EVALUATION SCHEME
&
SYLLABI

FOR

B. TECH.

in

Electronics & Communication Engineering

(Effective from the Session: 2021-22)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING G. B.

PANT INSTITUTE OF ENGINEERING & TECHNOLOGY PAURI GARHWAL

(UTTARAKHAND) INDIA

EVALUATION SCHEME
B.TECH. ECE
I-YEAR (I-SEMESTER)
(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TCS-111	Programming for problem solving	3	1	0	30	20	50	100	150	3
2.	TME-111	Basic Mechanical Engineering	3	1	0	30	20	50	100	150	3
3.	TAH-111	Engineering Chemistry	3	1	0	30	20	50	100	150	3
4.	TAH-115	Professional Communication	3	0	0	30	20	50	100	150	2
5.	TAH-116	Engineering Mathematics-II	3	1	0	30	20	50	100	150	3
PRACTICAL											
6.	PCS-111	Programming for problem solving Lab	0	0	2	10	15	25	25	50	1
7.	PME-111	Basic Mechanical Engg. Lab	0	0	2	10	15	25	25	50	1
8.	PAH-111	Engineering Chemistry Lab	0	0	2	10	15	25	25	50	1
9	PME-112	Workshop Practice	1	0	2	10	15	25	25	50	2
10.	PAH-115	Language Lab	1	0	2	10	15	25	25	50	1
11.	GPP-111	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**17**	**4**	**10**	**200**	**225**	**425**	**625**	**1050**	**20**

EVALUATION SCHEME
B.TECH. ECE
FIRST YEAR (II-SEMESTER)
(Effective from session: 2021-22)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-121	Basic Electronics Engineering	3	1	0	30	20	50	100	150	3
2.	TEE-121	Basic Electrical Engineering	3	1	0	30	20	50	100	150	3
3.	TAH-122	Engineering Mathematics-I	3	1	0	30	20	50	100	150	3
4.	TAH-124	Engineering Physics	3	1	0	30	20	50	100	150	3
5.	TCE-121	Environmental Science	3	0	0	30	20	50	100	150	2
PRACTICAL											
6.	PEC-121	Basic Electronics Engg. Lab	0	0	2	10	15	25	25	50	1
7.	PEE-121	Basic Electrical Engg. lab	0	0	2	10	15	25	25	50	1
8.	PBS-124	Engineering Physics lab	0	0	2	10	15	25	25	50	1
9	PCE-121	Engineering Graphics	1	0	2	10	15	25	25	50	3
10.	GPP-121	General Proficiency	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**16**	**4**	**8**	**190**	**210**	**400**	**600**	**1000**	**20**

TEC-121 BASIC ELECTRONICS ENGINEERING

UNIT-1: SEMICONDUCTOR MATERIALS AND PROPERTIES: Group-IV materials, covalent bond, electron-hole concepts, basic concepts of energy bands in materials, forbidden energy gap, intrinsic and extrinsic semiconductors, donors and acceptors impurities, conductivity of semiconductors.
JUNCTION DIODE: p-n junction, depletion layer, V-I characteristics, diode resistance, diode capacitance, Light emitting diode, varactor diode, photo diode, Schottky diode, Tunnel diode.

UNIT-2: DIODE APPLICATIONS: Rectifiers (half wave and full wave), calculation of ripple factor, efficiency, and transformer utilization factor, capacitor filter, clipping circuits, clamping circuits, voltage multipliers.
BREAKDOWN of DIODES: Breakdown mechanisms (zener and avalanche), breakdown characteristics, zener resistance, zener diode application as shunt voltage regulator.

UNIT-3: BIPOLAR JUNCTION TRANSISTORS: Basic construction, transistor action, CB, CE, and CC configurations, input/output characteristics, biasing of transistors- fixed bias, emitter bias, and potential divider bias.
TRANSISTOR AMPLIFIERS: Graphical analysis of CE amplifier, concept of voltage and current gain, h-parameter model of BJT at low frequency, calculation of current and voltage gain, input and output resistances of single stage BJT amplifier in CE and CC configurations.

UNIT-4: FIELD EFFECT TRANSISTORS: Junction field-effect transistor; construction and action, concept of pinch-off, maximum drain saturation current, output and transfer characteristics, CG, CS and CD configurations, self-bias, and fixed-bias circuits. Metal-oxide field-effect transistor; depletion and enhancement type, construction, operation and characteristics, calculation of voltage gain, input and output resistances of single stage FET amplifiers in CG, CS and CD configurations.

UNIT-5: SWITCHING THEORY AND LOGIC DESIGN: Number systems, conversions of bases, Boolean algebra, logic gates, concept of universal gate, K-map.
OPERATIONAL AMPLIFIERS: Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non- inverting and unity gain amplifiers, summing amplifier.

BOOKS:

1. Boylestad and Nashelsky, Electronic Devices and Circuit Theory, PHI, 2017.
2. Milman, Halkias & Jit, Electronic Devices and Circuits, TMH, 2007.
3. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” Pearson, 2014.
4. D. Neamen, D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education
5. Salivahanan, Electronic Devices and Circuits, TMH, 2012.
6. Deshpande, Electronic Devices and circuits, McGraw-Hill, 2007.
7. Kulshrestha, ‘Electronic Devices and Circuits’ PHI, 2007.

COURSE OUTCOMES:

1. Students will be able to understand the operation and terminal behaviour of basic electronic devices.
2. Students will be able to design the biasing circuits of electronics devices.
3. Students will be able to understand the principles of basic amplifier circuits using BJTs and FETs.
4. Students will be able to understand the basic principles of the operational amplifier and digital logic design.
5. Students will be able to solve engineering problems related to electronics devices and circuits.

PEC-121 BASIC ELECTRONICS ENGINEERING LAB

1. To determine the energy band gap of a semiconductor material.
2. To determine and plot V-I characteristics of P-N junction in both forward bias and reverse bias.
3. To determine and plot the wave shapes of a clipping and champing circuits.
4. To determine the ripple in output of a half wave and a full wave rectifiers at different loads.
5. To determine and plot V-I characteristics of Zener diode in both forward bias and reverse bias.
6. To determine and input and output characteristics of an npn & pnp bipolar junction transistor in common emitter and common base mode.
7. To determine and plot input and output characteristics of a field-effect transistor.
8. To determine and plot input and output characteristics of a metal-oxide-semiconductor field-effect transistor.
9. To determine and plot the frequency response of an amplifier.
10. Realization and verification of the truth table of various logic gates.
11. Realization and verification of the basic logic gates using NAND and NOR gates.

Note: Handouts and manuals are available in the Lab.

COURSE OUTCOMES:

1. Students will be able to plot characteristics of various circuits using diode.
2. Students will be able to plot characteristics of various circuits using BJT.
3. Students will be able to plot characteristics of various circuits using FET.
4. Students will be able to implement of various logic gates and verify their truth-tables.
5. Students will improve skills of team work, technical communication and report writing.

EVALUATION SCHEME
B. TECH. ECE
SECOND YEAR (III-SEMESTER)
(Effective from session: 2022-23)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-231	Analog Electronics Circuits	3	1	0	30	20	50	100	150	3
2.	TEC-232	Digital System Design	3	1	0	30	20	50	100	150	3
3.	TEC-233	Network Theory	3	1	0	30	20	50	100	150	3
4.	TEC-234	Signals and Systems	3	1	0	30	20	50	100	150	3
5.	TCS-231	Data Structure	3	1	0	30	20	50	100	150	3
PRACTICAL											
6.	PEC-231	Analog Electronics Circuits Lab	0	0	2	15	10	25	25	50	1
7.	PEC-232	Digital Electronics Lab	0	0	2	15	10	25	25	50	1
8.	PEC-233	Network Lab	0	0	2	15	10	25	25	50	1
9.	PEC-234	Seminar-I	0	0	2	30	20	50	0	50	1
10.	GPP-231	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**225**	**200**	**425**	**575**	**1000**	**19**

TEC-231 ANALOG ELECTRONICS CIRCUITS

UNIT 1: BIPOLAR JUNCTION TRANSISTOR: Review of BJT biasing circuits, biasing stabilization techniques, thermal runaway, Ebers-Moll model, π −model and T-model, Early effect, analysis of low frequency BJT amplifiers.
BJT AMPLIFIERS: Cascade amplifiers, coupling of amplifiers, RC coupled, direct coupled and transformer coupled amplifiers, differential amplifier, Darlington-amplifier, bootstrapping, tuned-amplifiers.

UNIT 2: FEEDBACK AMPLIFIERS: Classification, feedback concept, transfer gain with feedback, General characteristics of negative feedback amplifiers, analysis of voltage-series, voltage-shunt, current-series and current-shunt feedback amplifiers, stability criterion.

UNIT 3: OSCILLATORS: Classification, criterion for sinusoidal oscillations, Hartley, Colpitts, Clapp, RC phase-shift, Wien-bridge and crystal oscillators, astable, monostable and bistable multivibrators using transistors.

UNIT 4: HIGH FREQUENCY AMPLIFIERS: Hybrid π − model, conductances and capacitances of hybrid π −model, high frequency analysis of CE amplifier, gain-bandwidth product, calculation of current gain at high frequencies, high frequency analysis of common-source, common-gate and common-drain FET amplifiers.

UNIT 5: POWER AMPLIFIERS: Classification; class-A, class-B, class-AB and class C amplifiers, push-pull amplifier, complementary-symmetry amplifier, distortion in power amplifiers, thermal consideration and power dissipation in power amplifiers.

BOOKS:

1. Boylestad and Nashelsky, Electronic Devices and Circuit Theory, PHI, 2013.
2. Milman, Halkias & Jit, Electronic Devices and Circuits, TMH, 2007.
3. Deshpande, Electronic Devices and circuits, McGraw-Hill, 2007.
4. Kulshrestha, 'Electronic Devices and Circuits' PHI, 2007.
5. Sedra, Microelectronic Circuits, 5e (Intl. Version), Oxford, 2017.
6. Bell,Electronic Devices and Circuits, Oxford, 2009.

COURSE OUTCOMES:

1. Students will be able to design and analyse single and multistage amplifier circuits for small signal applications.
2. Students will be able to understand feedback concepts in amplifier and oscillator circuits.
3. Students will be able to understand the concepts used to design and analyse high frequency amplifier circuits.
4. Students will be able to design and analyse power amplifier circuits.
5. This course will enhance the capability of students for solving engineering problems related to electronics circuits.

TEC-232 DIGITAL SYSTEM DESIGN

UNIT 1: MINIMIZATION OF LOGIC FUNCTIONS: Review of logic gate and Boolean algebra, DeMorgan's Theorem, SOP & POS forms, canonical forms, don't care conditions, K-maps up to 6 variables, Quine-McClusky's algorithm, X-OR & X-NOR simplification of K-maps, binary codes, code conversion.

UNIT 2: COMBINATIONAL CIRCUITS: Combinational circuit design, half and full adders, subtractors, serial and parallel adders, code converters, comparators, decoders, encoders, multiplexers, de-multiplexer, parity checker, driver & multiplexed display, BCD adder, Barrel shifter and ALU.

UNIT 3: SEQUENTIAL CIRCUITS: Building blocks like S-R, JK and master-slave JK FF, edge triggered FF, ripple and synchronous counters, shift registers, finite state machines, design of synchronous FSM, algorithmic state machines charts, designing synchronous circuits like pulse train generator, pseudo random binary sequence generator, clock generation

UNIT 4: LOGIC FAMILIES & SEMICONDUCTOR MEMORIES: TTL NAND gate, specifications, noise margin, propagation delay, fan-in, fan-out, tri-state TTL, ECL, CMOS families and their interfacing, memory elements, concept of programmable logic devices like FPGA, logic implementation using programmable devices.

UNIT 5: VLSI DESIGN FLOW: Design entry: schematic, FSM & HDL, different modelling styles in VHDL, data types and objects, dataflow, behavioural and structural modelling, synthesis and simulation VHDL constructs and codes for combinational and sequential circuits.

BOOKS:

1. Mano, Digital electronics, TMH, 2007.
2. Malvino, Digital Principle and applications TMH, 2014.
3. Jain, Modern digital electronics, PHI, 2012.
4. Tocci, Digital Electronics, PHI, 2001.
5. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.

COURSE OUTCOMES:

1. Students will understand the Boolean algebra and minimization of digital functions.
2. Students will be able to design and implement various combinational circuits.
3. Students will be able to design and implement various sequential circuits.
4. Students will be able to understand the digital logic families, semiconductor memories,
5. Students will be able to design the digital circuits using VHDL.

TEC-233 NETWORK THEORY

UNIT 1: CIRCUIT CONCEPTS: Independent and dependent sources, signals and wave forms; periodic and singularity voltages, step, ramp, impulse, Doublet, Loop currents and loop equations, node voltage and node equations.
AC NETWORK THEOREMS: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem.

UNIT 2: GRAPH THEORY: Graph of a network, definitions, tree, co-tree, link, basic loop and basic cut set, incidence matrix, cut set matrix, Tie set matrix, duality, loop and node methods of analysis.

UNIT 3:APPLICATIONS OF LAPLACE TRANSFORM: Transient analysis of RL series circuits, RC series circuits, RLC series circuits, RLC parallel circuits using Laplace Transform.
TWO PORT NETWORKS: Characterization of LTI two port networks, Z, Y, ABCD and h-parameters, reciprocity and symmetry, Inter-relationships between the parameters, inter-connections of two port networks, ladder and lattice networks; T and π representation.

UNIT 4: NETWORK SYNTHESIS: Network functions, impedance & admittance function, transfer functions, relationship between transfer and impulse response, poles & zeros and restrictions, network function for two terminal pair network, sinusoidal network in terms of poles & zeros, reliability condition for impedance synthesis of RL & RC circuits, network synthesis techniques for two-terminal network, foster and cauer forms.

UNIT 5: FILTER SYNTHESIS: Classification of filters, characteristic impedance and propagation constant of pure reactive network, Ladder network, T section, π −section, terminating half section, pass bands and stop bands, design of constant-K, m-derived filters, composite filters.

BOOKS:

1. Choudhury, Network & Systems, New Age, 2013.
2. Valkenberg, Network Analysis & Synthesis, PHI, 2014.
3. Mohan, Network Analysis and Synthesis, TMH, 2006.
4. Chakraborty, Circuit Theory, Dhanpat Rai, 2007.

COURSE OUTCOMES:

1. Students will be able to solve electrical circuits using various network laws and theorems.
2. Students will be able to design different electrical circuits and passive filters for various applications.
3. Students will be able to analyse different 2-port electrical networks and their parameters.
4. Students will be able to synthesize an electrical network from the given network function.
5. Students will be able to solve engineering problems related to electrical networks.

TEC-234 SIGNALS AND SYSTEMS

UNIT 1: SIGNALS AND SYSTEMS: Continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, continuous-time and discrete-Time LTI Systems and their properties, convolution sum and convolution integrals, LTI System described by differential and difference equation.

UNIT 2: FOURIER TRANSFORMS: Fourier series representation of continuous-time, periodic signals and their properties, continuous time and discrete time Fourier transforms and their properties, system characterized by linear constant coefficient differential equations and difference equation.

UNIT 3: LAPLACE TRANSFORM: Definition of Laplace Transform, concept of complex frequency, Basic Theorems of Laplace Transform, region of convergence, inverse Laplace transform, analysis and characterization of LTI system, block diagram representation, unilateral Laplace transform.

UNIT 4: Z-TRANSFORM: Z-Transform, Region of convergence, Inverse Z-transform, analysis and characterization of LTI system, block diagram representation, Unilateral Z-transform.

UNIT 5: SAMPLING: Representation of Continuous-time signals by its samples, Sampling theorem, Impulse train sampling, Sampling with Zero Order Hold (ZOH), Natural and Flat top sampling, Reconstruction of signal from its samples using interpolation, Effect of under sampling; Aliasing, sampling of Band pass signals, Discrete time processing of continuous time signals, Digital differentiator, half sample delay, Sampling of discrete-time signals.

BOOKS:

1. Oppenheim and Willsky, Signal and Systems, PHI, 1997.
2. Roberts, Fundamental of Signals and Systems, McGraw Hill, 2010.
3. Haykin, Communication Signal and Systems, Wiley, 2003.
4. Salivahan, Digital Signal Processing, TMH, 2001.
5. Saran, Signal & Systems, Khanna, 2003.

COURSE OUTCOMES:

1. Students will be able to understand different types of signals and their characteristics.
2. Students will be able to understand various transforms and their applications**.**
3. Students will be able to understand the sampling and its applications.
4. Students will have knowledge of random processes and their applications**.**
5. Student will be capable of solving engineering problems related to signals and systems**.**

TCS-231 DATA STRUCTURE

UNIT 1: INTRODUCTION: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.
Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT 2: Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

UNIT 3: LINKED LISTS: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.

UNIT 4: TREES AND GRAPHS: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.
Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

UNIT 5: SORTING AND HASHING: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods,of Hashing.

BOOKS:

1. An Introduction To Data Structures and Application by Jean Paul Tremblay & Pal G. Sorenson (McGraw Hill)
2. R.L. Kruse, B.P. Leary, C.L. Tondo, Data structure and program design in C , PHI
3. R. B. Patel, Expert Data Structures With C, Khanna Publications, Delhi, India, 3rd Edition 2008.
4. Data Structures using C by A. M. Tenenbaum, Langsam, Moshe J. Augentem, PHI Pub.
5. Data Structures and Algorithms by A. V. Aho, J. E. Hopcroft and T. D. Ullman, Original edition, AddisonWesley, 1999, Low Price Edition.

COURSE OUTCOMES:

1. Student will be able to Understand the concept of the algorithm to determine time and computational complexity, dynamic memory management.
2. Student will be able to solve the search problem in real scenario's
3. Students will be able to understand the data like arrays, linked lists, stack and queues.
4. Students will be able to solve the problems in trees and graphs.
5. Student will be able to understand and implement the algorithms for sorting searching, deletion and insertion

PEC-231 ANALOG ELECTRONICS CIRCUITS LAB

1. To design and verify various biasing techniques for BJTs.
2. To determine voltage-gain, output impedance and output power of a Darlington pair compound amplifier.
3. To determine "h" parameters of a PNP transistor in common emitter mode.
4. To determine the frequency response of an IFT amplifier.
5. To determine voltage-gain and plot the frequency response of a FET amplifier in common source mode.
6. To study the effect of negative feedback on voltage gain & bandwidth in a two-stage amplifier.
7. To determine frequency of a Hartley Oscillator circuit with change in the capacitor of the tank circuit.
8. To determine frequency and wave shape of a Colpitt's oscillator circuit.
9. To determine frequency and wave shape of a crystal oscillator circuit.
10. To determine frequency and wave shape of a phase shift oscillator circuit.
11. To determine voltage-gain and plot the frequency response of a single stage, two stage RC coupled and direct coupled amplifiers.
12. Design and implementation of nonlinear oscillator (vander pol, doffing etc.)

COURSE OUTCOMES:

6. Students will be able to plot characteristics of various electronics devices.
7. Students will be able to implement of various logic gates and verify their truth-tables.
8. Students will be able to perform experiments, analyze and interpretation of data.
9. Students will improve skills of team work, technical communication and report writing.
10. Students will be capable to solving practical related to basic electronic circuits.

PEC-232 DIGITAL ELECTRONICS LAB

1. To verify the De-Morgan's theorems using NAND/NOR gates.
2. To design the full adder and half adder using AND, OR and X-OR gates.
3. To implement the logic circuits using decoder.
4. To implement the logic circuits using multiplexer.
5. To design parity generator and checker circuits.
6. To design and implement RS FLIP-FLOP using basic latches.
7. Realization and testing of basic logic gates using discrete components.
8. Realization and testing of CMOS IC characteristics.
9. Realization and testing of TTL IC characteristics.
10. Realization and testing of RAM circuit using IC 7489.
11. Realization and testing of Interfacing of CMOS-TTL and TTL-CMOS ICs.

COURSE OUTCOMES:

1. Students will be able to design and implement various digital logic circuits using ICs.
2. Students will be able to design and implement analog and digital circuits using TCAD tools and on FPGAboards.
3. Students will be able to design the experiments, analyze and interpretation of data to achieve validconclusions.
4. Students will acquire skills of team work, technical communication and effective report writing.
5. Students will be capable of solving practical digital electronics circuits.

PEC-233 NETWORK LAB

1. Implementation and verification of Maximum Power Transfer and Superposition theorems in ac circuits.
2. Implementation and verification of Thevnin's and Norton's theorem in ac circuits.
3. Implementation and verification of Tellegens theorem.
4. Implementation and verification of Reciprocity theorem.
5. Design and testing of transient analysis in RC/RL circuits.
6. Design and testing of transient analysis in RLC circuits.
7. To calculate Z, Y, ABCD parameters of a given two-port networks.
8. Implementation and verification of transfer function of two-port network.
9. To calculate image and characteristic impedance in T and π networks.
10. Implementation and verification of inter-connection i.e. cascade, series, parallel, effect of loading of two-port networks.
11. Design and implementation of K-derived LPF and HPF in T-sections.
12. Temperature dependent circuits and their analysis.

COURSE OUTCOMES:

1. Students will be able to design and implement various theorems.
2. Students will be able to design and implement transient response of RLC circuits.
3. Students will be able to design the experiments, analyze and interpretation various two port network parameters
4. Students will be able to design the experiments, analyze and interpretation filters.
5. Students will acquire skills of teamwork, technical communication and effective report writing.

EVALUATION SCHEME
B. TECH. ECE
IInd YEAR (IV-SEMESTER)
(Effective from session: 2022-23)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-241	Communication Systems	3	1	0	30	20	50	100	150	3
2.	TEC-242	Electronic Measurement	3	1	0	30	20	50	100	150	3
3.	TEC-243	Microprocessor and Microcontroller	3	1	0	30	20	50	100	150	3
4.	TEC-244	Electromagnetic Field Theory	3	1	0	30	20	50	100	150	3
5.	TCS-243	Object oriented Programming	3	1	0	30	20	50	100	150	3
PRACTICAL											
6.	PEC-241	Communication Systems Lab	0	0	2	15	10	25	25	50	1
7.	PEC-242	Electronic Measurement Lab	0	0	2	15	10	25	25	50	1
8.	PEC-243	Microprocessor and Microcontroller Lab	0	0	2	15	10	25	25	50	1
9.	PCS-	Object oriented Programming Lab	0	0	2	15	10	25	25	50	1
10.	GPP-241	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**210**	**190**	**400**	**600**	**1000**	**19**

TEC-241 COMMUNICATION SYSTEMS

UNIT 1: CW MODULATION SYSTEMS: Review of signals and systems, Frequency domain representation of signals, principles of amplitude modulation systems- DSB, SSB and VSB modulations. Angle modulation, representation of FM and PM signals, spectral characteristics of angle modulated signals.

UNIT 2: NOISE IN CW MODULATIONS: Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems, Pre- emphasis and De-emphasis, threshold effect in angle modulation.

UNIT 3: PULSE MODULATIONS: Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation, Delta modulation, Noise considerations in PCM, Time Division multiplexing, Digital Multiplexers.

UNIT 4: DETECTION THEORY: Elements of detection theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations, Base band Pulse Transmission- Inter symbol Interference and Nyquist criterion, Pass band Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

UNIT 5: Digital Modulation tradeoffs, Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver), Equalization Techniques, Synchronization and Carrier Recovery for Digital modulation.

BOOKS:

1. Haykin, Communication Systems, John Wiley & Sons, 2003.
2. Lathi, Modern Digital and Analog Communication System, Oxford, 2012.
3. Haykin, Digital Communications, Wiley, 2013.
4. Thomes and Cover, Elements of information theory, Wiley, 2005.
5. Taub & Schilling, Principles of Communication Systems, TMH, 2013.
6. Sklar & Ray, Digital Communication, Pearson, 2009.
7. Glover, Digital Communication, Pearson, 2009.
8. Shanmugam, Digital and Analog Communication Systems, Wiley, 2006.
9. Tomasi, Electronic communications systems, Pearson Education, 2004.

COURSE OUTCOMES:

1. Student will be able to design and analyze various continuous modulation schemes.
2. Student will be able to analyse the noise performance of continuous modulation systems.
3. Students will acquire knowledge of digital base band transmissions.
4. Students will be able to understand different modulation techniques used in digital communications.
5. Students will be capable of solving engineering problems related to communication systems.

TEC 242 ELECTRONICS MEASUREMENT

UNIT 1: Sensors & Transducers: Role of sensors in measurement system, Transducer and its classifications, basic requirements of Transducer/Sensors. Displacement Transducers: LVDT, RVDT and Piezo Electric. Resistance Thermometer, Thermistors, Thermocouples and Strain Gauge Transducer: Basic principle of operation of Resistance strain gauge.

UNIT 2: Oscilloscope: Basic principle & construction, CRT, sweep modes, applications in measurement of voltage , freq. (Lissajous pattern), Dual Trace Oscilloscope, sweep modes, active, passive probes, delay line, analog storage oscilloscope, principle of secondary emission, Digital Storage Oscilloscope, sampling rate, sampling oscilloscope, application of the CRO in instrumentation and measurement, sampling oscilloscope. Comparison between analog and digital oscilloscope

UNIT 3: Bridges: Measurement of Resistance; Low, Medium and High using; Kelvin Double Bridge, Ammeter-Voltmeter method, substitution method, Wheat Stone Bridge, Loss of Charge and Megger. Measurement of Inductance and Capacitance using; Maxwell Inductance, Hay's, Anderson and Schering Bridges. Measurement of frequency by Wein bridge method

UNIT 4: Analyzers: Wave analyzer, Frequency selective wave analyzer, Heterodyne wave analyzer, applications of wave analyzer, Distortion analyzer, spectrum analyzer. **Digital Voltmeter**: Types of DVM; Ramp, Integrating, Successive approximation and Atomization in DVM. **Digital Frequency Meter**: Basic circuit, Frequency Measurement Circuit, High Frequency Measurement.

UNIT 5: Instrumentation: Strip Chart Recorders, X-Y Recorders, Ultraviolet Recorders, Magnetic Tape Recorders. **Display Devices**: Digital display methods, Seven Segment LED display, Dot Matrix display and LCD Display, Geiger Muller Tube, Ionization Chamber, Scintillation Counter, Anechoic chamber.

BOOKS:

1. Kalsi, Electronic Instrumentation, TMH, 2010.
2. Sawhney, A Course In Electrical & Electronic Measurement & Instrumentation, Dhanpatrai, 2004.
3. Nakra & Chaudhry, Instrumentation Measurement & Analysis, TMH, 2009.
4. Bernard Oliver, Electronic Measurements & Instrumentation, TMH, 1971.
5. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI, 1992.
6. Bell, Electronic Instrument and Measurement, Oxford, 2009.

COURSE OUTCOMES:

1. Students will have knowledge of various measuring instruments and their applications.
2. Students will be able to understand principles of different AC and DC bridges and their applications.
3. Students will be able to understand about different types of signal generators and signal analysistechniques.
4. Students will be able to understand various types of transducers.
5. Students will be able to solve engineering problems related to measurements and instrumentation.

TEC-243 MICROPROCESSORS & MICROCONTROLLERS

UNIT 1: 8085 MICROPROCESSOR: Microprocessors evolution, basic microcomputer architecture and components. 8085 microprocessor: pin diagram, internal architecture and register organization, interrupts flags, instruction set and writing program using assembly language.

UNIT 2: 8086 MICROPROCESSOR: 8086 microprocessor pin diagram internal architecture and register organization, 8086 Interrupts, Physical memory organization, General bus operation, I/O addressing capabilities, addressing modes, Instruction set description, writing programs using assembly language, Memory and I/O interfacing.

UNIT 3: INTERFACING: Direct Memory Access and DMA controlled I/O, Interfacing of microprocessors with 8255, 8254, 8259, 8251, 8279.

UNIT 4: 8051 MICROCONTROLLER: Evolution of microcontrollers, 8051 architecture and pin diagram, 8051 flag bits and the PSW register, 8051 register banks and stack, addressing modes and accessing memory using various addressing modes, arithmetic and logic instructions and programs, 8051 assembly programming.

UNIT 5: INTERFACING TO MICROCONTROLLER: 8051 connections to RS-232, 8051 serial communication programming, Interrupt structure in 8051, timer/counter programming of 8051, Serial I/O interface, Parallel I/O ports interface, LCD and keyboard interfacing, sensor interfacing.

BOOKS:

1. Nagoorkani, Microprocessors & Microcontrollers, TMH, 2010.
2. Gaonkar, Microprocessor Architecture, Programming, Wiley, 2007.
3. Barry, Intel Microprocessors, PHI, 2014.
4. Liu & Gibson, Microprocessor Systems, PHI, 2000.
5. Ray and Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2006.
6. Hall, Microprocessors and Interfacing, TMH, 2006.
7. Mazidi & Mazidi, 8051 Microcontroller and Embedded Systems, Pearson, 2007.

COURSE OUTCOMES:

1. Students will be able to understand the architecture and develop program of Intel 8085/8086.
2. Students will be able to understand the working and use of different peripherals of microprocessors.
3. Students will be able to understand the architecture of microcontroller and programming.
4. Students will be able to interface a microcontroller system to other electronic systems.
5. Students will be capable of solving engineering problems related to microprocessors and microcontrollers.

TEC-244 ELECTROMAGNETIC FIELD THEORY

UNIT 1: VECTOR ANALYSIS: Vector algebra, dot and cross products, Coordinate systems, Relation in rectangular, cylindrical, and spherical coordinate systems, concept of differential line, differential surface and differential volume in different coordinate systems
ELECTROSTATICS: Coulomb's law, electric field intensity, fields due to different charge distributions, electric flux density, gauss law of electrostatics, divergence theorem, electric potential, relations between E and V, Maxwell's equations for electrostatic fields, energy density, convection and conduction currents, continuity equation, boundary conditions, dielectric materials, boundary conditions, capacitance – parallel plate, coaxial, spherical capacitors, Poisson's and Laplace's equations.

UNIT 2: MAGNETOSTATICS: Biot-Savart law, Ampere's circuital law, magnetic flux density, curl, Stoke's theorem, Maxwell's equations for static EM fields, magnetic scalar and vector potentials, forces due to magnetic fields, Ampere's Force law, inductances and magnetic energy.
MAXWELL'S EQUATIONS (TIME VARYING FIELDS): Faraday's law and emf, concept of displacement current density, Maxwell's equations in integral and differential forms, retarded potential.

UNIT 3: TRANSMISSION LINES: Definition of characteristic impedance and propagation constant, general solution of the transmission line; two standard forms for voltage and current of a line terminated by impedance, input impedance of a lossless line terminated by impedance, meaning of reflection coefficient, wavelength and velocity of propagation, distortion less transmission line, standing wave ratio on a line, the quarter wave line and impedance matching, single stub matching and double stub matching, Smith chart, application of the smith chart, conversion from impedance to reflection coefficient and vice-versa.

UNIT 4: ELECTROMAGNETIC WAVES: Wave propagation in free space, conducting and perfect dielectric media, Skin effect, Poynting vector and Poynting theorem, wave polarization

UNIT 5: PLANE WAVES REFLECTION AND DISPERSION: Reflection of wave at normal incidence and multiple interfaces wave propagation in general direction, reflection at oblique incident angles, Brewster angle, total reflection and transmission of obliquely incident wave, wave propagation and pulse broadening in dispersive media.

BOOKS:

1. Hayt and Buck, Engineering Electromagnetic, TMH, 2014.
2. Sadiku, Elements of Electromagnetics, Oxford, 2007.
3. Liao, Microwave Devices & Circuits; PHI, 2003.
4. Kraus, Electromagnetic with Applications, TMH, 2010.
5. Prasad, Antenna and wave propagation, Satya Prakashan, 2012.

COURSE OUTCOMES:

1. Students will be able to understand principles, theorems of electromagnetic, and their applications.
2. Students will be able to apply the knowledge of electromagnetic for time-varying fields.
3. Students will be able to understand the working of transmission lines and their applications.
4. Students will be able to understand the propagation of EM waves through waveguides.
5. Students will be able to solve engineering problems related to electromagnetic.

TCS-243 OBJECT ORIENTED PROGRAMMING

UNIT 1: C++ standard library, pre-processor directives, illustrative simple C++ programs, header files and namespaces, library files, concept of objects, object oriented analysis & object modelling techniques. Object oriented programming, encapsulation, access modifiers: controlling access to a class, method, or variable, polymorphism: overloading, inheritance, overriding, abstract classes, reusability.

UNIT 2: CLASSES AND DATA ABSTRACTION: structure, definitions, accessing members of structures, class scope and accessing class members, controlling access function and utility functions, initializing class objects: constructors, Const (constant) object and const member functions, object as member of classes, friend function and friend classes, using this pointer, dynamic memory allocation with new and delete, static class members, container classes and iterators, function overloading.

UNIT 3: OPERATOR OVERLOADING: Introduction, fundamentals of operator overloading, restrictions on operators overloading, operator functions as class members vs. as friend functions, overloading,
INHERITANCE: Base classes and derived classes, protected members, casting base class pointers to derived- class pointers, using member functions, overriding base -class members in a derived class, public, protected and private inheritance, using constructors and destructors in derived classes, implicit derived -class object to base- class object conversion, composition vs. inheritance.

UNIT 4: Virtual functions, abstract, base classes and concrete classes, new classes and dynamic binding, constructors, destructors, dynamic binding, files and i/o streams and various operation on files, stream input/output classes and objects, stream output, stream input, unformatted i/o (with read and write), stream manipulators, stream format states, stream error states.

UNIT 5: TEMPLATES & EXCEPTION HANDLING: Function templates, overloading template functions, class template, class templates and non-type parameters, templates and inheritance, templates and friends.
TEMPLATES AND STATIC MEMBERS: Introduction, basics of C++ exception handling: try throw, catch, throwing an exception; catching an exception, re-throwing an exception, exception specifications, processing unexpected exceptions, constructors, destructors and exception handling, exceptions and inheritance.

BOOKS:

1. C++ How to Program by H M Deitel and P J Deitel, 1998, Prentice Hall
2. Object Oriented Programming in Turbo C++ by Robert Lafore, 1994, WAITE Group Press.
3. Programming with C++ by D Ravichandran, 2003, T.M.H
4. Object oriented Programming with C++ by E Balagurusamy, 2001, Tata McGraw-Hill
5. Computing Concepts with C++ Essentials by Horstmann, 2003, John Wiley,
6. C++ Programming Fundamentals by Chuck Easttom, Firewall Media

COURSE OUTCOMES:

1. Students will be able to understand the principles of OOPs and their applications.
2. Students will be capable of writing programs using object-oriented language tokens, expressions, controlstructures and functions.
3. Students will be capable of writing programs for data encapsulation and data security.
4. Students will be able to understand the concepts of overloading, overriding, inheritance and polymorphismin C++.
5. Students will be capable of solving engineering problems using OOP language.

PEC-241 COMMUNICATION SYSTEMS LAB

1. Design and testing of an amplitude modulator & demodulator circuit and determine the depth of modulation.
2. Design and testing of a frequency modulator & demodulator circuit and determine the modulation index.
3. Design and tracing the signals at various points of a PAM, PWM, PPM modulator and demodulator circuits.
4. Design and tracing the signals at various points of a DSB-SC, SSB-SC modulator and demodulator circuits.
5. Design and tracing the signals at various points of a Delta modulation & demodulation modulator anddemodulator circuit.
6. Implementation and verification of ASK, FSK, PSK modulation and demodulation techniques.
7. Implementation and verification of the pulse code modulation and demodulation systems.
8. Implementation and verification of delta modulation and demodulation techniques and observe the effect ofslope overload.
9. Verification of communication signals between a TDM-PCM transmitter and receiver.
10. Verification of analog signal transmission using sampling & reconstruction Transceiver.
11. Implementation and verification of delta sigma modulation & demodulation techniques.

COURSE OUTCOMES:

1. Students will be able to design and test different modulation and demodulation schemes of analogcommunication.
2. Students will be able to implement various digital modulation techniques using hardware circuits.
3. Students will be able to design the experiments, analyze and interpret the measured data.
4. Students will acquire skills of teamwork, technical communication and report writing.
5. Students will be capable of solving practical communication engineering problems.

PEC-242 ELECTRONICS MEASUREMENT LAB

1. To calculate the frequency using Wein Bridge.
2. To determine the value of unknown Inductor using Maxwell Bridge.
3. To determine the value of unknown Inductor using Hey's Bridge.
4. To verify and calibrate temperature using RTD circuit.
5. To measure the speed of a motor using magnetic sensor.
6. To measure the speed of a motor using photo-electric sensor.
7. To determine the characteristics of LVDT.
8. To measure the temperature using thermo-couple module.
9. To measure the pressure using pressure transducer module.
10. To measure strain using strain gauge module.
11. To measure the weightusingload cell module.
12. To determine andplot the characteristics of a light sensor.
13. Spectral analysis of signals- white noise, color noise, pink noise.

COURSE OUTCOMES:

1. Students will be able to measure the values of R, L and C components using different bridges.
2. Students will be able to understand how transducers measured different physical quantities.
3. Students will be able to perform the experiments, analyze and interpretation of data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems in the field of measurement andinstrumentation.

PEC-243 MICROPROCESSORS & MICROCONTROLLERS LAB

1. Write and implement a program for adding two 8- bit numbers using 8085 microprocessor.
2. Write and implement a program for subtracting two 8- bit numbers using 8085 microprocessor.
3. Write and implement a program for finding the smallest number from a given set of numbers using 8085 microprocessor.
4. Write and implement a program for finding the largest number from a given set of numbers using 8085microprocessor.
5. Write and implement 8086 assembly language program to add, sub of two 8-bit numbers.
6. Write and implement 8086 assembly language program to ascending order, descending order of an array of numbers.
7. Write and implement 8086 assembly language program for multiplication of the given numbers.
8. Write and implement 8086 assembly language program for division of the given numbers.
9. Write and implement assembly language program for stepper motor interfacing to 8086.
10. Write and implement a program for arithmetic operation of two 8-bit numbers using 8051 microcontroller.
11. Write and implement a program for interfacing sensor with microcontroller 8051.
12. Write and implement a program for interfacing keyboard with microcontroller 8051.

COURSE OUTCOMES:

1. Students will able to write assembly language program in 8085 & 8086 microprocessor.
2. Students will get the knowledge of Memory and peripheral interfacing with Microprocessors (8085/8086).
3. Students will be able to write program for 8051 microcontrollers.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to application of microprocessors and microcontrollers.

EVALUATION SCHEME
B. TECH. ECE
THIRD YEAR (V-SEMESTER)
(Effective from session: 2023-24)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-351	Antenna and wave Propagation	3	1	0	30	20	50	100	150	3
2.	TEC-352	Integrated Circuits	3	1	0	30	20	50	100	150	3
3.	THS-351	Principles of Management	3	1	0	30	20	50	100	150	3
4.	EEC-31X	Program Elective-1	3	1	0	30	20	50	100	150	3
5.	EEC-32X	Program Elective-2	3	1	0	30	20	50	100	150	3
PRACTICAL											
6.	PEC-351	Integrated Circuits Lab	0	0	2	15	10	25	25	50	1
7.	PEC-352	Circuits Simulation Lab	0	0	2	15	10	25	25	50	1
8.	PEC-353	Soft Computing Lab	0	0	2	15	10	25	25	50	1
9.	PEC-354	Seminar-II	0	0	2	30	20	50	0	50	1
10.	GPP-351	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**225**	**200**	**425**	**575**	**1000**	**19**

Program Elective-1

EEC-311 Multimedia Communication
EEC-312 Embedded Systems
EEC-313 Microelectronics
EEC-314 Computer Networks

Program Elective-2

EEC-321 Python Programming
EEC-322 Artificial Neural Network and Fuzzy Logic
EEC-323 IoT & Machine learning
EEC-324 Power Electronics

TEC-351 ANTENNA AND WAVE PROPAGATION

UNIT 1: REVIEW OF ELECTROMAGNETIC THEORY

Functions and properties of antennas, basic antenna elements, radiation mechanism, radiated power and radiation resistance of current element/Hertzian dipole, radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, beam width, bandwidth, polarization, antenna input impedance, elementary idea about self and mutual impedance, radiation efficiency, effective aperture, antenna temperature.

UNIT 2: ANTENNA ARRAYS

Introduction, array of two point sources, n-element linear array with uniform amplitude and spacing, analysis of broadside array, ordinary end-fire array, Hansen-Woodyard end fire array, n-element linear array with non-uniform spacing, analysis of binomial and Dolph-Tschebyscheff array, scanning array, super directive array.

UNIT 3: TYPES OF ANTENNA

HF, VHF and UHF antennas: folded dipole, V-antenna, rhombic antenna, Yagi-Uda antenna, log-periodic antenna, loop antenna, radiation field from short magnetic dipole, microwave antennas, helical antenna, horn antenna, parabolic dish, micro-strip antenna: rectangular patch, circular patch, circular polarization, array and feed networks.

UNIT 4: WAVE PROPAGATION

Friis free space equation, reflection from earth‟s surface, surface and space wave propagation, field strength of space wave, range of space wave propagation, effective earth‟s radius, effect of earth imperfections and atmosphereon space wave propagation, modified refractive index, duct propagation, tropospheric propagation, structure of ionosphere, propagation of radio waves through ionosphere, refractive index of ionosphere, reflection and refraction of waves by ionosphere, critical frequency, maximum usable frequency, optimum working frequency, lowest usable frequency, virtual height, skip distance, effect of earth‟s magnetic field.

UNIT 5: ANTENNA MEASUREMENT

Antenna ranges**,** reflection, free-space ranges, near field/far field, measurement of radiation pattern, gain measurement, directivity measurement, radiation efficiency, impedance measurement, current measurement, polarization and scale model measurement, basics of wireless energy transfer.

BOOKS:

1. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons, 2015.
2. Jordan, Electromagnetics and radiating systems, PHI, 2003.
3. Collins, Antenna and radio wave propagation, McGraw Hill, 2013.
4. Krauss, Antenna Theory, TMH, 2013.
5. Gautam, Antenna and wave propagation, Katson books, 2014.

COURSE OUTCOMES:

1. Students will have knowledge of various performance parameters of antenna and their applications.
2. Students will be able to understand principles of various practical antenna and antenna arrays.
3. Students will be to understand different aspects of wave propagation.
4. Students will be able to measure various antenna parameters.
5. Students will be able to solve engineering problems related to antenna and propagation.

TEC-352 INTEGRATED CIRCUITS

UNIT 1: DIFFERENTIAL AMPLIFIERS: Introduction, Differential amplifier circuit configuration, D.C. and A.C. analysis of dual-input balanced output, single input-balanced output, dual input unbalanced output, single input on balanced output, differential amplifier configuration, FET differential Amplifier, an introduction, differential amplifier with swamping resistors, cascaded differential amplifier stages, cascade or CE-CB configurations.

UNIT 2: OPERATIONAL AMPLIFIERS: Block diagram of a typical Op-Amp, Schematic symbol, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Block diagram representation of feedback configuration, voltage series and voltage shunt feedback amplifier; voltage gain, input & output resistances, bandwidth with feedback expressions, voltage follower circuits. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Change in Input offset voltage and Input offset current with time, Temperature and supply voltage sensitive parameters, Noise, Common mode configuration and common mode rejection ratio.

UNIT 3: APPLICATIONS OF OP-AMP: Summing amplifier, Integrator, Differentiator, Scaling and Averaging Amplifier, Instrumentation Amplifier, V to I and I to V converter, Log and Antilog Amplifier, Peak Detector, Sample and Hold Circuit, Op-amp as precision diode and its application in half and full wave rectifiers.

UNIT 4: FREQUENCY RESPONSE OF OP-AMP AND ACTIVE FILTERS: Frequency response, compensating networks, slew rate, causes of slew rate and its effect on applications. Advantages of active filters over passive filters, First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second order HP Butterworth filter, Higher order filters, Band pass filter, Band reject filters, All pass filter.

UNIT 5: COMPARATORS AND WAVEFORM GENERATORS: Basic comparator, zero crossing detectors, Schmitt trigger, Square wave generator, Triangular wave generator, Saw tooth wave generator. **TIMERS:** Pin configuration, Block diagram, application of 555 IC as Mono-stable, bi-stable and Astable-Multivibrators. **PHASE LOCK LOOPS:** Basic operating principle, phase detector, voltage controlled oscillator (VCO), PLL IC 565, applications of PLL.

BOOKS:

1. Choudhary and Jain, Linear integrated circuits, PHI, 2003.
2. Coughlin, Op Amps & Linear Integrated circuits, PHI,2016
3. Gayakwad, Op Amps & Linear Integrated circuits, PHI, 2000.
4. Sze, VLSI Technology, McGraw Hill, 2003.
5. Gandhi, VLSI Fabrication Principles, John Wiley & Sons, 1994.
6. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2011.
7. Sedra & Smith, Microelectronic Circuits, Oxford University Press, 2017.
8. Plummer, Silicon VLSI Technology: Fundamentals, Practice and modeling, Pearson, 2009.

COURSE OUTCOMES:

1. Students will be able to understand different applications of operational amplifiers.
2. Students will be able to design and analyze active filters and waveforms generation using analog ICs.
3. Students will be able to understand various processes used in IC technology.
4. Students will be able to understand integration of processes used for fabrication of ICs.
5. Students will be able to solve engineering problems related to integrated circuits.

EEC-311 MULTIMEDIA COMMUNICATION

UNIT 1: Introduction: Multimedia, definition, different types of multimedia products in different fields, introduction to making of multimedia, stages of the projects, the hardware and software requirements, authoring tools, categories of authoring tools.

UNIT 2: Lossless and lossy compression, run length coding, statistical coding, transform coding, text compression using static Huffman technique, dynamic Huffman technique and arithmetic coding techniques.

UNIT 3: Distributed multimedia systems, resource management of DMS, IP networking, multimedia operating systems, distributed multimedia servers, distributed multimedia applications, multimedia file formats.

UNIT-4: Multimedia communication standards, making of JPEG, making of MPEG, MPEG-1, MPEG-2, MPEG-4Audio/Video, MPEG-4 Visual Texture coding (VTC), Multimedia communication across networks, compression techniques; JPEG, MPEG.

UNIT-5: Transmission media: Twisted pair cable, coaxial cable, optical fiber, infrared, radio link, microwave link and satellite link.
Multimedia Application: Education (use of CAI tool), Entertainment, Edutainment, Virtual Reality, Digital Libraries, Information Kiosks, Video on Demand, Web Pages Video phone, Video conferencing and Health care.

BOOKS:

1. Rao, Bojkovic, Milovanovic, Multimedia Communication Systems, PHI, 2002.
2. Andleigh, Thakrar, Multimedia System Design, PHI, 2002.
3. Sharda, Multimedia Information Networking, PHI, 2003.
4. Vaughan, Multimedia making it Work, Tata McGraw Hill, 2006.

COURSE OUTCOMES:

1. Students will be able to understand aspects multimedia communication system.
2. Students will be able to understand the coding techniques used in multimedia communication.
3. Students will have knowledge of standards of multimedia communication.
4. Students will have knowledge of transmission links and applications of multimedia communication.
5. Students will be capable of solving engineering problems related to multimedia communication.

EEC-312 EMBEDDED SYSTEM

UNIT 1: INTRODUCTION TO EMBEDDED SYSTEMS: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT 2: CORE OF THE EMBEDDED SYSTEM: General Purpose and Domain Specific Processors, ASICs, PLDs, Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT 3: DEVICE AND COMMUNICATION BUS FOR DEVICES NETWORK: Serial communication devices, Parallel Device ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Serial Bus Communication Protocols, parallel Bus Devices protocol Parallel communication Network using ISA, PCI, PCI-X and advanced buses.

UNIT 4: DEVICE DRIVERS AND INTER-PROCESS COMMUNICATION: Device Driver, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, CPU Scheduling, Threads and Tasks, Shared Data, Inter process Communication, Signal Function, Semaphore Functions, Message Queue Functions, Mailbox Functions, Pipe Functions, Socket Functions, RPC Functions.

UNIT 5: REAL TIME OPERATING SYSTEM: Introduction to Real Time Operating Systems, Process management, process scheduling, co-operating processes, Timer function, Event function, Memory management, Device, File and I/O subsystem management, RTOS Task Scheduling Models, Interrupt routine in RTOS environment and handling of interrupt Sources calls, hands-on for basic embedded project.

BOOKS:

1. Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata McGraw-Hill.
2. Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier.
3. Embedded Systems Design by Steve Heath, II edition, Newnes publications.
4. Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers by Tammy Noergaard, Elsevier.
5. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
6. Embedded Systems–Lyla, Pearson, 2013
7. An Embedded Software Primer - David E. Simon, Pearson Education.

COURSE OUTCOMES:

1. Students will be able to understand various techniques of embedded systems.
2. Students will be able to understand the device drivers and interrupt services.
3. Students will be able to understand inter-process communication and synchronization.
4. Students will be able to understand the concepts of real time operating systems.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problems related to embedded systems

EEC-313 MICROELECTRONICS

UNIT 1: FUNDAMENTALS OF SEMICONDUCTORS: Semiconductor materials, elemental and compound semiconductors, energy band diagram, carrier concentration, drift and diffusion currents, conductivity, Effect of temperature and doping on mobility, The Hall Effect, relation between the energy band diagram and electric field, Einstein relations, Direct and Indirect recombination of electrons and holes , Steady-state carrier generation, Quasi-Fermi level; generation, recombination and injection of carriers and lifetime, transient response, Deby length, Continuity equations.

UNIT 2: JUNCTIONS AND INTERFACES: Procedure for analyzing semiconductor devices: Basic equations and approximations; Description of PN junctions, abrupt, linearly graded, diffused junctions, Low level and high level injection effects, Diode models, current voltage characteristics: Shockley Equation temperature dependence of I-V characteristics, breakdown mechanism in PN junctions, small signal and switching transients in diodes, LED, varactor, photodiode, Schottky, tunnel diodes and their constructions and characteristics.

UNIT 3: BIPOLAR JUNCTION TRANSISTORS: Transistor action and amplification, doping profiles, analysis of ideal diffusion BJT, static I-V characteristics, charge control equations, drift, power and switching transistors.

UNIT 4: MOSFETS: C-V characteristics of a MOS capacitor, Basic MOSFET Characteristics, Threshold Voltage, Body Bias concept, Current Voltage Characteristics, Square Law Model, MOSFET Modelling, Drain Source Resistance, MOSFET Capacitances, Geometric Scaling Theory, Full Voltage Scaling, Constant Voltage Scaling, short channel effects.

UNIT 5: ADVANCE SEMICONDUCTOR DEVICES: Structure, working principle and I-V characteristics of Tunnel FETs, Junction-less Field-Effect Transistors and Fin-FETs fundamentals and applications of hetero-junctions, HEMTs.

BOOKS:

1. Robert F. Pierret, “Semiconductor Device Fundamentals”, Pearson, 2006.
2. Streetman and Banerjee, “Solid state electronics devices”, PHI, 2015.
3. Muller, Device Electronics for Integrated Circuit, Wiley, 2002.
4. Sze, Semiconductor devices Physics and technology, Wiley, 2008,
5. Tyagi, Introduction to Semiconductor materials and devices, Wiley, 2008.
6. Neamen, Semiconductor Physics and Devices, TMH, 2015.
7. Dutta “Semiconductor Devices and circuits” Oxford, 2008.

COURSE OUTCOMES:

1. Students will be able to acquire knowledge about physics of semiconductor devices.
2. Students will be able to understand the design and performance parameters of PN junction and BJTs.
3. Students will be able to understand the design and performance parameters of MOSFETs and
4. Students will be able to acquire knowledge about working principles of advance semiconductor devices.
5. Students will be able to solve engineering problems related to microelectronics.

EEC-314 COMPUTER NETWORKS

UNIT 1: INTRODUCTION: Goals and Applications of Networks, Network structure and architecture layering, design issues for layering, reference models and their comparison, network topology.
PHYSICAL LAYER: Transmission media and channel impairments, modulation, multiplexing, digital channels, mobile telephone systems

UNIT 2: DATA LINK LAYER: Design issues, framing, error control, elementary data link protocols and sliding window protocols, HDLC, data link layer in internet.
MEDIUM ACCESS CONTROL: Channel allocation problem, MAC protocols; Aloha, CSMA, collision free protocols, limited contention protocol, Ethernet, IEEE 802.3 standards.

UNIT 3: NETWORK LAYER: Design issues, VC and datagram subnets, routing algorithms for wired and wireless hosts, congestion prevention policies, load shedding, connectivity of networks, connectionless inter-networking, inter-network routing, fragmentation, IP protocols, IP addressing, OSPF, IPv6.

UNIT 4: TRANSPORT LAYER: Transport service and primitives, addressing, connation establishment and release, flow control, buffering, multiplexing and crash recovery, introduction of UDP, modeling TCP connection management, TCP congestion control and performance issues.

UNIT 5: DNS andname space, overview of www, http, introduction of cryptography, substitution cipher and transposition cipher, DES, cipher methods, public key algorithms, social issues; privacy, freedom of speech & copyright.

BOOKS:

1. Tanenbaum “Computer Networks”, Pearson Education, 2012.
2. B. A. Forouzan “Data Communications and Networking (3rd Ed.) “ – TMH
3. Kumar, Manjunath, Kuri, Communication Networking: An Analytical Approach, 2004.
4. Stallings, “Data and Computer Communication”, PHI, 2007.
5. Kuros and Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Addison Wesley,2000.

COURSE OUTCOMES:

1. Students will be able to understand aspects various layers used in data communication networks.
2. Students will be able to understand switching systems.
3. Students will have knowledge of protocols used in data communication networks
4. Students will have knowledge of cryptography and algorithms.
5. Students will be capable of solving engineering problems related to computer networks.

EEC-321 PYTHON PROGRAMMING

UNIT 1: INTRODUCTION: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT 2: TYPES, OPERATORS AND EXPRESSIONS: Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-else, for, while break, continue, pass, Data Structures Lists – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions.

UNIT 3: **FUNCTIONS:** Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Python Packages.

UNIT 4: OBJECT-ORIENTED PROGRAMMING OOP IN PYTHON: Classes, self-variable Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions.

UNIT 5: BRIEF TOUR OF THE STANDARD LIBRARY: Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing, concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson, 2010.
2. Learning Python, Mark Lutz, Orielly, 2015.
3. Think Python, Allen Downey, Green Tea Press, 2017.
4. Core Python Programming, W.Chun, Pearson, 2007.
5. Introduction to Python, Kenneth A. Lambert, Cengage, 2011.

COURSE OUTCOMES:

1. Students will be able to making Software easily right out of the box.
2. Students will be able to experience with an interpreted Language.
3. Students will be able to build software for real needs.
4. Students will be able to prior Introduction to testing software.
5. Students will be able to understand applications of signal processing.

EEC-322 ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC

UNIT 1: NEURAL NETWORKS-1(INTRODUCTION & ARCHITECTURE): Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture; single layer and multilayer feed forward networks, recurrent networks, various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

UNIT 2: NEURAL NETWORKS-II (BACK PROPAGATION NETWORKS): Architecture; Perceptron model solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule coefficient, back propagation algorithm, factors affecting back propagation training, applications.

UNIT 3: FUZZY LOGIC-I (INTRODUCTION): Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT 4: FUZZY LOGIC–II (FUZZY MEMBERSHIP, RULES): Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzifications &De-fuzzifications, Fuzzy Controller.

UNIT 5: APPLICATION OF NEURAL NETWORK AND FUZZY LOGIC: Application of neural network, case study, Inverted pendulum, Image processing, introduction to neuro & fuzzy logic controller.

BOOKS:

1. Simon Haykin, “Artificial Neutral Networks”.
2. Yegna Narayanan,”Artificial Neural Networks”.
3. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”.
4. S.N. Sivanandam, S.N Deepa, “Principles of Soft Computing”
5. Jack M. Zurada, “Introduction to Artificial Neural Systems”, PWS Publishing Co., Boston,2002.

COURSE OUTCOMES:

1. Students will be able to understand the applications of neural networks.
2. Students will be able to understand the different aspects of neural networks.
3. Students will be able to understand the perceptron neural network.
4. Students will be able to understand the fuzzy set theory and fuzzy mapping.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problemsrelated to neural networks.

EEC-323 IOT AND MACHINE LEARNING

Unit 1: Fundamental of IoT: Introduction and evolution of IoT, industrial IoT, conceptual framework (connectivity layer, access layer, abstraction layer, service layer), cloud infrastructure, architectural view, technology behind IoT (RFID, wireless sensor networks, addressing schemes, data storage and analytics, visualization), source of IoT, characteristics of IoT, sensor and actuators.

Unit II: IoT Protocols: IoT system layers – IoT system architecture, end to end interaction between IoT layers, interoperability, design consideration for IoT, attributes, M2M communication, communication technologies for IoT – Zigbee, low energy Bluetooth, Wi-Fi, LoRa. IoT networks, wireless sensor network, MAC (medium access control) layer, Routing protocol.

Unit 3: Embedded platforms for IoT: Embedded computing basics (microcontrollers, system-on-chips, platform). IoT supported hardware platforms – Arduino, Raspberry Pi, Intel Galileo. Arduino IDE-coding, emulator, libraries. Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Interoperability in IoT.

Unit 4: Design and development: Introduction to python programming, Introduction to Raspberry Pi, Integration of Sensors and Actuators with Raspberry Pi, Implementation of IoT with Raspberry Pi, Introduction to SDN, SDN for IoT, Data Handling and Analytics, Cloud Computing, Sensor-Cloud, Fog Computing. Pervasive computing, Application of IoT.

Unit 5:Introduction To machine learning: Classic machine and adaptive machine, basics of training and testing phase, Over-fitting and under-fitting, Feature Selection Techniques, Multi-Class classification approaches, Principal component analysis(PCA), Application of machine learning.

Books:

1. Internet-of-Things (IoT) Systems - Architectures, Algorithms, Methodologies: Dimitrios Serpanos Marilyn Wolf, Springer International Publishing AG 2018
2. IoT Fundamentals- Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
3. Decentralized Internet of Things – A. Khan, T. Quasim, F. Algarni, Springer , 2020.
4. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
5. Internet of Things- Architecture, Design Principles And Applications, Rajkamal, McGraw Hill, 2017
6. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013

Course Outcomes:

1. Understand the fundamentals of IoT and machine learning.
2. Understand the Architecture of an IoT
3. Understand design methodology and hardware platforms involved in IoT.
4. Implement the IOT in Industry & real world

EEC-324 POWER ELECTRONICS

UNIT 1: POWER SEMICONDUCTOR DEVICES: Two-transistor model of thyristor, methods of triggering a thyristor, thyristor types, triggering devices; triggering devices, uni-junction transistor, characteristics and applications of UJT, programmable uni-junction transistor, DIAC, silicon-controlled switch, silicon unilateral switch, silicon bilateral switch, Shockley diode, Opto-isolators.

UNIT 2: THYRISTOR FIRING CIRCUITS TURN ON SYSTEMS: Requirements for triggering circuits, thyristor firing circuits, full wave control of ac with one thyristor, light activated SCRs (LASCR) control circuit, pulse transformer triggering, firing SCR by UJT, TRIAC firing circuit, phase control of SCR by pedestal and ramp controlled rectifier; types of converters, effect of inductive load, commutating diode or free-wheeling diode, controlled rectifiers, bi-phase half wave (single way), single-phase full wave phase controlled converter using bridge principle (double way), single phase fullwave phase controlled converter using bridge principle (double way) harmonics.

UNIT 3: INVERTERS: Types of inverters, bridge inverters, voltage source inverters (VSI)and pulse width modulated inverters, current source inverter ac voltage controllers; types of ac voltage controllers, ac phase voltage controllers, single-phase voltage controller with R-L load, harmonic analysis of single-phase full-wave controller with R-L load, gating signals.
DC to DC Converters (Choppers): dc choppers, chopper classification, two quadrant chopper, four quadrant chopper, and Morgan chopper.

UNIT 4: CYCLOCONVERTERS: Types of cyclo-converters, single-phase cyclo-converter and three-phase cyclo-converter.
Protection: Protection, *dv/dt* protection, *di/dt* protection and over voltage protection.

UNIT 5: INDUSTRIAL APPLICATIONS: Industrial applications of power electronics components; one-shot thyristor trigger circuit, overvoltage protection, simple battery charger, battery charging regulator, ac static switches, dc static switches and microprocessor based applications**.**

BOOKS:

1. Rashid, Power Electronics: Circuits, Devices &Applications, PHI, 2003
2. Sen, Power Electronics, TMH, 2001
3. Rai, Power Electronics Devices, Circuits, Systems and Application, Galgotia, 2003.
4. Bimbhara, Electrical Machinery, Theory Performance and Applications, Khanna publication, 2000.

COURSE OUTCOMES:

1. Students will be able to understand principles and working of power semiconductor devices.
2. Students will be able to design the thyristor firing circuits and their applications.
3. Students will be able to design the inverters circuits and their applications.
4. Students will be able to understand the cyclo-converters circuits and their applications.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problemsrelated to power electronics.

PEC 351 INTEGRATED CIRCUITS LAB

1. To design and verify the op-amp working as:
    i. Unity Gain amplifier.
    ii. Inverting amplifier.
    iii. Non-Inverting amplifier.
2. Design & test a difference amplifier using operational amplifier.
3. Design & test Integrator and Differentiator using operational amplifier.
4. Design an active second order low pass filter using operational amplifier & plot the Frequency response characteristics.
5. Design an active second order high pass filter using operational amplifier and plot the frequency response characteristics.
6. Design and test a square wave generator using operational amplifier.
7. Design and test a triangular wave generator using operational amplifier.
8. Design and test a mono stable multivibrator using Timer IC 555.
9. Design and test an Astable multivibrator using Timer IC 555.
10. Design and test IC voltage regulator circuits using ICs 723/7805/7905.
11. Determine the locking and capture range of a PLL IC 565.

COURSE OUTCOMES:

1. Students will be able to simulate the electronic circuits using Op-amp.
2. Students will be able to implement the filters using Op-amp.
3. Students will be able to design and implement multivibrator circuits using Timer IC 555.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems in the field of integrated circuits.

PEC 352 SOFT COMPUTING LAB

1. Study of MATLAB software and its toolboxes & write a program to solve mathematical functions/operators like arithmetic, complex, trigonometric operator.
2. Write a program to plot the following activation functions: Sigmoidal, log sigmoidal, linear, saturating linear, etc.
3. Generate XOR function using McCulloch-Pits Neural Network by MATLAB program.
4. Write a MATLAB program for perceptron net for an AND function with bipolar inputs and targets.
5. Write a program to calculate simple addition and subtraction of fuzzy sets, Union Intersection and Complement operation.
6. Write a program in MATLAB to implement De-Moragan's Law.
7. Write a Program in MATLAB to plot various membership functions.
8. Case Study: Write a MATLAB program to train and simulate Multilayer perceptron neural network(Back-propagation neural network)
9. Case Study: Design a Fuzzy logic controller(Air conditioning system/ water level control)
10. Case study: Pattern recognition/alphabet recognition/number recognition

COURSE OUTCOMES:

1. Understand components of Soft Computing and differentiate between hard & soft computing.
2. Understand the difference between learning and programming and explore practical applications of Neural Networks (NN)
3. To analyse and appreciate the applications which can use fuzzy logic.
4. Understand the efficiency of a hybrid system and how Neural Network and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications and they will be able to design inference systems.
5. Appreciate the importance of optimizations and its use in computer engineering fields and other domains.

PEC-353 CIRCUIT SIMULATION LAB

Experiments based on Simulation and Implementation of Electronic Circuits:

1. Design simulation and analysis of two input NAND and NOR gate.
2. Design, simulation and analysis of NMOS and CMOS inverter.
3. Design, simulation and analysis of full adder circuit.
4. Design, simulation and analysis of push-pull amplifier.
5. Design, Simulation and analysis of different amplifier.
6. Design, Simulation and analysis of amplitude modulation using MATLAB.
7. Design, Simulation and analysis of frequency modulation using MATLAB.
8. Design, Simulation and analysis of phase modulation using MATLAB.
9. Design, Simulation and analysis of ASK using MATLAB.
10. Design, Simulation and analysis of FSK using MATLAB.
11. Design, Simulation and analysis of PSK using MATLAB.

COURSE OUTCOMES:

1. Students will be able to simulate the electronic circuits using CAD tools.
2. Students will be able to implement the electronic circuits on nano boards.
3. Students will be able to perform the experiments, analyze and interpretation of data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems using MATLAB.

EVALUATION SCHEME
B. TECH. ECE
THIRD YEAR (VI-SEMESTER)
(Effective from session: 2023-24)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-361	Control Systems	3	1	0	30	20	50	100	150	3
2.	TEC-362	Digital Signal Processing	3	1	0	30	20	50	100	150	3
3.	TEC-363	Microwave Engineering	3	1	0	30	20	50	100	150	3
4.	EEC-33X	Program Elective-3	3	1	0	30	20	50	100	150	3
5.	EEC-34X	Program Elective-4	3	1	0	30	20	50	100	150	3
PRACTICAL											
6.	PEC-361	Control Systems Lab	0	0	2	15	10	25	25	50	1
7.	PEC-362	Digital Signal Processing Lab	0	0	2	15	10	25	25	50	1
8.	PEC-363	RF Engineering Lab	0	0	2	15	10	25	25	50	1
9.	PEC-364	Mini Project	0	0	2	15	10	25	25	50	1
10.	GPP-361	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**210**	**190**	**400**	**600**	**1000**	**19**

Program Elective-3

EEC-331 Probability Theory and Stochastic Processes
EEC-332 Information Theory & Coding
EEC-333 Radar and Navigation
EEC-334 Analog Filter Design

Program Elective-4

EEC-341 CMOS Design
EEC-342 Mixed Signal Design
EEC-343 Micro-electromechanical Systems (MEMS)
EEC-344 Nanoelectronics

TEC-361 CONTROL SYSTEMS

UNIT-1: GENERAL INTRODUCTION TO CONTROL SYSTEM: Historical background, open loop and closed loop control systems, basic elements of a feedback control system, types of feedback control systems, and effects of feedback.
TRANSFER FUNCTION: Laplace transform and inverse Laplace transform, differential equations of physical systems, poles and zeros, characteristic equation; Block diagrams: representation and reduction; Signal flow graphs: definitions, properties, gain formula; analogous systems.

UNIT-2: TIME RESPONSE ANALYSIS: standard test signals, response of first and second order systems, time response specifications, steady state errors, types of control systems, static error constants; effects of addition of poles and zeros.
CONCEPT OF STABILITY: definition, absolute and relative stability, asymptotic stability; Routh-Hurwitz stability criterion: stability conditions, Hurwitz criterion, Routh-array, special cases, relative stability analysis and design applications. Root-locus technique: root-locus, complementary root-locus and root contours, basic fundamentals, construction rules, effects of addition of poles and zeros.

UNIT-3: FREQUENCY DOMAIN ANALYSIS: frequency response specifications, correlation between time and frequency response, Bode plot, Polar plot, Nyquist stability criterion, gain and phase margins; Closed-loop frequency response: M-circles, N-circles, closed-loop frequency response for unity and non-unity feedback systems.

UNIT-4: AUTOMATIC CONTROLLERS: Basic control actions, PD, PI and PID controllers, effect on the time response.
Compensation techniques: classifications, lead, lag and lag-lead compensations.
Digital control systems: Introduction, sampling theorem, Jury's stability criterion.

UNIT-5: STATE SPACE ANALYSIS: Concepts of states, state variables and state model, state models of linear systems, state-transition matrix; solution of state equations, various canonical forms, transfer matrix, characteristic equation,Eigen-values and Eigen-vectors, derivation of transfer function from state model, Introduction of state space representation of digital system, Controllability and observability tests, Introduction to Stochastic system, model, analyze and simulate stochastic systems.

BOOKS:

1. Nagrath & Gopal, "Control System Engineering", New age International, 2000.
2. Ogata, "Modern Control Engineering", Prentice Hall of India, 2016
3. Kuo & Golnaraghi, "Automatic Control System", Wiley India Ltd, 2012
4. Choudhary, "Modern Control Engineering", Prentice Hall of India, 2005

COURSE OUTCOMES:

1. Students will be able to understand the block diagram representation and reductions techniques of controlsystem and its application to find the transfer function.
2. Students will be able to understand the time and frequency response analysis as well as stability conceptsof first and second order control systems.
3. Students will be able to use the graphical techniques to analyze and design the control systems.
4. Students will be able to understand the system equations in variable form.
5. Students will be capable of solving engineering problems related to control systems.

TEC-362 DIGITAL SIGNAL PROCESSING

UNIT 1: DISCRETE FOURIER TRANSFORM: Discrete Fourier transform, DFT as a linear transformation, relationship of the DFT to other transforms, properties of the DFT: periodicity, linearity, and symmetry, multiplication of two DFTs and circular convolution, additional DFT properties, frequency analysis of signals using DFT, The Goertzel algorithm, Chirp z-transform algorithm, introduction to MATLAB (Coding of Implementation of LTI using DFT).

UNIT 2: EFFICIENT COMPUTATION OF DFT: Efficient computation of DFT: FFT algorithms, direct computation of the DFT, Radix-2 FFT algorithms, efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of 2N-point real sequences (Coding of FFT algorithms).
FILTER STRUCTURES: Direct form (I & II), Lattice for FIR & IIR filters.

UNIT 3: DESIGN OF FIR FILTERS: Properties of non-recursive filters, rectangular, Hamming, Blackman, Chebyshev and Kaiser windowing, optimum approximation of FIR filters, multistage approach to sampling rate concession (Coding of windowing for FIR filters).

UNIT4: DESIGN OF IIR FILTERS: Impulse invariant and bilinear transformation techniques for Butterworth and Chebyshev filter; cascade and parallel (Coding of Butterworth and Chebyshev filters).

UNIT5: APPLICATION OF DSP AND CODING: Sampling frequency conversion, quadrature-mirror-image filter banks, Hilbert transforms, Adaptive digital filters, two dimensional filter designs, Audio and Video coding, MPEG coding standardization, DCT, Walsh and Hadamard Coding.
DSP PROCESSOR ARCHITECTURE FUNDAMENTALS: Study of ADSP and TMS series of processor architectures.

BOOKS:

1. Proakis &Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", PrenticeHall (India), 2007.
2. Apte, "Digital Signal Processing", 2nd Edition, John Wiley (India), 2009.
3. Rabiner and Gold, "Theory and Applications of DSP", PHI, 2011.
4. Oppenhein, Digital Signal Processing, PHI, 1997.

COURSE OUTCOMES:

1. Students will be able to understand discrete Fourier transform and its applications.
2. Students will be able to understand filter structures and its applications.
3. Students will be able to design of FIR filters and IIR filters for various applications.
4. Students will be able to understand the advance DSP processors and their applications.
5. Students will be capable of solving engineering problems related to digital signal processing.

TEC-363 MICROWAVE ENGINEERING

UNIT 1: PROPAGATION THROUGH WAVEGUIDES: Rectangular and circular waveguides, solution of wave equation for TE & TM modes, degenerate and dominant modes, power transmission& power loss, excitation of wave guides, non-existence of TEM mode in waveguide, introduction to stripline and microstrip-line.
MICROWAVE CAVITY RESONATORS: Rectangular and cylindrical cavities, quality factor and excitation of cavities.

UNIT 2: MICROWAVE COMPONENTS: Scattering matrix, E-plane, H-plane and hybrid tee, hybrid ring, waveguide discontinuities, waveguide couplings, bends and twists, transitions, directional couplers, matched load, attenuators and phase shifters, irises and tuning screws, detectors, wave meter, isolators and circulators.

UNIT 3: MICROWAVE MEASUREMENTS: Tunable detector, slotted line carriage, VSWR meter, measurement of frequency, wavelength, VSWR, impedance, attenuation, low and high power radiation patterns.

UNIT 4: MICROWAVE TUBES: Limitation of conventional active devices at microwave frequency, Klystron, Reflex klystron, magnetron, TWT, BWO; principle of operation and performance characteristics and applications.

UNIT 5: MICROWAVE SEMICONDUCTOR DEVICES: PIN diode, Tunnel diode, Gunn diode, IMPATT, TRAPATT and BARRIT, High electron mobility transistors; principle of operation, characteristics and applications.

BOOKS:

1. Liao, Microwave Devices & Circuits; PHI, 2003.
2. Das and Das, Microwave Engineering; TMH, 2009.
3. Collin, R.E. Foundations for Microwave Engineering; TMH, 2007.
4. Gautam, A K, Microwave Engineering; Kataria & Sons

COURSE OUTCOMES:

1. Students will be able to understand the propagation of electromagnetic waves through waveguides.
2. Students will be able to understand the function of various microwave components.
3. Students will be able to understand the measurements of various microwave parameters.
4. Students will be able to understand the principle and operation of microwave tubes and microwave solid-state devices.
5. Students will be able to solve engineering problems related to microwave applications.

EEC-331 PROBABILITY THEORY AND STOCHASTIC PROCESSES

UNIT 1: Sets and set operations, probability space, conditional probability and Bayes theorem, combinatorial probability and sampling models.

UNIT 2: Discrete random variables, probability mass function, probability distribution function, example random variables and distributions, continuous random variables, probability density function, probability distribution function, example distributions.

UNIT 3: Joint distributions, functions of one and two random variables, moments of random variables; conditional distribution, densities and moments; characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds.

UNIT 4: Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); limit theorems; strong and weak laws of large numbers, central limit theorem.

UNIT 5: Random process, stationary processes, mean and covariance functions, Ergodicity, transmission of random process through LTI, power spectral density.

BOOKS:

1. H. Stark and J. Woods, Probability and Random Processes with Applications to Signal Processing, Third Edition, Pearson Education
2. Papoulis and S. Unnikrishnan Pillai, Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw Hill.
3. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
4. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,
5. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

COURSE OUTCOMES:

1. Students will demonstrate the ability to understand representation of random signals.
2. Students will be able to investigate characteristics of random processes.
3. Students will be able to make use of theorems related to random signals.
4. Students will be able to understand propagation of random signals in LTI systems.
5. Students will be able to solve engineering problems related to random signals.

EEC-332 INFORMATION THEORY AND CODING

UNIT 1: SOURCE CODING: Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Source Coding Theorem, Huffman Coding, The Lempel- Ziv Algorithm, Rate Distortion Function, Optimum Quantizer Design.

UNIT 2: CHANNEL CAPACITY AND CODING: Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem The Shannon Limit, Random Selection of Codes.

UNIT 3: LINEAR BLOCK CODES FOR ERROR CORRECTION: Introduction to Error Correcting Codes, Basic Definitions, Matrix Description of Linear Block Codes, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction), Perfect Codes Hamming Codes, Optimal Linear Codes, Cyclic Codes, Polynomials, division Algorithm for Polynomials, Minimal Polynomials, BCH Codes, Primitive Elements.

UNIT 4: CONVOLUTIONAL CODES: Introduction to Convolutional Codes, Tree Codes and Trellis Codes, Polynomial Description of Convolutional Codes (Analytical Representation), Notions for Convolutional Codes, The Generating Function, Matrix Description of Convolutional Codes, Veterbi Decoding of Convolutional Codes.

UNIT 4: TRELLIS CODES MODULATION: Introduction to TCM, The concept of Coded Modulation, Mapping by Set Partitioning, Ungerboeck's TCM Design Rules, TCM Decoder, Performance Evaluation for AWGN Channel, Computation of dfree, TCM for Fading Channel.

BOOKS:

1. Bose, Ranjan "Information Theory, Coding & Cryptography" Tata McGraw Hill
2. Van Lint, J.H. "Introduction to Coding Theory" Springer
3. Proakis, John G. "Digital Communications" McGraw Hill
4. Sathyanarayana, P.S. "Probability Information and Coding Theory" Dynaram Publications Bangalore
5. Gallager "Information Theory and Reliable Communication"
6. Shulin & Costello "Error Correcting Codes" Prentice Hall (India).
7. Taub & Schilling "Principles of Communication Systems" Tata McGraw Hill

COURSE OUTCOMES:

1. Students will be able to understand the concept of information and entropy
2. Students will be able to calculate of channel capacity.
3. Students will be able to apply coding techniques.
4. Students will be able to understand the error sources and error control coding.
5. Students will be able to solve engineering problems related to information theory and coding

EEC-333 RADAR & NAVIGATION

UNIT 1: RADAR SIGNAL MODELS: Radar block diagram operation distributed target forms of range equation, radar cross section, Clutter, signal to clutter ratio, noise model and signal to noise ratio, frequency models, Doppler shift, simplifies approach to Doppler shift, pulse and CW radar, FMCW radar,

UNIT 2: RADAR WAVE FORMS: Waveform matched filter of moving targets, ambiguity function and ambiguity function of the simple matched pulse filter for the pulse burst.
ADVANCED RADAR: MTI radar, MST radar, Synthetic aperture radar (SAR)

UNIT 3: DETECTION FUNDAMENTALS: Radar detection as hypothesis testing, Neyman-Pearson detection rule, likelihood ratio test, threshold detection of radar signals, non-coherent integration of non-fluctuating targets, Albersheim and Shnidaman equations, Binary integration.

UNIT 4: RADIO DIRECTION FINDING: Loop direction finder, goniometerand errors in direction finding, Radio Ranges; LF /MF four course radio ranges, VOR, ground equipment & receiver, VOR errors.
HYBERBOLIC SYSTEM OF NAVIGATION: LORAN, Decca, DME & TECAN.

UNIT 5: AIDS TO APPROACH AND LANDING: ILS, GCA & MLS Doppler Navigation; Doppler frequency, Doppler radar equipment, CW & FMCW Doppler radar, frequency trackers, Doppler range equation.
SATALLITE NAVIGATION SYSTEM: Transit system, IRNSS, NAVSTAR and GPS, basic principles of operation, signal structure of NAVSTAR broadcasts, data message, velocity determination, accuracy of GPS & differential navigation, NAVSTAR receiver.

BOOKS:

1. Skolnik, Introduction to Radar Systems, McGraw Hill, 2002.
2. Richards, Fundamentals of Radar Signal Processing, TMH, 2014.
3. Nagraja, Elements of Electronics Navigation, TMH, 2001.
4. Peebles, Radar Principles, Wiley, NY, 1993.
5. Sen and Bhattacharya, Radar Systems and Radio Aids to Navigation, Khanna, 2001.

COURSE OUTCOMES:

1. Students will be able to understand the principle and working of radar systems.
2. Students will be able to analyze and handle the signals and waveform of radar systems.
3. Students will have knowledge of detection and direction finding techniques.
4. Students will have knowledge of satellite navigation systems.
5. Students will be able to solve engineering problems related to radar and navigation systems.

EEC-334 ANALOG FILTER DESIGN

UNIT-1: Review of basic concepts: Review of Op-amp circuits, Ideal and Real operational amplifiers, Categorization of filters-Low-pass filter, High-pass filter, band-pass filter, band-reject filter, Gain equalizers, and Delay equalizers.

UNIT-2: Approximation Theory: Butterworth approximation, Chebyshev approximation, Inverse Chebyshev approximation, Pole locations, Filter specifications, Comparison of maximally flat and equal ripple response, Basic of sensitivity, Frequency Transformations: Low pass to High pass, Low pass to band pass, Low pass to band elimination.

UNIT-3: Biquad Filters: Three amplifier Biquad: Basic low pass and band pass circuit, realization of the general Biquadratic Functions, summing of four Amplifier biquad, feed forward three amplifier biquad, Passive Ladder structures, Inductor Substitution using Gyrator, Transformation of elements using the FDNR.

UNIT-4: Transconductance–C Filters: Basic Transconductance Cell, Basic transconductor building blocks- resistors, integrators, amplifiers, summers, gyrator, First and second order filters, higher order filters.

UNIT-5: Switched capacitor filters: The MOS switch, The switched capacitor, first order building blocks, second order sections, sampled data operation, Switched capacitor first and second order filters, Bilinear transformation.

BOOKS:

1. Gobind Daryanani, "Principles of active network synthesis and design", John Wiley and Sons.
2. R. Schaumann, M. E. Van Valkenburg, "Design of analog filters", Oxford University Press.
3. T. L. Deliyannis, Y. Sun and J. Kel Fiedler, "*Continuous-Time Active Filter Design",* Boca Raton: CRC Press LLC,1999

Course Outcomes:

1. The students will understand the basics of analog filter design
2. The mathematical problem solving ability of students get improved.
3. The students will be motivated to design of resistor less active filter design
4. The analog system analyzing and designing skills of students will be improved.

EEC-341 CMOS DESIGN

UNIT 1: REVIEW Basic MOSFET Characteristics, Threshold Voltage, Body Bias concept, Current Voltage Characteristics, Square Law Model, MOSFET Modeling, MOSFET Capacitances, Geometric Scaling Theory, Full Voltage Scaling and Constant Voltage Scaling.

UNIT 2: CMOS INVERTER: Static CMOS inverter, layout, switching threshold and noise margin concepts and their evaluation, dynamic behavior, power consumption. NMOS MOS pass transistor inverter.
COMBINATIONAL LOGIC: Static CMOS design, rationed logic, pass transistor logic, dynamic logic, cascading dynamic gates, CMOS transmission gate logic.

UNIT 3: SEQUENTIAL LOGIC: Static latches and registers, bi-stability principle, MUX based latches, static SR flip-flops, master-slave edge-triggered register, dynamic latches and registers, concept of pipelining, timing issues.

UNIT 4: MEMORY AND ARRAY STRUCTURE: ROM, RAM, peripheral circuitry, memory reliability and yield, SRAM and DRAM design, flash memory, PLA, PAL, FPGA.

UNIT 5: DESIGN FOR TESTABILITY: Logic testing, sequential logic testing, guidelines to be adopted in design for test, scan-designing techniques, and built-in self-test (BIST) techniques.

BOOKS:

1. Kang, Yusuf, CMOS Digital Integrated Circuits, TMH, 2002.
2. Rabaey, Chandrakasen, Digital Integrated Circuits: A Design Perspective, PHI, 2009.
3. Weste, Harris, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson, 2005.
4. Pucknell, Eshraghian, Basic VLSI Design PHI, 2017.

COURSE OUTCOMES:

1. Students will be able to understand the principles of MOS devices and their applications in designing ofvarious MOS inverter circuits.
2. Students will be able to implement efficient techniques at circuit level for improving power and speed ofcombinational and sequential circuits.
3. Students will be able understand the pass transistors logic, transmission gates logic, static and dynamicCMOS logic circuits.
4. Students will be able to design memories with efficient architectures to improve their performance.
5. Students will be able to solve electronic circuit problems.

EEC 342-MIXED SIGNAL DESIGN

UNIT 1: Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous- time filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

UNIT 2: Switched-capacitor filters- Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

UNIT 3: Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT 4: Mixed-signal layout, Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.

UNIT 5: Introduction to frequency synthesizers and synchronization; Basics of PLL, Analog PLLs; Digital PLLs; DLLs.

BOOKS:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, and 2008.
4. Rudy V. de Plassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill.
6. R. Schauman, Design of analog filters by, Prentice-Hall.
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University press, first Indian edition, 2008.

COURSE OUTCOMES:

1. Students will be able to understand the practical situations where mixed signal analysis is required.
2. Students will be able to analyze and handle the inter-conversions between signals.
3. Students will be able to design systems involving mixed signals.
4. Students will have knowledge of various ICs used in mixed signals.
5. Students will be able to solve engineering problems related to mixed signals.

EEC-343 MICRO ELECTRO-MECHANICAL SYSTEMS (MEMS)

UNIT-1: INTRODUCTION TO MICROSYSTEMS: Overview of microelectronics manufacture and Microsystems technology, Definition MEMS materials, Laws of scaling, multi-disciplinary nature of MEMS, Survey of materials central to micro engineering, Applications of MEMS in various industries.

UNIT-2: MICRO SENSORS AND ACTUATORS: Working principle of Microsystems, micro actuation techniques, micro sensors types, Micro-actuators types, micro-pump, micro-motors, micro-valves, micro-grippers, and micro-accelerometers.

UNIT-3: FABRICATION PROCESS: Substrates single crystal silicon wafer formation, Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Physical vapour deposition, Deposition epitaxy, etching process.

UNIT-4: MICRO SYSTEM MANUFACTURING: Bulk Micro manufacturing, surface micro machining, LIGA, SLIGA, Micro system packaging materials, die level, device level, system level, packaging techniques, die preparation, surface bonding, wire bonding, sealing.

UNIT-5: MICROSYSTEMS DESIGN AND PACKAGING: Design considerations, Mechanical Design, Process design, Realization of MEMS components, Micro system packaging, Packing Technologies, Assembly of Microsystems, Reliability in MEMS

BOOKS:

1. Mohamed Gad – el – Hak, "MEMS Handbook", CRC Press, 2002.
2. Rai-Choudhury P. "MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, 2009.
3. Sabrie Solomon, "Sensors Handbook," McGraw Hill, 1998.
4. Marc F. Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition, 2002.
5. Francis E.H. Tay and Chong .W.O, "Micro fluidics and Bio MEMS application", IEEE Press New York, 1997.
6. Trimmer William S., Ed., "Micromechanics and MEMS", IEEE Press New York, 1997.
7. Maluf, Nadim, "An introduction to Micro electro mechanical Systems Engineering", AR Tech house, Boston 2000.
8. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadel Karim, "Micro sensors MEMS and Smart Devices", John Wiby & sons Ltd., 2001.

COURSE OUTCOMES:

1. Students will be able to understand the MEMS structures and their applications.
2. Students will be able to understand the micro sensors and actuators.
3. Students will be able to understand the fabrication process of MEMS.
4. Students will have knowledge of manufacturing and design procedures of MEMS.
5. Student will be capable of solving engineering problems related to MEMS.

EEC 344 NANOELECTRONICS

UNIT I: SHRINK-DOWN APPROACHES: Introduction to Nano scale Systems, Length energy and time scales, Top down approach to Nanolithography, CMOS Scaling, Limits to Scaling, System Integration Limits - Interconnect issues, etc.

UNIT II: OVERVIEW OF NANOELECTRONICS AND DEVICES: The Nano-scale MOSFET, FinFETs, Vertical MOSFETs, Resonant Tunneling Transistors, Single Electron Transistors, New Storage devices, Optoelectronic and Spin electronics Devices.

UNIT III: BASICS OF QUANTUM MECHANICS: History of Quantum Mechanics, Schrödinger Equation, Quantum confinement of electrons in semiconductor nano structures, 2D confinement (Quantum Wells), Density of States, Ballistic Electron Transport, Coulomb Blockade, NEGF Formalism, Scattering.

UNIT IV: LEAKAGE IN NANOMETER CMOS TECHNOLOGIES: Taxonomy of Leakage: Introduction, Sources, Impact and Solutions. Leakage dependence on Input Vector: Introduction, Stack Effect, Leakage reduction using Natural Stacks, Leakage reduction using Forced Stacks. Power Gating and Dynamic Voltage Scaling: Introduction, Power Gating, Dynamic Voltage Scaling, Power Gating methodologies.

UNIT V: FUTURE ASPECTS OF NANOELECTRONICS: Molecular Electronics: Molecular Semiconductors and Metals, Electronic conduction in molecules, Molecular Logic Gates, Quantum point contacts, Quantum dots and Bottom up approach, Carbon Nano-tube and its applications, Quantum Computation and DNA Computation.

BOOKS:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003.
3. K.E. Drexler, Nanosystems, Wiley, 1992.
4. J.H. Davies, Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003
6. Lundstorm, M. and Guo, J., Nanoscale Transistors – Device Physics, Modeling and Simulation, Springer (2006).
7. Bhushan, B., Handbook of Nanotechnology, Springer (2007) 2nd ed.
8. Beenaker, C.W.J., and Houten, V., Quantum Transport in Semiconductor Nanostructures in Solid State Physics, Ehernreich and Turnbell, Academic Press (1991).

COURSE OUTCOMES:

1. Students will be able to acquire knowledge about nano-electronics and shrink down approach.
2. Students will be able to understand concept behind nano-MOSFETs and nano-devices.
3. Students will be able to set up and solve the Schrodinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.
4. Students will be able to acquire knowledge about leakage in nano-devices.
5. Students will be able to understand applications of nano-electronics.

PEC-361 CONTROL SYSTEMS LAB

1. To determine response of second order systems for step input for various values of constant 'k' using linear simulator unit and compare theoretical and practical results.
2. To verify and compare the performance of P, PI and PID temperature controller for an oven.
3. To determine the performance of a dc position control system.
4. To obtain transfer characteristics of a synchro-transmitter and receiver.
5. To determine speed–torque characteristics of aservomotor.
6. To determine the performance parameters of a dc servomotor.
7. To analyze the behavior of dc motor in open loop at various loads.
8. To design and test a lag, lead and lag-lead compensator using Bode plot.
9. To calculate the basic step angle of a stepper motor.
10. To verify the response of a digital controller over a second order simulated process.
11. To verify the frequency response analysis of the dc servomotor control system using PID controller.
12. To position the D.C Servomotor to required degree using DSP Controller

COURSE OUTCOMES:

1. Students will be able to analyze the performance of various control systems under different operatingconditions.
2. Students will be able to verify the responses of various control systems.
3. Students will be able to design the experiments, analyze and interpretation of data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to control systems.

PEC-362 DIGITAL SIGNAL PROCESSING LAB

1. To determine the linear convolution of the given sequences.
2. To determine the circular convolution of the given sequences.
3. To determine the discrete Fourier transform of a given sequence.
4. To determine the fast Fourier transform of a given sequence.
5. To design a FIR low pass filter using Rectangular window.
6. To design a FIR low pass filter using Hamming window.
7. To design a FIR low pass filter using Triangular window.
8. To design a FIR high pass filter using Rectangular window.
9. To design a FIR high pass filter using Hamming window.
10. To design a FIR high pass filter using Triangular window.
11. To design an IIR low pass filter using impulse invariance method.
12. To design an IIR high pass filter using bilinear transformation method.
13. To determine the discrete cosine transform of a given sequence.
14. Digital signal processing using TMS320C6713 DSK and code composer studio.
15. Consider a LTI system with impulse response h(t) and input excitation x(t). Develop a generic program toobtain the output response in time-domain and in frequency-domain.
16. Develop a program to show that the sum of n number of Random variables (n tending to infinite) has the probability distribution function tending to Gaussian (central-limit theorem).
17. To develop program for computing inverse Z-transform.
18. To develop program for finding magnitude and phase response of LTI system described by system functionH(z).
19. To develop program for computing DFT and IDFT.
20. To develop program for computing circular convolution.
21. To develop program for conversion of direct form realization to cascade form realization.
22. To develop program for cascade realization of IIR and FIR filters.
23. To develop program for designing FIR filter.
24. To develop program for designing IIR filter.
25. To develop program to analyze the frequency content of the voice signal.
26. To write a program using FFT to obtain the frequency spectrum of AM, FM signal and to examine theeffect of modulation index on the frequency contents.
27. Let us consider a non-linear device governed by equation $y(t)=a_1\times x(t)+a_2\times x^2(t)+a_3\times x^3(t)$. Let $x(t)=\sin(wt)$. Develop a program to obtain the output signal and plot its spectrum.

COURSE OUTCOMES:

1. Students will be able to implement various digital processing techniques using modern tools such asMATLAB and DSP processors.
2. Students will be able to design various digital filters using MATLAB.
3. Students will be able to design the experiments, analyze and interpretation of data to achieve validconclusions.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to digital signal processing.

PEC-363 RF ENGINEERING LAB

1. Verification of characteristics of the reflex klystron tube and determine its electronic tuning range.
2. Measurement of frequency and wavelength for a rectangular waveguide working on TE_{10} mode.
3. To determine standing wave ratio and coefficient of rectangular wave-guide.
4. To verify the following characteristics of Gunn Diode:
   (a) V-I characteristics.
   (b) Output power and frequency as a function of voltage.
   (c) Square wave modulation through PIN diode.
5. To measure the polar pattern and the gain of wave guide horn antenna.
6. Verification of the function of multi-hole directional coupler using the following parameters:
   (a) Main line and auxiliary line VSWR.
   (b) Coupling factor &directivity of the coupler.
7. Determine S-parameters of magic Tee terminated by matched load.
8. Verify working principle of the Isolator.
9. Verify working principle of the Circulators.
10. Verify working principle of Attenuators (Fixed and variable type).
11. Verify working principle of the Phase shifter.
    Experiments based on Microstrip antenna design, simulation and fabrication.

COURSE OUTCOMES:

1. Students will be able to measure the different characteristics and parameters of various electromagnetic components using standard microwave bench.
2. Students will be able to characterize the performance parameters of wave guides and antennas.
3. Students will be able to design the electromagnetic experiments, analyze and interpretation of data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to electromagnetic waves.

PEC-363 MINI PROJECT

GUIDELINES:

1. The mini-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of mini-project.
6. Student expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student expected to exert on design, development and testing of the proposed work as per the schedule.
8. Artwork and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submit at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/ product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation/ report writing.

COURSE OUTCOMES:

1. Students will demonstrate the ability to conceive a problem statement from literature survey.
2. Students will demonstrate the ability to conceive a problem from the requirements raised from need analysis.
3. Students will be able to design, implement and test the prototype/algorithm in order to solve the conceived problem.
4. Students will be able to write comprehensive report on mini project work.
5. Students will develop ability to solve practical electronics and communication engineering problems.

EVALUATION SCHEME
B. TECH. ECE
FOURTH YEAR (VII-SEMESTER)
(Effective from session: 2024-25)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-471	Optical Communication	3	1	0	30	20	50	100	150	3
2.	EEC-4XX	Program Elective-5	3	1	0	30	20	50	100	150	3
3.	TOE-4XY	Open Elective-1	3	1	0	30	20	50	100	150	3
PRACTICAL											
4.	PEC-471	Project	0	0	16	15	10	25	25	50	8
5.	PEC-472	Summer Industrial Internship	0	0	4	15	10	25	25	50	2
6.	GPP-471	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**9**	**3**	**20**	**120**	**130**	**250**	**350**	**600**	**19**

Program Elective-5

EEC-451 Biomedical Signal Processing
EEC-452 Digital Image Processing and Applications
EEC-453 Advance Digital Signal Processing
EEC-454 Nano Materials

Open Elective-1
Open Electives will be offered by other departments.
TOC-4YY
TOC-4YY
TOC-4YY

TEC-471 OPTICAL COMMUNICATION

UNIT 1: INTRODUCTION: Demand of information age, block diagram of optical fiber communication system, technology used in OFC system, structure and types of fiber, modes and configuration**,** mode theory for circular guide modal equation, modes in optical fiber, linearly polarized modes, Single mode fibers, mode field diameter.

UNIT 2: TRANSMISSION CHARACTERISTICS:
Attenuation: Material absorption losses, scattering losses, bending losses.
Dispersion: Intra-modal dispersion (material, waveguide), Intermodal dispersion (multimode step index fiber, multimode graded index fiber), modal noise, Overall fiber dispersion (multimode fiber, single mode fiber), Dispersion modified single mode fibers (dispersion shifted fibers, dispersion flattened fibers).
Polarization: Modal birefringence, polarization-maintaining fibers.

UNIT 3: OPTICAL SOURCES:
LED: Visible LED, infrared LED, LED structure and configuration, loss mechanism, application of LED, operating characteristics of materials for visible LED.
LASER: Principle of LASER action, efficiency of LASER diode, principles and structures, index guided and gains guided lasers, mode separation, quantum well laser, laser modulation.

UNIT 4: OPTICAL DETECTORS: Optical absorption in semiconductors, types of photo diodes, Principle of photo detection, working and structures of p-i-n and APD photo detectors, noises in photo detectors, SNR, detector response time effects, comparison of various photo detectors.

UNIT 5: ANALYSIS AND PERFORMANCE OF OPTICAL RECEIVER: Receiver sensitivity, photodiode for optical receiver, optical receiver design, recent receiver circuits, system configuration and power budget.
OPTICAL NETWORKS: WDM concepts and principles, passive components, SONET/SDH networks, performance of WDM.

BOOKS:

1. Senior, Optical Fiber Communications, PHI, 2010.
2. Keiser, Optical Fiber Communications, TMH, 2007.
3. Agarwal, Fiber Optic Communication Systems, John Wiley, 2007.
4. Mynbaev, Gupta, Scheiner, Fiber Optic Communications Pearson, 2010.
5. Palais, Fiber Optic Communications Pearson, 2015.

COURSE OUTCOMES:

1. Students will have knowledge of different optical fibers.
2. Students will be able to understand the attenuation, dispersion and polarization of the optical communication.
3. Students will have knowledge of various optical sources and their applications.
4. Students will have knowledge of optical detectors and their applications
5. Students will be capable of solving engineering problems related to optical networks.

EEC-451 BIOMEDICAL SIGNAL PROCESSING

UNIT 1: INTRODUCTION TO BIOMEDICAL SIGNALS: Classification, Acquisition and Difficulties during Acquisition Basics of Electrocardiography, Electroencephalography, Electromyography & electro-ethnography, Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in biomedical field.

UNIT 2: ECG: Measurement of Amplitude and Time Intervals, QRS Detection (Different Methods), ST Segment Analysis, Removal of Baseline Wander and Power Line Interferences, Arrhythmia Analysis, Portable Arrhythmia Monitors.

UNIT 3: DATA REDUCTION: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.

UNIT 4: EEG: Neurological Signal Processing, EEG characteristic, linear prediction theory, Sleep EEG, Dynamics of Sleep/Wake transition, study of pattern of brain waves, Epilepsy-Transition, detection and estimation.

UNIT 5: EP ESTIMATION: Signal Averaging, Adaptive Filtering; General Structures of Adaptive filters LMS Adaptive Filter, Adaptive Noise Canceling, Wavelet Detection; Introduction, Detection by Structural features, Matched Filtering, Adaptive Wavelet Detectionand Detection of Overlapping Wavelets.

BOOKS:

1. Tomkin, Biomedical Digital Signal Processing, PHI, 2000.
2. Reddy, Biomedical Signal Processing, McGraw Hill, 2005.
3. Crommwell, Biomedical Instrumentation and Measurement, PHI, 1990.
4. Cohen, Biomedical Signal Processing, I & Licrc Press, 1986.
5. Rangaraj, Biomedical Signal Analysis a Case Study Approach, John Wiley, 2017.
6. Webster, Medical instrumentation Application and Design, John Wiley, 2010.

COURSE OUTCOMES:

1. Students will have knowledge of different biomedical signals.
2. Students will be able to understand the ECG and EEG signals and its analysis.
3. Students will have knowledge of data reduction algorithms and their applications.
4. Students will have knowledge of various filtering algorithms used in biomedical signal processing.
5. Students will be capable of solving engineering problems related to biomedical signals.

EEC-452 DIGITAL IMAGE PROCESSING AND APPLICATIONS

UNIT 1: DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS: Elements of visual perception, Image sampling and quantization, Basic relationship between pixels, Basic geometric transformations, Introduction to Fourier Transform and DFT, Properties of 2D Fourier Transform, FFT, Separable Image Transforms, Walsh, Hadamard, Discrete Cosine Transform, Haar, Slant, Karhunen, Loeve transforms and Wavelet Transform.

UNIT 2: IMAGE ENHANCEMENT TECHNIQUES: Spatial Domain methods; Basic grey level transformation, Histogram equalization, Image subtraction, Image averaging, spatial filtering; smoothing, sharpening filters, Laplacian filters, Frequency domain filters; smoothing, sharpening filters, Homomorphic filtering.

UNIT 3: IMAGE RESTORATION: Model of Image Degradation/restoration process, Noise models, Inverse filtering,least mean square filtering, Constrained least mean square filtering, Blind image restoration.

UNIT 4: IMAGE SEGMENTATION AND REPRESENTATION: Edge detection, threshold, Region Based segmentation, Boundary representation; chair codes, Polygonal approximation, Boundary segments, boundary descriptors; Simple descriptors, Fourier descriptors, Regional descriptors, simple descriptors and texture.

UNIT 5: IMAGE COMPRESSION: Pseudo inverse, Singular value decomposition Lossless compression; Variable length coding, LZW coding, Bit plane coding, predictive coding, DPCM, Lossy Compression; Transform coding, Wavelet coding, Basics of Image compression standards, JPEG, MPEG, Basics of Vector quantization.

BOOKS:

1. Gonzalez, Woods, Digital Image Processing, Pearson,2006.
2. Pratt, Digital Image Processing, John Willey,2010.
3. Sonka, hlavac, Boyle, Broos, Image Processing Analysis and Machine Vision, Thompson Learning, 2007.
4. Jain, Fundamentals of Digital Image Processing, PHI ,1995.
5. Magundar – Digital Image Processing and Applications, Prentice Hall of India.
6. Sriidhar, Digital Image Processing, Oxford University Press, 2011.

COURSE OUTCOMES:

1. Students will be able to understand various transforms used in digital image processing.
2. Students will be able to understand image enhancement techniques and its applications.
3. Students will have knowledge of image restoration and its applications.
4. Students will be able to understand image segmentation, compression, and their practical use.
5. Students will be able to solve engineering problems related to digital image processing.

EEC-453 ADVANCE DIGITAL SIGNAL PROCESSING

UNIT 1: REVIEW OF DFT, FFT, IIR FILTERS AND FIR FILTERS: Introduction to Filter Structures (IIR & FIR), Frequency Sampling Structures of FIR, Lattice Structures, Forward Linear Prediction, Backward Linear Prediction, Reflection Coefficients for Lattice Predictors, Implementation of Lattice Structures for IIR filters, Advantages of Lattice Structures.

UNIT 2: MULTI RATE SIGNAL PROCESSING: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling Rate Conversion by a Rational Factor I/D, Implementation of Sampling Rate Conversion, Multistage Implementation of Sampling Rate Conversion.

UNIT 3: APPLICATIONS OF MULTI RATE SIGNAL PROCESSING: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Sub-band Coding of Speech Signals, Digital Filter Banks, Trans-multiplexers, Quadrature Mirror Filter Bank.

UNIT 4: POWER SPECTRUM ESTIMATION: Estimation of Spectra from Finite Duration Observations of Signals, Nonparametric Methods: Bartlett, Welch & Blackman-Tukey Methods, Comparison of all Nonparametric Methods.

UNIT 5: PARAMETRIC METHODS OF POWER SPECTRUM ESTIMATION: Relationships between the Autocorrelation & the Model Parameters, AR Models; Yule-Walker & Burg Methods, MA & ARMA Models for Power Spectrum Estimation.

BOOKS:

1. Proakis & Manolakis, Digital Signal Processing: Principles, Algorithms & Applications, PHI, 2007.
2. Salivahanan, Vallavaraj, Gnanapriya, Digital Signal Processing, TMH, 2010.
3. Kay, Modern Spectral Estimation: Theory & Application, PHI, 2000.
4. Vaidyanathan, Multi Rate Systems and Filter Banks, Pearson Education, 2002.

COURSE OUTCOMES:

1. Students will be able to understand theory of different filters and algorithms
2. Students will be able to understand theory of multi-rate DSP, solve numerical problems and writealgorithms
3. Students will be able to understand the power spectrum estimation techniques.
4. Students will have knowledge of parametric methods of power spectrum estimation.
5. Students will be able to solve engineering problems related to DSP.

EEC464 NANO MATERIALS

Unit 1: Introduction: Description of various international standards, IEEE radar band , Significance of Absorbers, permittivity, permeability, loss angle, Electromagnetic Interference (EMI), Shielding, Need of Microwave absorbers, Significance of Absorbers, dielectric absorber, hard ferrite, soft ferrite, Microwave Absorbing Materials, Ferrite Materials, magnetic properties and crystal structure, Industrial need of Microwave Absorbers.

Unit 2: Basics of Synthesization: need of weighing, mixing & grinding, drying, pre-sintering, need of pestle mortar, sieving of powder, need of PVA, palletisation, Solid-state Reaction (standard ceramic method), preparation of M-type hexagonal Ferrite.

Unit 3: Role of Characterization: Need of characterization, Types of characterization, Bragg's Law, Lattice constants, miller indices, Bulk density, X-ray powder diffraction (XRD), Scanning Electron Microscopy (SEM), wave number, Fourier Transform Infrared Spectroscopy (FTIR), Vector network analyzer (VNA), Dielectric and magnetic loss, Nicholson-Ross-Weir (NRW).

Unit 4: Different Mechanisms of analysis: Reflection loss, input impedance, characteristic impedance, real and imaginary impedance, Quarter wavelength mechanism, Impedance matching mechanism, Eddy current effect, coercivity, anisotropy field, Hysteresis Properties.

Unit 5: Structural and Morphological Analysis: Dielectric and Magnetic Loss Tangent, Eddy Current Loss, Matching thickness, frequency band and absorption bandwidth for reflection loss, Matching Between Absorber Impedance and Characteristic Impedance, Curie Point Measurement, DC Electrical Resistivity, Ferromagnetic Resonance

BOOKS:

1. Hitchcock, R. Timothy, "Radio-frequency and microwave radiation", American Industrial Hygiene Assn. p. 1. ISBN 1931504555, 2004.
2. Kumar, Sanjay, Shukla, Saurabh, "Concepts and applications of microwave Engineering", PHI Learning Pvt. Ltd. p. 3. ISBN 8120349350, 2014.
3. Jones, Graham A., Layer, David H., Osenkowsky, Thomas G, "National Association of Broadcasters Engineering Handbook", 10th Ed. Taylor & Francis. p. 6. ISBN 1136034102, 2013.
4. Vincent G. Harris "Handbook of Magnetic Materials", Volume 20, 2012.
5. A.J. Moulson and J. M. Herbert, "Electro ceramics: materials, properties, applications", 2nd edition, 2016.

COURSE OUTCOMES:

1. Students will able to understand the role of nanomaterial in communication
2. Students will get familiar with basics of synthesis mechanism of Nano Materials.
3. Students will be able to understand different characterization techniques.
4. Students will be able to do various analyses for understanding material behavior.
5. Students will be having options to choose a particular application based on possible frequency bands.

PEC-471 PROJECT

The object of Project is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. It is expected to provide a good training for the student(s) in R&D work and technical leadership.

The project assignment normally includes:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminaryAnalysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Final development of product/process, testing, results, conclusions and future directions;
5. Preparing a paper for Conference presentation/Publication in Journals, if possible;
6. Preparing a dissertation in the standard format for evaluation by the Department.
7. Final Seminar Presentation before a Departmental Committee.

COURSE OUTCOMES:

1. Students will acquire the ability to make links across different areas of knowledge and to generate, develop and evaluate ideas for sustainable development of society.
2. Students will demonstrate the skills to solve complex engineering problems and to analyze and interpret the data.
3. Students will demonstrate a sound technical knowledge and skill of their selected project and attitude of an engineer with professional ethics and life-long learning in context of modern technology.
4. Students will acquire skills of team management to achieve common goals using modern engineering tools.
5. Students will be able to develop communication skills in written and oral forms.

PEC-472 SUMMER INDUSTRY INTERNSHIP

An internship is on the job training for the professional and is often taken up by students during his undergraduate in their free time to supplement their formal education and expose them to the world of work. Internships offer various occasion to interns during internship programs to expand familiarity in their choose area of work, to find out what they have an importance in an exacting in specific line of business, develop professional network links, build interpersonal skill. An internship may be compensated, non-compensated or some time to some extent paid. The student has to undergo an internship of 4 to 6 weeks during the vacation period.

The objectives of internship are:

1. To have the intern's individual development through challenging occupational coursework
2. To a typical and worthy extra-curricular activity that helps develops credentials for their semester.
3. It is designed and planned through consultation with the institute so as to fit into the undergraduate practice.
4. The internship involves closed direction or mentoring by a specialized expert.
5. It includes work experiences that go together with classroom learning.
6. It builds upon the association of any academy institute or university with has employers.
7. It is mainly victorious when the intern, the institute, and the employer all share conscientiousness in making it a valuable practice.

COURSE OUTCOMES:

1. Students will be able to make links across different areas of engineering and technology.
2. Students will understand the application of technology, resources and modern engineering tools to solve complex practical problems.
3. Students will understand responsibilities of professional engineering practice.
4. Students will be able to understand the working of a team to manage the projects in industrial environment.
5. Students will be able to develop skills of technical communication and report writing.

EVALUATION SCHEME
B. TECH. ECE
FOURTH YEAR (VIII-SEMESTER)
(Effective from session: 2024-25)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-481	Advance Communication Engineering	3	1	0	30	20	50	100	150	3
2.	THS-481	Engineering Economics	3	1	0	30	20	50	100	150	3
3.	EEC-4XX	Program Elective-6	3	1	0	30	20	50	100	150	3
4.	TOE-4XY	Open Elective-2	3	1	0	30	20	50	100	150	3
5.	TOE-4XY	Open Elective-3	3	1	0	30	20	50	100	150	3
PRACTICAL											
4.	PEC-481	Advance Communication Engineering Lab	0	0	4	15	10	25	25	50	2
5.	PEC-482	VLSI Design Lab	0	0	4	15	10	25	25	50	2
6.	GPP-481	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**15**	**5**	**8**	**180**	**170**	**350**	**550**	**900**	**19**

Program Elective-6

EEC-461 Wireless Communications
EEC-462 Electronic Switching Systems
EEC-463 Audio Speech Processing
EEC-464 Public Broadcast Engineering

Open Elective-2:
Open Electives will be offered by other departments.
TOC-4YY
TOC-4YY
TOC-4YY

Open Elective-3:
Open Electives will be offered by other departments.
TOC-4YY
TOC-4YY
TOC-4YY

TEC-481 ADVANCE COMMUNICATION ENGINEERING

UNIT I: INTRODUCTION: Demand of information age, block diagram of optical fiber communication system, technology used in OFC system, direct modulation and indirect modulation. Structure and types of fiber, modes and configuration, mode theory for circular guide modal equation, modes in optical fiber, linearly polarized modes, Single mode fibers, mode field diameter.

UNIT II: TRANSMISSION CHARACTERISTICS: Attenuation: Material absorption losses, scattering losses, bend losses. Dispersion and nonlinear effects: Intra-modal dispersion (material, waveguide), Intermodal dispersion (multimode step index fiber, multimode graded index fiber), modal noise, Overall fiber dispersion (multimode fiber, single mode fiber), Dispersion modified single mode fibers (dispersion shifted fibers, dispersion flattened fibers), self-phase modulation, cross phase modulation and four wave mixing.
POLARIZATION: Modal birefringence, polarization-maintaining fibers

UNIT III: ANALYSIS AND PERFORMANCE OF OPTICAL RECEIVER: Receiver sensitivity, photodiode for optical receiver, optical receiver design, recent receiver circuits, system configuration and power budget.
OPTICAL NETWORKS: WDM concepts and principles, passive components, SONET/SDH networks, performance of WDM.

UNIT IV: OVERVIEW OF SATELLITE SYSTEMS, ORBITS AND LAUNCHING METHODS: Frequency Allocations, Intelsat, U.S. Domsats, Polar Orbiting Satellites, Problems, Kepler‟s Law, Definitions of Terms for Earth-orbiting Satellites, Orbital Elements, Effects of a Non-spherical Earth, Atmospheric Drag, Inclined Orbits, Calendars, Universal, Sidereal Time, Julian Dates, Orbital Plane, Geocentric, Top-centric Horizon, Sub-satellite Point, Predicting Satellite Position, GEO, LEO and MEO satellites.

UNIT V: EARTH SEGMENT & SPACE LINK: Equivalent Isotropic Radiated Power, Transmission Losses, Free-Space Transmission, Feeder Losses, Antenna Misalignment Losses, Fixed Atmospheric and Ionospheric Losses, Link Power Budget Equation, Carrier-to-Noise Ratio, Uplink, Saturation Flux Density, Earth Station HPA, Downlink, Output Back off, Effects of Rain, Uplink rain-fade margin, fade margin, Combined Uplink and Downlink C/N Ratio, Inter modulation Noise.

BOOKS:

1. Senior, Optical Fiber Communications, PHI, 2010.
2. Keiser, Optical Fiber Communications, TMH, 2007.
3. Agarwal, Fiber Optic Communication Systems, John Wiley, 2007.
4. Mynbaev, Gupta, Scheiner, Fiber Optic Communications Pearson, 2010.
5. Pratt, Bostian & Allnutt, Satellite Communications, Willy, 2003
6. Pritchars, Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd, 2013.

COURSE OUTCOMES:

1. Students will be able to understand the structures, types and mode of optical fiber communication.
2. Students will have knowledge of transmission principles of optical signal through optical fibers.
3. Students will be able to solve engineering problems related to optical communication.
4. Students will acquire knowledge of satellite systems, and various orbital mechanisms.
5. Students will be able to understand earth segments and space links.

EEC-461 WIRELESS COMMUNICATION

UNIT 1: SERVICES AND TECHNICAL CHALLENGES: Types of services, requirements for the services, multipath propagation, spectrum limitations, noise and interference limited systems, principles of cellular networks, multiple access schemes.

UNIT 2: WIRELESS PROPAGATION CHANNELS: Propagation mechanisms (qualitative treatment), propagation effects with mobile radio, channel classification, link calculations, narrowband and wideband models, propagation models, path loss components

UNIT 3: WIRELESS TRANSCEIVERS: Structure of a wireless communication link, modulation and demodulation, quadrature/4-differential quadrature phase shift keying, offset-quadrature phase shift keying, phase shift keying, binary frequency shift keying, minimum shift keying, Gaussian minimum shift keying, power spectrum and error performance in fading channels, 16-QAM, 64-QAM.

UNIT 4: SIGNAL PROCESSING IN WIRELESS SYSTEMS: Principle of diversity, macro-diversity, micro-diversity, signal combining techniques, transmit diversity, equalizers; linear and decision feedback equalizers, review of channel coding and speech coding techniques.

UNIT 5: ADVANCED TRANSCEIVER SCHEMES: Spread spectrum systems; cellular code division multiple access systems, principle, power control, effects of multipath propagation on code division multiple access, application of orthogonal frequency division multiplexing in GSM, IS-95, IS-2000 and III & IV generation wireless networks and standards.

BOOKS:

1. Molisch, “Wireless Communications”, John Wiley, 2012.
2. Rappaport, “Wireless communications”, Pearson Education, 2009.
3. Haykin&Moher, “Modern Wireless Communications”, Pearson Education, 2011.
4. Goldsmith, “Wireless Communications”, Cambridge University Press, 2014.

COURSE OUTCOMES:

1. Students will be able to analyze radio propagation mechanisms in wireless communication along with theirapplications.
2. Students will be able to understand concepts of cellular architecture and its application to trafficengineering problems.
3. Students will be able to understand various multiple access techniques used for proper utilization ofbandwidth resource.
4. Students will be able to understand various modulation schemes used in wireless communication and toformulate the problem related to spectrum efficiency.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problemsrelated to wireless communication.

EEC-462 ELECTRONIC SWITCHING SYSTEMS

UNIT 1: INTRODUCTION: Message switching, circuits switching, functions of a switching system, register translator senders, distribution frames, crossbar switch, a general trunking Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing; Pulse Transmission, Line Coding, Binary N-Zero Substitution, Digital Bi-phase, Differential Encoding, Time Division Multiplexing (T1 carrier system CCIT and DS lines) TDM Loops and Rings.

UNIT 2: DIGITAL SWITCHING: Switching functions, space division switching, multiple stage switching, non-blocking switches, blocking Probabilities DCS hierarchy, integrated cross connect equipment, digital switching in environment, zero loss switching.

UNIT 3: TELECOM TRAFFIC ENGINEERING: Network traffic load and parameters, grade of service and blocking probability, Traffic Characterization; Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities; End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems; Exponential service Times, Constant Service Times, Finite Queues.

UNIT 4: NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT: Timing Recovery, Phase Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter, Timing Inaccuracies; Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

UNIT 5: DIGITAL SUBSCRIBER ACCESS: ISDN Basic Rate Access Architecture, ISDN U Interface and ISDN Channel Protocol, HD-Rate Digital Subscriber Loops; Asymmetric Digital Subscriber Line, VDSL.

DIGITAL LOOP CARRIER SYSTEMS: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, Voice band Modems; PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.

DSL TECHNOLOGY: ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM &CMTS and DOCSIS. SONET; Devices, Frame, Frame Transmission, Synchronous Transport Signals, STSI, Virtual Tributaries and Higher rate of service.

BOOKS:

1. Thiagarajan, Tele communication switching system and networks, PHI, 2015.
2. Bellamy, Digital telephony, John Wiley, 2000.
3. Taub & Schilling, Principles of Communication Systems, TMH, 2008.
4. Flood, Telecommunication switching, Traffic and Networks, Pearson Education, 2001.

COURSE OUTCOMES:

1. Students will be able to understand various principles and techniques of switching systems.
2. Students will be able to design and analyze multistage switching systems.
3. Students will be able to understand different aspects of telecom traffic engineering.
4. Students will understand network synchronization, subscriber access and carrier systems.
5. Students will be capable of solving electronic switching system problems.

EEC-463 AUDIO AND SPEECH SIGNAL PROCESSING

UNIT1: MECHANICS OF SPEECH AND AUDIO: Introduction-Review of Signal Processing Theory-Speech production mechanism–Nature of Speech signal–Discrete time modeling of Speech production–Classification of Speech sounds–Phones–Phonemes–Phonetic and Phonemic alphabets–Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous Masking-Perceptual Entropy-Basic measuring philosophy -Subjective versus objective perceptual testing-The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT 2: TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS: Introduction-Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations-Quadrature Mirror and Conjugate Quadrature Filters-Tree-Structured QMF and CQF M-band Banks-Cosine Modulated "Pseudo QMF" M-band Banks-Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT)-Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion-Preecho Control Strategies.

UNIT-3: AUDIO-CODING-AND-TRANSFORM-CODERS: Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4Audio Coding-Optimum Coding in the Frequency Domain- Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder- CNET Coders-Adaptive Spectral Entropy Coding-Differential Perceptual Audio Coder-DFT Noise Substitution-DCT with Vector Quantization -MDCT with Vector Quantization.

UNIT 4: TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING: Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods

HOMOMORPHIC-SPEECH-ANALYSIS: Cepstral analysis of Speech–Formant and Pitch Estimation–Homomorphic Vocoders.

UNIT 5: LINEAR-PREDICTIVE-ANALYSIS-OF-SPEECH: Formulation of Linear Prediction problem in Time Domain–Basic Principle–Auto correlation method–Covariance method–Solution of LPC equations–Cholesky method–Durbin's Recursive algorithm–lattice formation and solutions-Comparison of different methods–Application of LPC parameters–Pitch detection using LPC parameters–Formant analysis–VELP–CELP.

BOOKS:

1. Digital Audio Signal Processing, Second Edition, Udo Zölzer, A. John Wiley& sons Ltd Publications
2. Applications of Digital Signal Processing to Audio And Acoustics Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow.
3. Digital Processing of Speech signals – L. R. Rabiner and R.W. Schaffer - Prentice Hall - 1978

COURSE OBJECTIVES:

1. To study the basic concepts of speech and audio
2. To study the analysis of various M-band filter banks for audio coding
3. To learn various transform coders for audio coding.
4. To study the speech processing methods in time and frequency domain

EEC-464 PUBLIC BROADCAST ENGINEERING

UNIT 1: TRANSMISSION TECHNOLOGIES: Public vs. Private broadcasting systems, Terrestrial transmission; Satellite and Cable broadcasting; Up linking and Down linking, Conditional Access System, DTH, IPTV

UNIT 2: RADIO BROADCASTING SYSTEMS: MW, SW, FM; Internet Radio, Podcasting: Satellite Radio, Community Radio, Analogue and Digital Audio, sampling, optical sound track, Audio formats and Dolby digital sound.

UNIT 3: MICROPHONES AND RECORDERS: Types of microphones, characteristics of microphones, Audio mixers and controls, equalizers; graphic and parametric, noise gate, filters, compressor, expander, limiters, dynamic range and gain controls, types of recorder; open reel, cassette recorders and Digital, multi-track recording.

UNIT 4: FUNDAMENTALS OF TELEVISION: Geometry form and Aspect Ratio, Image Continuity, Number of scanning lines, scanning; interlaced, progressive, Picture resolution, vestigial sideband modulation, VSB transmission, Broadcast standards; NTSC, PAL, SECAM and HDTV, ATSC terrestrial transmission standard, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, Video formats, MPEG-2.

UNIT 5: CAMERA AND PICTURE TUBES: Basic principle of camera tubes, Image orthicon, vidicon, plumbicon, silicon diode array vidicon, solid state image scanners, monochrome picture tubes, beam deflection, screen phosphor, face plate, picture tube characteristics, colour television display tubes, delta, gun-precision, in-line and Trinitron color picture tubes, 3D TV, HDTV, LCD, LED Television.

BOOKS:

1. Gulati, Monochrome Television Practice, Principles, Technology and Servicing, New age InternationalPublishes, 2014.
2. Defleur / Dennis, “Understanding Mass Communications”, Goyalsaab Publishers, 2001.
3. Millerson, TV Production, Focal Press, 2012.
4. Zettl, Herbert, Television Production Handbook, Thomson Wadsworth, 2014.
5. Chattergee, “Broadcasting in India”, Sage Publication, 2005.

COURSE OUTCOMES:

1. Students will be able to understand TV signal transmission and reception technologies.
2. Students will be able to understand the various broadcasting techniques.
3. This course is going to enhance the understanding of students about microphones and recorders.
4. Students will be able to understand the television receiver systems.
5. Students will be able to solve engineering problems related to TV systems.

PEC481 ADVANCE COMMUNICATION ENGINEERING LAB

1. Analysis and measurement of 16-ary QAM and ASK modulation scheme.
2. Analysis and measurement of FSK and QPSK, modulation scheme
3. Analysis and measurement of DPSK and BPSK modulation scheme
4. Analysis and measurement of QPSK and DBPSK modulation scheme
5. Analysis of wide band and narrow band modulation/demodulation
6. Setting up Fiber Optic Analog Link and Digital Link
7. Analysis of intensity modulation technique using analog input signal and digital input signal
8. Analysis of (i) Propagation loss (ii) Bending loss in optical fiber
9. Measurement of optical power using optical power meter at 660 nm & 950 nm
10. Measurement of propagation loss in optical fiber using power meter
11. Measurement of numerical aperture of an optical fiber
12. Analysis of direct sequence spread spectrum (DSSS) based modulation and demodulation technique.
13. Analysis of CDMA-DSSS technique in a two users/two channels environment.

COURSE OUTCOMES:

1. Students will be able to implement various modulation techniques using modern tool such as MATLABand Software Defined Radio.
2. Students will be able to design and implement the experiments related to RF communication link andoptical communication
3. Students will be able to design the experiments, analyze and interpret the data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical communication engineering problems.

PEC-482 VLSI DESIGN LAB

1. Draw resistive load inverter circuit schematic, also, perform transient and DC analysis of the inverter circuit.
2. Draw CMOS inverter circuit schematic; also, perform transient and DC analysis of the inverter circuit.
3. Create symbol and layout of CMOS inverter. Run DRC to check whether layout is following design rules and LVS to determine the parasitic resistances and capacitances used in design layout.
4. Design a common source amplifier, also draw schematic and perform transient and DC analysis.
5. Design a common drain amplifier (Source follower amplifier), also perform transient and DC analysis.
6. Design a differential amplifier using MOSFETs; also, perform transient and DC analysis.
7. Design a current mirror circuit; also, perform transient and DC analysis.
8. Design a NAND gate circuit; also, perform transient and DC analysis.
9. Create symbol and layout of NAND, run DRC to check whether layout is following design rules and LVS to determine the parasitic resistances and capacitances used in design layout.
10. Design a 2x1 MUX circuit using the NAND gate.

COURSE OUTCOMES:

1. Students will be able to design and implement digital systems TCAD software like Xilinx.
2. Students will be able to design and realize the MOSEFT technology using Cadence modern tools.
3. Students will be able to design the experiments, analyze and interpretation of data.
4. Students will acquire skills of teamwork, technical communication and effective report writing.
5. Students will be capable of solving practical electronics circuits.