing. Ontologies, Bayesian reasoning,	10
Module 4	**Fuzzy Logic** Crisp set and Fuzzy set, Basic concepts of fuzzy sets, membership functions. Basic operations on fuzzy sets, Properties of fuzzy sets, Fuzzy relations. Propositional logic and Predicate logic, fuzzy If-Then rules, fuzzy mapping rules, and fuzzy implication functions,	12
Module 5	**Applications in Machine learning: Supervised and Unsupervised methods** What is machine learning? Supervised vs. unsupervised learning, Regression -- linear, logistic, ridge , Classification – decision trees, SVM, random forests Reinforcement learning, Introduction to probabilistic graphical models (Bayesian networks, Hidden Markov models, Conditional random fields), Introduction to information systems (information retrieval, information extraction).	12

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Recommended Books:

S. No.	Title	Author
1.	A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.	Deepak Khemani.
2.	Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.	Stuart Russell and Peter Norvig.
3.	Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.	Judea Pearl.

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Computer and Network Security	ECT063	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: To develop an understanding of security on computer networks, various cipher techniques, public key cryptography, authentication, virtual private networks, firewalls.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Develop concept of security needed in communication of data through computers and Networks along with various possible attacks	III
CO2	Understand various encryption mechanisms for secure transmission of data and management of key required for encryption	I,II
CO3	Understand authentication requirements and study various authentication mechanisms	IV
CO4	Understand network security concepts and study different web security mechanisms	III

Details of the syllabus:

Module No.	Particulars	Hours
1.	**Introduction:** Need of security, Security attacks, services and mechanisms, Network security, Model.	08
2.	**Symmetric Ciphers:** Substitution and transposition techniques, Block cipher Principles and Modes of operation DES, Triple DES, Stream Ciphers and RC4.	08
3.	**Public Key Cryptography:** Need and principles of Public key cryptosystems, RSA Algorithm, Key, Distribution and management, Diffie-Hellman Key Exchange, Digital Signatures.	09
4.	**Authentication:** Authentication Requirements, Message Authentication Codes, Hashes, MD5andSHA, User Authentication: Password, Certificate based and biometric authentication, Kerberos.	08
5.	**Network Security:** Firewalls, IP Security, Virtual Private Networks and Intrusion Detection, Web Security-SSL and TLS.	11

Recommended Books:

1.	Cryptography and Network Security	William Stalling
2.	Cryptography and Network Security	Atul Kahate
3.	Cryptography and Network Security	Forouzan

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Design and analysis of Algorithms	ECT064	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: This course covers, principles of algorithm design, elementary analysis of algorithms, and fundamental data structures. The emphasis is on choosing appropriate data structures and designing correct and efficient algorithms to operate on these data structures.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Learn how to analyze algorithms and estimate their worst-case and average-case behavior (in easy cases).	I
CO2	Analyze the asymptotic performance of algorithms. Write rigorous correctness proofs for algorithms.	I, II
CO3	Accustomed to the description of algorithms in both functional and procedural styles.	IV,VI
CO4	Learn how to apply their theoretical knowledge in practice (via the practical component of the course).	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Analysis of Algorithms: Algorithm Design paradigms, motivation:** Review of algorithmic strategies, asymptotic analysis: upper and lower complexity bounds. Identifying differences among best, average and worst-Case Behaviors. Big O, little O, omega and theta notations, Standard complexity classes. Empirical measurements of performance. Time and space trade-offs in algorithms. Analyzing recursive algorithms using recurrence relations.	10
Module 2	**Divide & Conquer:** Structure of divide and conquer algorithms: examples, Binary search, Quick sort, analysis of divide and conquer run time recurrence relations. **Greedy Algorithms:** Overview of the greedy paradigm, examples of exact optimization solution (minimum cost spanning tree), approximate solution (Knapsack problem), single source shortest paths.	09
Module 3	**Dynamic Programming**: Overview, difference between dynamic programming and divide and conquer, applications: shortest path in graph, matrix multiplication, travelling salesperson problem, longest common sequence. **Graph Algorithms:** Graphs and their Representations, Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim's and Kruskal's algorithms for MST, Connected Components, Dijkstra's Algorithm for Single Source Shortest Paths, Warshall's Algorithm for finding Transitive Closure of a Graph, Floydd's Algorithm for All-Pairs Shortest Paths Problem	13
Module 4	**Back Tracking:** Overview, 8-Queens problem and Knapsack problem. **Branch & Bound:** LC searching, bounding, FIFO branch and bound, Applications: 0/1 Knapsack problem, Travelling salesperson problem. **Computational complexity:** Complexity measures, Polynomial vs non-	10

	polynomial time complexity; NP hard and NP complete classes, Examples.	

Recommended Books:

S. No.	Title	Author
1.	Introduction to Algorithms	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein
2.	Data Structures and Algorithm Analysis in C++	Mark Allen Weiss Third Edition, PearsonEducation, 2006
3.	Fundamentals of ComputerAlgorithms	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Digital Image Processing	ECT066	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-Requisites: None.

Objectives: The course aims to provide students an understanding of fundamental concepts and applications of digital image processing including improvement of pictorial information for human perception, Restoration of degraded images, efficient storage and transmission of images and segmentation of images.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand different techniques used for the enhancement of images	II
CO2	Understand different types of image transforms and apply it for Image compression	II, III
CO3	Understand different causes for image degradation and overview of image restoration techniques	II
CO4	Apply segmentation to Develop any image processing application	V

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	**Image Fundamentals and Image Enhancement**: Fundamental steps in digital image processing, Image sensing and acquisition, Image sampling and Quantization, basic relationship between pixels, Basic Mathematical tools used in image processing. Intensity transformation, Histogram Processing, Spatial filtering, , smoothing and sharpening spatial filters, 2D-DFT and IDFT, Filtering in the frequency domain, Image smoothing using Low pass frequency domain filters, Image sharpening using high pass filters	14
Module 2	**Image restoration:** Model of Image Degradation/restoration, Noise models, Estimating the degradation function, order static filters, Inverse filtering, wiener filtering, adaptive filters.	08
Module 3	**Image transforms and image compression**: Walsh-hadamard Transforms, Discrete Cosine transform, Haar transform, wavelet transforms, Image compression fundamentals, Huffman coding, Run length coding, Bit plane coding, wavelets based image compression.	10
Module 4	**Image Segmentation:** Fundamentals, Point , Line and edge detection, Thresholding, boundary based approaches, Region based approaches and clustering, template matching, texture segmentation	10

Recommended Books:

S. No.	Title	Author
1	Digital Image Processing	Rafael C. Gonzalez, Richard E. Woods
2	Fundamentals of Digital Image Processing	A K Jain

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Multimedia Information Systems	ECT067	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: The course aims to expose students to various audio, image, and video standards to gain enough skills to understand and handle multimedia systems.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand various digital audio standards and their utility in practical systems.	II
CO2	Comprehend various image data formats & their practical applications.	III
CO3	Handle video systems used in practice.	III
CO4	Understand various data compression standards used in practice.	V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction**: Multimedia systems: Components, Functional Requirements and Applications Multimedia Data Acquisition and formats	8
Module 2	**Digital Audio:** Sound digitization, Representation- Time Domain & Transform Domain Representation, Coding for Digital Audio - Pulse code modulation, Differential Coding Techniques	10
Module 3	**Graphics & Image Data:** Graphics/ Image Data Types, Image Data Formats Color Models in Images; RGB, CMY, CMYK	8
Module 4	**Fundamental of Video Processing:** Types of Video Signals- Composite Video, S- video; Analog and Digital Video Standards	6
Module 5	**Multimedia Data Compression:** Lossless Compression, Run Length Coding, Variable Length Coding. Lossy Compression; Discrete Cosine Transform, Wavelet Transform	10

Recommended Books:

S. No.	Title	Author
1.	Fundamentals of Multimedia, Pearson	Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan
2.	Multimedia Systems and Design Pearson	Prabat K Andleigh and Kiran Thakrar

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Python Programming	ECT068	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Basic understanding of programming concepts, Familiarity with mathematics, including calculus and linear algebra.

Objectives: The objective of this course is to equip students with the necessary programming skills in Python and to demonstrate its application in various domains relevant to Electronics and Communication engineering, including signal processing, communication systems, optimization, and machine learning.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Understand the fundamentals of Python programming language.	I
CO2	Apply Python for scientific computing, including Monte Carlo simulations, linear algebra operations, and signal processing tasks.	II
CO3	Utilize Python for optimization problems, including convex optimization, linear programming, and non-linear programming.	IV
CO4	Implement machine learning algorithms in Python for data analysis and modeling in Electronics and Communication systems.	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Introduction to Python Programming**: Overview of Python programming language, Basic syntax, data types, and variables, Control flow structures: loops and conditionals. Functions and modules in Python, plotting with matplotlib.	10
Module 2	**Python for Scientific Applications**: Introduction to scientific computing with Python, Monte Carlo simulations for random processes, Linear algebra operations using NumPy library, Signal processing techniques with SciPy library.	12
Module 3	**Python for Optimization**: Introduction to optimization problems, Convex optimization using CVXPY library, Linear and non-linear programming with scipy. Optimize, Applications of optimization in communication systems.	10
Module 4	**Python for Machine Learning Algorithms**: Introduction to machine learning and Python libraries (scikit-learn), Supervised learning algorithms: regression, classification, Unsupervised learning algorithms: clustering, dimensionality reduction, Applications of machine learning in signal processing and communication systems.	10

Recommended Books:

S. No.	Title	Author
1.	Numerical Python: Scientific Computing and Data Science Applications with Numpy, SciPy and Matplotlib	Robert Johansson
2.	Introduction to Machine Learning with Python: A Guide for Data Scientists	Andreas C. Müller, Sarah Guido

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Real Time operating systems	ECT069	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: C-Programming, Embedded Systems

Objectives: The objectives of a real-time operating system (RTOS) revolve around providing deterministic behavior and efficient resource management to support the execution of real-time applications.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Students should gain a solid understanding of the principles and concepts underlying real-time operating systems, including task scheduling, interrupt handling, priority inversion, and timing constraints.	II
CO2	Students should be able to evaluate different RTOS platforms and select the most suitable one for specific application requirements. They should also gain proficiency in configuring and customizing RTOS features to meet project needs.	III,IV,V
CO3	Students should learn how to design, create, and manage tasks in an RTOS environment. This includes defining task priorities, assigning resources, and implementing task synchronization and communication mechanisms.	V,VI
CO4	Students should be familiar with different task scheduling algorithms used in RTOS, such as preemptive and non-preemptive scheduling, rate-monotonic scheduling, and earliest deadline first (EDF) scheduling.	II,IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Operating system and function, Evolution of operating system, Batch, Interactive, Time Sharing and Real Time System, System protection.	10
Module 2	Operating Systems types, Process Concept. Concurrency and Synchronization, Mutual Exclusion and Deadlock Problems. Process Management. Process States, Process scheduling Algorithms and Implementation.	12
Module 3	Storage Management. Concepts and implementation of Real and Virtual Storage. File Management, File Organization, File Systems, Protection and security Performance Evaluation, Case study of the UNIX Operating Systems.	14
Module 4	Basic issues in Multiprocessor and Distributed Operating Systems.	8

Recommended Books:

S. No.	Title	Author
1	Real-Time System Design.	S.T. Levi, A.K Agrawala
2	Real-Time Concepts for Embedded Systems, Q.Li, C.Yao.	Q.Li, C.Yao
3	Real-Time Systems Specification, Verification and Analysis.	M. Joseph

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Software Engineering	ECT070	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Python Programming, C Programming, Discrete Mathematics.

Objectives: software engineering aims at designing software systems that are modular, well-structured, and easy to understand, maintain, and extend over time. It aims to deliver high-quality software products that meet the needs of customers, stakeholders, and end-users while ensuring efficiency, reliability, and maintainability throughout the software development lifecycle.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Students will know classical and evolving software engineering methods, can select and tailor appropriate methods for projects, and can apply them as both team members and managers to achieve project goals.	II,III
CO2	Ability to effectively apply software engineering practice over the entire system lifecycle. This includes requirements engineering, analysis, prototyping, design, implementation, testing, maintenance activities and management of risks involved in software and embedded systems.	III,IV
CO3	Students will demonstrate proficiency in programming languages commonly used in software engineering, such as Java, Python, C++, or JavaScript.	III
CO4	Understanding software testing approaches such as unit testing and integration testing along with the need for lifelong learning and readily adapting to new software engineering environments.	II,III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Software Process:** The Evolving role of Software , Defining Software, Software Myths, Legacy software, A generic view of process, A layered Technology, Process Framework, Capability Maturity Model Integration (CMMI), Process Assessment, Personal and Team Process Models, Product and Process, Process Models – Build and fix model, The Waterfall Model, Incremental Process Model, RAD Model, Evolutionary Process Models, Unified Process, Agile Methodology, SCRUM Approach.	9
Module 2	**Requirement Engineering:** Software Engineering Practice, Requirements Engineering tasks, Types of requirements, Feasibility studies, initiating the requirements Engineering Process, Eliciting Requirements, Developing Use cases, Requirement Analysis, Documentation and validation, Building the Analysis Model, Elements of the Analysis Model	10
Module 3	**Analysis Modeling And Project Planning:** Requirements Analysis, Analysis Modeling approaches, data modeling concepts, Object oriented Analysis, Scenario based modeling, Flow oriented Modeling, Class based modeling, creating a behavior model. Planning: Size estimation, Cost estimation, COCOMO, Software risk management.	10
Module 4	**Testing & Maintenance**: Testing strategies, Testing Tactics and terminologies, functional testing, structural testing, levels of testing, validation testing, system testing, Art of debugging. Software maintenance, maintenance models, Regression testing, Reverse Engineering, ReEngineering, evolution, Quality Management, Process	13

	Improvement, Risk Management. **Design & Implementation:** Design Engineering, Design Concepts, Modularity, Strategy of Design, Function oriented Design, Architectural Design, Detailed Design, Design process, Design Quality, Design model, User interface Design, Implementation, issues in implementation. Software metrics, SCM.	

Recommended Books:

S. No.	Title	Author
1	Software Engineering, Pearson Education.	Ian Sommerville
2	Software Engineering Concepts, McGraw Hill.	Richard Fairley
3	Software Engineering, Tata McGraw Hill.	Stephan Schach

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Visual Programming	ECT071	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: The objective of a visual programming subject is to equip students with foundational programming skills, problem-solving abilities, and the confidence to continue exploring and innovating in the field of computer science and technology.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Gain a solid understanding of visual programming concepts, including the principles of flowcharting, drag-and-drop interfaces, and visual scripting languages.	II
CO2	Students should become proficient in using visual programming tools and environments such as Scratch, Blockly, or LabVIEW, depending on the focus of the course.	III,IV
CO3	Through practical exercises and projects, students should develop problem-solving skills using visual programming techniques to design algorithms, implement solutions, and debug programs.	III,V
CO4	Students should learn how to translate algorithms and logical processes into visual representations, and vice versa, gaining insight into fundamental programming concepts such as loops, conditionals, and data structures.	IV,V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Windows concepts and terminology:** key elements, Creating the look, communication via messages, windows resources and functions, adding multimedia and sound resources, Writing windows applications, taking control of windows, adding menus, dialog boxes, Special controls. Concepts of X-Windows System & programming. Introduction to Visual Basic & difference with BASIC. Concept about form Project, Application, Tools, Toolbox, Controls & Properties. Idea about Labels, Buttons, Text Boxes. Data basics, Different type variables & their use in VB, sub-functions & Procedure details, Input box()& Msgbox(). Making decisions, looping List boxes & Data lists, List Box control, Combo Boxes, data Arrays. Frames, buttons, check boxes, timer control, Programming with data, built in functions, ODBC database connectivity. Dataform Wizard, query, and menus in VB Applications, Graphics.	10
Module 2	**Dynamic Web Pages:** The need of dynamic webpages; an overview of DHTML, cascading style sheet(css), comparative studies of different technologies of dynamic page creation.	14
Module 3	**Active Web Pages:** Need of active web pages; java applet lifecycle. **Java Script:** Datatypes, variables, operators, conditional statements, array object, date object, string object.	11

	Java Servlet: Servlet environment and role, HTML support, Servlet API, The servlet lifecycle, Cookies and Sessions.	
Module 4	**JSP:** JSP architecture, JSP servers, JSP tags, understanding the layout in JSP, Declaring variables, methods in JSP, inserting java expression in JSP, processing request from user and generating dynamic response for the user, inserting applets and java beans into JSP, using include and forward action, comparing JSP and CGI program, comparing JSP and ASP program; Creating ODBC data source name, introduction to JDBC, prepared statement and callable statement. **J2EE:** An overview of J2EE web services, basics of Enterprise Java Beans, EJB vs. Java Beans, basics of RMI, JNI.	07

Recommended Books:

S. No.	Title	Author
1.	Visual Basic 6 from the Ground Up	Cornell, TMH
2.	Visual Basic 6	CDG, TMH

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Advanced Power Electronics	EET081	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Power Electronics I.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand three phase voltage source and current source inverters and their modulation strategies.	I
CO2	Understand the operation of isolated DC-DC converter. Understand the operation of non-isolated DC-DC Converters	I, II
CO3	Perform comparative assessment of different modulation techniques	IV, VI
CO4	Understand the applications of power electronics in appliances such as Power conditioners and UPS.	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	Three phase Voltage source inverters in square wave mode. 120 and 180degree modes of conduction. Three phase Current Source Converter	10
Module 2	Different modulation strategies- Sine PWM, Hysteresis Current Control Technique, Selective Harmonic Elimination, Space Vector Modulation.	12
Module 3	Isolated DC-DC converters: Flyback converter, Forward converter, Push-Pull converter, Half-Bridge converter and Full-Bridge converter Non-Isolated D.C to D.C converters in CCM and DCM, Boundary conditions, Non-Ideal Behavior, Design of Passives for: Buck, Boost, Buck-Boost and Cuk-converter circuits.	13
Module 4	Power line disturbances and their effect on equipment, Power conditioners, offline and online UPS	07

Recommended Books:

S. No.	Title	Author
1.	Power Electronics	Daniel W Hart
2.	Power Electronics: Converter, Applications & Design	N. Mohan, T.M. Undeland& W.P. Robbins
3.	Fundamentals of Power Electronics	Erickson and Macsimovic

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Electrical Machines	EET082	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None.

Objectives: The objective of the course is to describe the operating principles, characteristics & applications of transformers and rotating electric machines.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Study transformer construction, operation, various tests, find efficiency & voltage regulation.	I, IV
CO2	Understand operation, performance, applications, recent advancements of DC machines.	II, III
CO3	Study induction motor operation, find efficiency & speed regulation.	I, IV
CO4	Study of synchronous machine and its applications.	III, IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Transformers:** Operating principle, classification, construction, EMF equation, phasor diagrams, equivalent circuit model, losses &efficiency, voltage regulation, frequency response, polarity test, autotransformers, three-phase transformer connections, impedance matching, isolation &instrument transformers.	9
Module 2	**DC Machines:** Operating principle, generator& motor action, construction, types of excitations, EMF & torque equations, power stages & efficiency. Commutation & Armature Reaction, characteristics &application of DC generators, starting & speed control of DC motors, characteristics &applications of DC motors, electric braking.	10
Module 3	**Induction Machines:** Three-phase induction motors. Principle of operation, construction, types. Rotating magnetic field, EMF equation of an AC Machine, the torque developed in an induction motor, equivalent circuit model, torque-speed characteristics, starting &speed control. Single-phase induction motors, starting, application.	10
Module 4	**Synchronous Machines:** Construction, types & operating principle of synchronous generator, AC armature windings, equivalent circuit, phasor diagrams, voltage regulation, parallel operation, synchronization, Power Angle characteristics, and effect of field excitation change. Synchronous Motor, principle, starting, hunting, damper windings.	10
Module 5	**Special Purpose Motors:** Stepper Motor, Universal Motor, Shaded-pole Motor.	3

Recommended Books:

S. No.	Title	Author
1	Electric Machinery	Fitzgerald,Kingslay,Umans
2	Electric Machinery Fundamentals	Chapman
3	Electric Machines	Nagrath and Kothari

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Power Electronics	EET083	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Knowledge of basic electronics.

Objectives: To understand the fundamentals of power devices like diodes, transistors, Thyristors, phase control circuits, converters, etc.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Explain the need for Power Electronics Devices and Circuits and their basic operation.	II
CO2	Analyze driving, control, and triggering circuits for the power electronic converter.	IV
CO3	Analyze AC to DC converters (Single phase and three phases, controlled and uncontrolled), AC voltage controllers, DC to DC converters (choppers), and single-phase DC to AC converters (Inverters) in square wave mode.	IV
CO4	Perform Fourier analysis and understand Power Quality issues associated with power electronic circuits.	IV

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**An Introduction to Thyristor Engineering**	8
Module 2	**Power Electronic Devices:** Heavy current and high voltage solid-state devices, power diodes, power transistors, SCR's, TRIACS, DIACS, and other Thyristors. Basic theory of operation and characteristics of SCR, Ratings, protection, series, and parallel operation of SCRs. Driving circuits, GTOs, IGBT, MOSFET.	12
Module 3	**Firing Circuits:** Line commutation of SCRs and forced commutation techniques.	8
Module 4	**Line Commutated Converters:** 2 pulse, 3 pulse, 6 pulse, and higher pulse configurations. AC Phase Control: Integral cycle control. Choppers: Principle and basic chopper circuits. Inverters: Series parallel and bridge inverters and voltage control. Application of Thyristor Technology to Electric Drives. Design of transformers, pulse transformer, and design of inductors.	14

Recommended Books:

S. No.	Title	Author
1	Power Electronics, Pearson	Rashid
2	Power Electronics, Wiley	Ned Mohan

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Power Systems	EET084	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Electric Circuit Analysis, Electrical Machines, Power System

Objectives: To introduce the concept of power systems, AC & DC distributors, transmission lines and to develop the concept of mechanical design of transmission lines.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Explain the knowledge of power systems generation, transmission & distribution	II
CO2	Explain the knowledge of overhead line insulators and string efficiency	II
CO3	Modelling, design, capacity and various parameters of transmission lines	III, VI
CO4	Acquire knowledge of sag and tension calculations of overhead Transmission lines	I
CO5	Explain concept of corona and its effect on line design	II

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**DC and AC Distribution System:-** Introduction to a power system, definition and classification of distribution systems, connection schemes, various types of DC and AC distributors, voltage drop calculations	9
Module 2	**Overhead AC Transmission lines: -** Line Parameters and their calculations, types of conductors, skin effect and proximity effect, classification of overhead AC transmission lines, performance of transmission lines	9
Module 3	**Insulators for overhead lines:-** Overview of insulators and materials used, types of insulators and their uses, potential distribution over a string of suspension insulators, string efficiency, methods for equalizing the potential	9
Module 4	**Interference of power lines with communication circuits**:- Electrostatic and electromagnetic effect, definition and theory of Corona formation, factors affecting corona, critical disruptive and visual critical voltage, power loss due to corona, methods of reducing corona effect	10
Module 5	**Mechanical design of transmission lines**. Sag and tension calculations, effect of wind and ice loading, stringing charts	5

Recommended Books:

S. No.	Title	Author
1.	Elements of Power System Analysis	W. D. Stevenson
2.	Transmission & Distribution of Electrical Energy	H. Cotton & Barber
3.	Power System Engineering	Nagrath & Kothari
4	Electrical Power Systems	C. L. Wadhwa

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Discrete Mathematics	MAT085	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Elementary knowledge of set theory

Objectives: Equip students with a comprehensive understanding of combinatorics, ordered sets, lattices, graph theory, and algebraic structures, enabling them to analyze and solve problems in coding theory and related domains effectively

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO 1	Use different counting techniques	III
CO 2	Understand and identify structures on many levels	II, III
CO 3	Apply the concepts needed to test the logic of a programme	III, VI
CO4	Familiarize the applications of some elementary algorithims and classical theorems on graphs, apply graphs in concrete situations	I ,III
CO 5	Apply the concepts and properties of algebraic structures like groups, rings and fields and to familiarize the properties of modular arithmetic	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Combinatorics:** Introduction, basic counting principles, pigeon hole priniciple with applications, inclusion-exclusion principle, recurrence relations and generating functions, introduction to special numbers.	8
Module 2	**Ordered sets and Lattices:** Ordered sets, Partially ordered sets, Supremum and Infimum, well ordered sets, Lattices, basic properties of algebraic systems defined by lattices, complemented lattices and distributive lattices. Coding Theory: coding of binary information and error detection, decoding and error correction	8
Module 3	**Graph Theory:** Introduction to graphs, graph terminology, Euler and Hamiltonian paths, graph connectivity, graph homomorphism, graph isomorphism, planar graphs, graph coloring, matrix representation of graphs, introduction to directed graphs, strong directed graphs. Introduction to trees, properties of trees, spanning trees, minimal spanning trees, Prim's Algorithm and Kruskal's Algorithm, matrix tree theorem, Degree sequences in trees, Necessary and sufficient conditions for a sequence to be a degree sequence of a tree	12
Module 4	**Algebraic Structures:** Groups, subgroups, generators and relations, cyclic groups, groups of rotations and reflections, cosets and Langrange's Theorem, homomorphisms and normal subgroups, isomorphisms, automorphisms, semi-groups, rings, ring homomorphism and isomorphism, ideals, finite fields.	8
Module 5	**Number Theory & Cryptography:** Modular arithmetic, the distribution of primes, prime number theorem, Fermat's theorem and its consequences, symmetric ciphers, public key cryptography	6

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Recommended Books:

S. No.	Title	Author
1.	A first course in graph theory	G. Chartand and P. Zhang
2.	Discrete Mathematics (Schaum's Outline series),	M. R. Spiegel
3.	Discrete Mathematics and its applications, 5th Edition	K. H. Rosen
4.	An Introduction to Theory of Numbers, 5th Edition	I. Niven, H. Zuckerman

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Fuzzy Logic and Neural Networks	MAT086	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: Fundamental of Computing Assumed knowledge: fuzzy control system is a control system based on fuzzy logic—a mathematical system that analyzes analog input values in terms of logical variables that take on continuous values between 0 and 1, in contrast to classical or digital logic.

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

CO No.	Course Outcome	Bloom's Taxonomy Level
CO1	Understand the Fuzzy logic systems	I
CO2	Study the basic architecture of neural networks and applications	I, II
CO3	Understand the basic neural network operations	IV,VI
CO4	Have knowledge of various types of neural networks, their operations and applications in real life problems.	III

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**FUNDAMENTALS OF FUZZY LOGIC:** Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements- union intersection- combination of operation- general aggregation operations- fuzzy relations-compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems	09
Module 2	**ARCHITECTURE OF NEURAL NETWORKS:** Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations function Basic learning rules- McCulloch-Pitts neuron- Architecture, algorithm, applications-single layer net for Page 1 of 7 pattern classification- Biases and thresholds, linear separability - Hebb's rule- algorithm -perceptron - Convergence theorem- Delta rule	10
Module 3	**BASIC NEURAL NETWORK TECHNIQUES:** Back propagation neural net: standard back propagation-architecture algorithm- derivation of learning rules number of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzmann machine	10
Module 4	**COMPETITIVE NEURAL NETWORKS:** Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2 **SPECIAL NEURAL NETWORKS**: Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems.	13

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Recommended Books:

S. No.	Title	Author
1.	Fuzzy System & Fuzzy logic	T1. Kliryvan
2.	Fundamental of Neural network	Lawrence Fussett
3.	Neural network and Fuzzy System	Bart Kosko
4.	Introduction to artificial neural systems	J.M.Zurada

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Year (Semester)	Course Title	Course Code	L-T-P Credits
	Numerical Analysis & Techniques	MAT087	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Objectives: The objective of this subject is to make the students aware of the numerical methods for solving scientific problems that cannot be solved analytically.

Course Outcomes (COs): At the end of the course, the student will be able to:

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Error estimate and solve algebraic and transcendental equations using numerical techniques	III
CO2	Solution of Simultaneous Linear Algebraic Equations	III
CO3	Construction of Interpolating polynomial and finding intermediate value	III
CO4	Solve ordinary differential equations by numerical techniques	III
CO5	Apply Numerical techniques in Electronics & Communication Engineering problems.	IV

Details of the syllabus:

Module No.	Particulars	Hours
Module 1	Errors in Numerical Calculations: Floating-point form of numbers, Round-off, Algorithm, Stability, Programming errors, Errors of Numerical Results, Error propagation, Basic error principle, Loss of significant digits.	3
Module 2	Interpolation: Difference Table and its usage, Interpolation Forward, Backward and Shift operators, Central differences, Over-raging operator, Relations between operators, Existence, Uniqueness of interpolating polynomial, Interpolation with equal intervals: Newton's advancing difference formula, Newton's backward difference formula, Interpolation with unequal intervals, Newton's divided difference formula, Lagrange's interpolation formula, Gauss forward and backward interpolation formula.	11
Module 3	Numerical solution of algebraic and Transcendental Equations: Graphic Method, Regula-Falsi method, Bolzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance.	4
Module 4	Numerical Integration: Numerical Integration, General Quadrature Formula, Simpson's 1/3rd and 3/8th rules, Weddle's rule, Trapezoidal rule.	4
Module 5	Numerical Solution of ordinary differential equations: Numerical solution of ordinary differential equations, Picard's method, Taylor's series method, Euler's method, Runge-Kutta Method.	4

Recommended Books:

S. No.	Title	Author
1.	Numerical Methods for Scientists and Engineering, Wiley	M.K. Jain, S. R. Iyengar & R.K. Jain
2.	Introductory Methods in Numerical Analysis, Prentice Hall India Learning	S.S. Sastry
3.	Elementary Numerical Analysis, Wiley	Kendall E. Atkinson, Han
4.	Elementary Numerical Analysis an Algorithmic Approach, McGraw-Hill	S. D. Conte and C. de Boor

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Year (Semester)	Course Title	Course Code	L-T-P-Credits
	Optimization Techniques	MAT088	2-1-0
Evaluation Policy	**Mid-Term**	**Internal Assessment**	**End-Term**
	26 Marks	24 Marks	50 Marks

Pre-requisites: None

Objectives: The objective of the course is to understand the fundamentals of computational intelligence, to know about the various knowledge representation methods, to understand the features of neural network and its implementation, to study about various data clustering methods. To gain knowledge in evolutionary computation and neuro – fuzzy systems.

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

CO No.	Course Outcomes	Bloom's Taxonomy Level
CO1	Identify, formulate, and solve the practical Engineering design problems by applying the optimization techniques	III, V
CO2	Figure out the optimal value of the objective function besides presenting an organized strategy for evaluating a feasible region's vertices	V
CO3	Determine the schedule for transporting goods from source to destination in a way that minimizes the shipping cost	V
CO4	Solve multitude of operations research situations through conveniently modeling as networks (nodes connected by branches). Find sequence of processing jobs to minimize total elapsed time. Determine performance of queuing situation for deciding an appropriate level of service for the facility.	VI, V

Details of the Syllabus:

Module No.	Particulars	Hours
Module 1	**Unit-I: Introduction &Concepts of Optimization** Formulation of Linear Programming Problems, General Statement of LPP, Assumptions Underlying LP, Solution of Linear Programming Problems: Graphic Method. Some Special Cases of Graphic Method, Convex Set: Extreme points of Convex Set, Convex hull	9
Module 2	**Unit-II: Simplex Techniques** LP Model in Equation Form, Transition From Graphical To Algebraic Solution, Simplex Algorithm, Artificial starting solution: Big M-Method, Two-phase Method, Special cases in Simplex Method: Degeneracy, Alternative Optima, Unbounded solution, infeasible solution	10
Module 3	**Transportation Models** Mathematical Model of Transportation Problem, Methods of finding Initial basic feasible solution by NWC Rule, LCM, VAM, Test for optimality by Stepping Stone and MODI method, Balanced and Unbalanced Transportation Problems, Degeneracy. Assignment Model: Mathematical Model of Assignment Problem, The Hungarian Method, Simplex Explanation of the Hungarian Method.	12
Module 4	**Engineering Applications** Network Models: Shortest route Algorithm, network Construction, Rules for network diagram, Techniques in project planning and Construction, CPM, Project Crashing. Sequencing Model: Advantages of Sequencing, Johnsons Algorithm of Sequencing problems, Type I: n jobs two machines, Type II: n jobs three machines, Type III: two jobs m machines.	11

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Recommended Books:

S. No.	Title	Author
1.	Linear Programming	G. Hadlay, Addison Wasley
2.	Operations Research – An Introductory	Hamidi A. Taha, Macmillan
3.	Operations Research – Methods and problems	M. Sasieni, A. Yaspam and L. Friedman,
4.	Linear Programming	S.I. Gass, Mc-Graw Hill