EVALUATION SCHEME
&
SYLLABI

FOR

B. TECH.

IN

ELECTRONICS & COMMUNICATION ENGINEERING

(Effective from the session: 2018-2019)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

G B PANT INSTITUTE OF ENGINEERING & TECHNOLOGY

PAURI GARHWAL (UTTARAKHAND) INDIA

VISION OF THE DEPARTMENT

To become a center of excellence offering high quality education and research in the field of Electronics and Communication Engineering.

MISSION OF THE DEPARTMENT

M 1. To provide best facilities, infrastructure and conducive environment to the students, researchers and faculty members for high quality education and research in the field of Electronics and Communication Engineering.

M 2. To adopt the best pedagogical methods in order to maximize knowledge transfer.

M 3. To have adequate mechanisms to enhance understanding of implementation of theoretical concepts in practical scenarios.

M 4. To enable students to develop skills for solving complex technological problems for societal needs.

M 5. To inculcate creative thinking, ethics, learning attitude, communication skills, leadership and teamwork qualities among the students.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Sl. N.	Program Educational Objectives (PEO)
PEO 1	To impart the graduates a sound technical knowledge and skills in mathematics, engineering sciences and core subjects of electronics & communication engineering.
PEO 2	To develop the educational foundation of graduates that prepares them for professional career/higher studies in the field of electronics & communication engineering.
PEO 3	To aspire the graduates to be innovative and passionate about the rapid changes in tools and technology in the field of electronics & communication engineering.
PEO 4	To inculcate leadership qualities and communication skills in the graduates to work efficiently with diverse teams, promote and practice ethical and societal values.
PEO 5	To develop life-long learning ability in the graduates to work in collaborative and multi-disciplinary environment.

PROGRAM OUTCOMES (POs)

Sl. N.	Program Outcome (PO)	Graduate Attribute
PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and electronics and communication engineering to the solution of complex engineering problems.	Engineering knowledge
PO 2	Identify, formulate, research literature, and analyse complex electronics and communication engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	Problem analysis
PO 3	Design solutions for complex electronics and communication engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	Design/ Development of Solutions
PO 4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	Conduct Investigations of Complex Problems
PO 5	Create, select, and apply appropriate techniques, resources, and modern electronics and communication engineering tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	Modern Tool Usage
PO 6	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional electronics and communication engineering practice.	The Engineer and Society
PO 7	Understand the impact of the professional electronics and communication	Environment and

	engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	Sustainability
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the electronics and communication engineering practice.	Ethics
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	Individual and Team Work
PO 10	Communicate effectively on complex electronics and communication engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	Communication
PO 11	Demonstrate knowledge and understanding of the electronics and communication engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	Project Management and Finance
PO 12	Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	Life-long Learning

PROGRAM SPECIFIC OUTCOMES (PSOs)

Sl. N.	Program Specific Outcome (PSO)
PSO 1	Ability to design and analyze different electronic circuits and systems using modern CAD tools.
PSO 2	Demonstrate aptitude in the design of RF antenna and communication systems using modern software and hardware tools.

EVALUATION SCHEME
B. TECH. ECE
I-YEAR (I-SEMESTER)
(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TBS-111	Chemistry	3	1	0	40	40	80	120	200	4
2.	TBS-112	Mathematics-I	3	1	0	40	40	80	120	200	4
3.	TES-111	Programming for Problem Solving	3	1	0	40	40	80	120	200	4
4.	TMC-111	Environmental Science*	2	0	0	20	20	40	60	100	0
PRACTICAL											
5.	PBS-111	Chemistry Lab	0	0	2	10	15	25	25	50	1
6.	PES-111	Programming for Problem Solving Lab	0	0	2	10	15	25	25	50	1
7.	PES-112	Workshop/Manufacturing Practices	1	0	4	30	45	75	75	150	3
8.	GPP-111	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**3**	**8**	**190**	**265**	**455**	**545**	**1000**	**17**

EVALUATION SCHEME
B. TECH. ECE
I-YEAR (II-SEMESTER)
(Effective from session: 2018-19)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TBS-124	Physics	3	1	0	40	40	80	120	200	4
2.	TBS-125	Mathematics-II	3	1	0	40	40	80	120	200	4
3.	TES-123	Basic Electrical Engineering	3	1	0	40	40	80	120	200	4
4.	THS-121	English	2	0	2	30	30	60	90	150	3
PRACTICAL											
5.	PBS-124	Physics Lab	0	0	2	10	15	25	25	50	1
6.	PES-123	Basic Electrical Engineering Lab	0	0	2	10	15	25	25	50	1
7.	PES-124	Engineering Graphics & Design	1	0	4	30	45	75	75	150	3
8.	GPP-121	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**3**	**10**	**200**	**275**	**475**	**575**	**1050**	**20**

EVALUATION SCHEME
B. TECH. ECE
II-YEAR (III-SEMESTER)
(Effective from session: 2020-21)

S. No.	COURSE CODE	SUBJECT	PERIODS			EVALUATION SCHEME					
						SESSIONAL EXAM			ESE	Subject Total	Credits
			L	T	P	CT	TA	Total			
THEORY											
1.	TEC-231	Electronic Devices	3	1	0	40	40	80	120	200	4
2.	TEC-232	Digital System Design	3	1	0	40	40	80	120	200	4
3.	TEC-233	Signals and Systems	3	1	0	40	40	80	120	200	4
4.	TEC-234	Network Theory	3	1	0	40	40	80	120	200	4
5.	TES-231	Data Structure	2	1	0	30	30	60	90	150	3
PRACTICAL											
6.	PEC-231	Electronic Devices Lab	0	0	2	10	15	25	25	50	1
7.	PEC-232	Digital System Design Lab	0	0	2	10	15	25	25	50	1
8.	GPP-231	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**5**	**4**	**210**	**270**	**480**	**620**	**1100**	**21**

TEC-231 ELECTRONIC DEVICES

UNIT-1: SEMICONDUCTORS: Energy band theory of crystals, covalent bond, forbidden energy gap, classification of materials based on energy bands, group-IV semiconductors, electron-hole concepts, intrinsic and extrinsic semiconductors, donors and acceptors impurities, mass action low, Fermi level, diffusion current, drift current, mobility, resistivity, conductivity, sheet resistance, generation and recombination of carriers, Poisson and continuity equations.

UNIT-2: PN JUNCTION DIODE: PN junction, depletion layer, V-I characteristics, diode resistance, diode capacitance, Diode applications; rectifiers (half wave and full wave), calculation of ripple factor, efficiency, and transformer utilization factor, clipping circuits, clamping circuits and voltage multipliers.

UNIT-3: BIPOLAR JUNCTION TRANSISTORS: Basic construction, transistor action, CB, CE, and CC configurations, input and output characteristics, transistor parameters, biasing circuits, bias stabilization, graphical analysis of CE amplifier, concept of voltage and current gain, h-parameter model at low frequency, calculation of current and voltage gain, input and output resistances of single stage CE amplifier.

UNIT-4: FIELD EFFECT TRANSISTORS: Junction field effect transistor; construction and action, concept of pinch-off, maximum drain saturation current, output and transfer characteristics, biasing circuits. Metal oxide field effect transistor; depletion and enhancement type, construction, operation and characteristics, CMOS inverter, biasing circuits of MOSFETs, small signal model of FETs at low frequency, calculation of voltage gain, input and output resistances of single stage FET amplifiers in CS configuration.

UNIT-5: SPECIAL DIODES: Avalanche and zener breakdown mechanisms, zener diode, zener characteristics, zener diode as shunt voltage regulator, metal-semiconductor junctions, Schottky diode, light emitting diode, photodiode, solar cell, tunnel diode and varactor diode, applications of these diodes.

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 design and analyze the electronic circuits.
4. Students will be able to understand and utilize the mathematical models of semiconductor devices.
5. Students will be able to solve engineering problems related to electronics devices and 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 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: TRANSFORMS: 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, response of LTI systems to complex exponentials, 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: 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.

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: STATIONARY RANDOM PROCESSES: Probability density and probability distribution functions of a random variable, expected value of random variable, Markov and Chebyshev inequalities, computer methods for generating random variables, multidimensional random variables, Chi-square tests of hypotheses concerning distribution, analysis of various probability distribution functions and their applications.

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**.**

TEC-234 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 representations.

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.

TES-231 DATA STRUCTURE

UNIT 1: INTRODUCTION TO DATA STRUCTURE: Types of data Structure, arrays, strings, recursion, ADT (abstract data type), concept of files, and operations with files, types of files.
DERIVED TYPES: Structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self-referential structures, unions, type def, bit fields, and C program examples.

UNIT 2: ARRAYS: Concepts, declaration, definition, accessing elements, storing elements, arrays and functions, two-dimensional and multi-dimensional arrays, applications of arrays, pointers- concepts, initialization of pointer variables, pointers and function arguments, address arithmetic, character pointers and functions, pointers to pointers, pointers and multidimensional arrays, dynamic memory managements functions, command line arguments, c program examples.

UNIT 3: DYNAMIC ARRAY: Singly linked lists, doubly linked lists, circular list, representing stacks and queues in C using arrays and linked lists, infix to post fix conversion, postfix expression evaluation.
Searching: Linear and binary search methods, sorting - bubble sort, selection sort, insertion sort, quick sort, merge sort.

UNIT 4: STACK: Stack as an ADT, stack operation, array representation of stack, link representation of stack, application of stack – recursion, polish notation.
Queues: Queue as an ADT, queue operation, array representation of queue, linked representation of queue, circular Queue, priority queue, & de- queue, application of queues – Johnsons algorithm.

UNIT 5: TREES: Basic trees concept, binary tree representation, binary tree operation, binary tree traversal, binary search tree implementation, thread binary tree, The Huffman algorithm, expression tree, introduction to multi-way search tree and its creation (AVL, B-tree, B+ tree).
Graphs: Basic concepts, graph representation, graph traversal (DFS & BFS).

BOOKS:

1. Computer science, A structured programming approach using C, B.A. Forouzan and R.F. Gilberg, Third edition, Thomson.
2. Data Structures Using C - A.S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.
3. C & Data structures - P. Padmanabham, B.S. Publications.
4. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
5. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press

COURSE OUTCOMES:

1. Student will be able to understand pre-defined data structures.
2. Student will be able to choose appropriate data structure as applied to specified problem.
3. Students will be able to apply concepts learned in various domains like DBMS, compiler construction etc.
4. Students will be able to use linear and non-linear data structures like stacks, queues, linked list etc.
5. Student will be able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.

PEC-231 ELECTRONIC DEVICES 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 BJT CE amplifier.
10. To determine and plot the frequency response of MOSFET CS amplifier.

COURSE OUTCOMES:

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

PEC-232 DIGITAL SYSTEM DESIGN 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.
12. Design, simulation and analysis of two input NAND and NOR gate.
13. Design, simulation and analysis of NMOS and CMOS inverter.
14. Design, simulation and analysis of full adder circuit.
15. Design, simulation and analysis of 4-bit full-adder circuit.
16. Design, simulation and analysis of Up-down counter circuit.

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 FPGA boards.
3. Students will be able to design the experiments, analyze and interpretation of data to achieve valid conclusions.
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.

EVALUATION SCHEME
B. TECH. ECE
II-YEAR (IV-SEMESTER)
(Effective from session: 2019-20)

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	40	40	80	120	200	4
2.	TEC-242	Analog Circuits	3	1	0	40	40	80	120	200	4
3.	TEC-243	Microprocessors & Microcontrollers	3	1	0	40	40	80	120	200	4
4.	TEC-244	Electromagnetic Field Theory	3	1	0	40	40	80	120	200	4
5.	TES-241	Object Oriented Programming	2	1	0	30	30	60	90	150	3
PRACTICAL											
6.	PEC-241	Communication Systems Lab	0	0	2	10	15	25	25	50	1
7.	PEC-242	Analog Circuits Lab	0	0	2	10	15	25	25	50	1
8.	PEC-243	Microprocessors & Microcontrollers Lab	0	0	2	10	15	25	25	50	1
9.	GPP-241	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**14**	**5**	**6**	**220**	**285**	**505**	**645**	**1150**	**22**

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 ANALOG CIRCUITS

UNIT 1: BJT MODELS AND APPLICATIONS: Ebers-Moll model, π −model and T-model, Early effect, analysis of low frequency 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, emitter follower at high frequencies, high frequency analysis of common-source, common-gate and common-drain amplifiers.

UNIT 5: POWER AMPLIFIERS: Classification; class-A, class-B, class-AB and class C amplifiers, push-pull amplifier and complementary-symmetry amplifier.
OPERATIONAL AMPLIFIER: Differential amplifier; dc and ac analysis, current mirror circuit to bias differential amplifier, Input offset voltage, output offset voltage, input bias current, input offset current, common mode rejection ratio (CMRR), ideal operation amplifier characteristics, virtual short, applications of operation amplifier; inverting and non-inverting amplifiers, voltage follower, summing amplifier, integrator, differentiator.

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 analyze 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 analyze high frequency amplifier circuits.
4. Students will be able to design and analyze power amplifier and operational amplifier circuits.
5. This course will enhance the capability of students for solving engineering problems related to electronics circuits.

TEC-243 MICROPROCESSORS & MICROCONTROLLERS

UNIT 1: EVOLUTION OF MICROPROCESSORS: Microprocessors evolution, Architecture: Princeton and Harvard, RISC, CISC, basic microcomputer architecture and components. 8085 microprocessor pin diagram, internal architecture, interrupts, instruction set and programming.

UNIT 2: 8086 MICROPROCESSOR: 8086 microprocessor pin diagram internal architecture and register organization, 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, 8086 Interrupts.

UNIT 3: INTERFACING: Direct Memory Access and DMA controlled I/O, Interfacing of microprocessors with 8255, 8254, 8259, 8251, 8279, Weighted register R-2R ladder D/A converter, binary ladder D/A converter, parallel A/D converter, Counter type A/D converter, successive approximation A/D converter, A/D accuracy and resolution.

UNIT 4: 8051 MICROCONTROLLER: Evolution of microcontrollers, 8051 assembly programming, assembling and running an 8051 program, I/O port programming: addressing modes and accessing memory using various addressing modes, arithmetic and logic instructions and programs, single bit instructions and timer/counter programming of 8051.

UNIT 5: INTERFACING TO MICROCONTROLLER: 8051 connections to RS-232, 8051 serial communication programming, Interrupts, Multiple sources of interrupts, Non-maskable sources of interrupts, Interrupt structure in 8051, Timers, Serial I/O interface, Parallel I/O ports interface, LED array, keyboard, Printer, Flash memory interfacing, Concepts of virtual memory, Cache memory.

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 design and develop algorithms and assembly language programs 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 systems.

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, 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,
MAXWELL'S EQUATIONS (TIME VARYING FIELDS): Faraday's law and emf, concept of displacement current density, Maxwell's equations in integral and differential forms.

UNIT 3: ELECTROMAGNETIC WAVES: Wave propagation in free space, conducting and perfect dielectric media, Skin effect, Poynting vector and Poynting theorem, wave polarization.
PLANE WAVES REFLECTION AND DISPERSION: Reflection of wave at normal incidence, wave propagation in general direction, reflection at oblique incident angles, Brewster angle.

UNIT 4: 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.

UNIT 5: WAVEGUIDES: Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide, introduction to s-parameters.

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 and 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.

TES-241 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, control structures 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 polymorphism in 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 and demodulator 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 of slope 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 analog communication.
2. Students will be able to implement various digital modulation techniques using hardware circuits.
3. Students will be able to design the experiments, analyse and interpret the measured data.
4. Students will acquire skills of team work, technical communication and report writing.
5. Students will be capable of solving practical communication engineering problems.

PEC-242 ANALOG CIRCUITS LAB

1. To determine voltage-gain output impedance and output power of a Darlington pair compound amplifier.
2. To determine "h" parameters of a PNP transistor in common emitter mode.
3. To determine the frequency response of an IFT amplifier.
4. To determine voltage-gain and plot the frequency response of a FET amplifier in common source mode.
5. To study the effect of negative feedback on voltage gain & bandwidth in a two-stage amplifier.
6. To determine frequency of a Hartley Oscillator circuit with change in the capacitor of the tank circuit.
7. To determine frequency and wave shape of a Colpitt's oscillator circuit.
8. To determine frequency and wave shape of a crystal oscillator circuit.
9. To determine frequency and wave shape of a phase shift oscillator circuit.
10. To determine voltage-gain and plot the frequency response of a single stage, two stage RC coupled and direct coupled amplifiers.
11. To design and verify the op-amp working as:
    i. Unity Gain amplifier.
    ii. Inverting amplifier.
    iii. Non-Inverting amplifier.
12. Design & test Integrator and Differentiator using operational amplifier.

COURSE OUTCOMES:

1. Students will be able to design and test the performance characteristics of different amplifier circuits.
2. Students will be able to design and test the performance of different oscillator circuits.
3. Students will be able to design the experiments, analysis and interpretation of data.
4. Students will acquire skills of team work, technical communication and effective report writing.
5. Students will be capable of solving practical electronic circuit problems.

PEC-243 MICROPROCESSORS & MICROCONTROLLERS LAB

1. Write and implement a program for adding two 8- bit numbers using microprocessor.
2. Write and implement a program for subtracting two 8- bit numbers using microprocessor.
3. Write and implement a program for finding the smallest number from a given set of numbers using microprocessor.
4. Write and implement a program for finding the largest number from a given set of numbers using microprocessor.
5. Write and implement a program for arranging the numbers in ascending order of a set of the numbers.
6. Write and implement a program for converting Binary code into Gray code using 8086 microprocessor.
7. Write and implement a program for conversion of data string to its 2's complement using 8086 microprocessor.
8. Write and implement a program for multiplication of the given numbers.
9. Write and implement a program for division of the given numbers.
10. Design and test microprocessor based traffic light control system using 8086 microprocessor.
11. Write and implement a program for interfacing of keyboard controller with microprocessor.

COURSE OUTCOMES:

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

EVALUATION SCHEME
B. TECH. ECE
III-YEAR (V-SEMESTER)
(Effective from session: 2020-21)

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	40	40	80	120	200	4
2.	TEC-352	Integrated Circuits	3	1	0	40	40	80	120	200	4
3.	THS-351	Principles of Management	2	1	0	30	30	60	90	150	3
4.	EEC-31X	Program Elective -1	2	1	0	30	30	60	90	150	3
5.	EEC-32X	Program Elective -2	2	1	0	30	30	60	90	150	3
PRACTICAL											
6.	PEC-351	RF Engineering Lab	0	0	2	10	15	25	25	50	1
7.	PEC-352	Electronic Measurement Lab	1	0	2	20	30	50	50	100	2
8.	PEC-353	Circuit Simulation Lab	0	0	2	10	15	25	25	50	1
9.	GPP-351	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**13**	**5**	**6**	**210**	**280**	**490**	**610**	**1100**	**21**

Program Elective-1
EEC-311 Electronic Switching Systems
EEC-312 Python Programming
EEC-313 Power Electronics
EEC-314 Electronic Measurement

Program Elective-2
EEC-321 Embedded Systems
EEC-322 Artificial Neural Networks & Fuzzy Logic
EEC-323 Microwave Engineering
EEC-324 Microelectronics

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 atmosphere on 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: BASIC APPLICATIONS OF OP-AMP: 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 2: FREQUENCY RESPONSE OF OP-AMP AND ACTIVE FILTERS: Frequency response, slew rate, causes of slew rate and its effect on applications, advantages of active filters over passive filters, first order and second low pass Butterworth filter, first order and second high pass Butterworth filter, higher order filters, band pass filter, band reject filters, all pass filter.

UNIT 3: COMPARATORS AND WAVEFORM GENERATORS: Op-amp as comparator, zero crossing detectors, Schmitt trigger, Square wave generator, Triangular wave generator, Saw tooth wave generator, pin & block diagram of 555 IC, mono-stable, bi-stable and astable multi-vibrators using 555 IC.

UNIT 4: IC PROCESSES: Wafer preparation and specifications, fabrication steps, oxidation growth, calculation of SiO_2 thickness, dry and wet, defects induced due to oxidation, diffusion in solids and its laws, diffusion profile and parameters, ion implantation, chemical vapour deposition, sputtering, MBE system.

UNIT 5: LITHOGRAPHY AND PROCESS INTEGRATION: Photolithography and pattern transfer, photo resist, ion beam and X-ray lithography, wet and dry etching, metallization, PMOS**,** NMOS and CMOS IC technology, bipolar IC fabrication.

BOOKS:

1. Choudhury 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. Ghandhi, 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 Modelling, 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 wave forms 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 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-312 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 313 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 full wave 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, Khannapublication, 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 problems related to power electronics.

EEC-314 ELECTRONIC MEASUREMENT

UNIT 1: THEORY OF ERRORS AND BRIDGES: Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, Modelling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors, Method of measuring low, medium and high resistance, sensitivity of Wheat stones bridge, Carey Foster’s bridge, Kelvin’s double bridge for measuring low resistance.
A.C. BRIDGES: Measurement of inductance, Maxwell’s bridge, Hay’s bridge, Anderson’s bridge, Owen’s bridge, Heaviside Bridge and its modifications, Measurement of capacitance, equivalent circuit of an imperfect capacitor, Desauty bridge, Wien’s bridge, Schering Bridge.

UNIT 2: ELECTRONIC INSTRUMENTS FOR MEASURING BASIC PARAMETERS: Electronic Voltmeter, Electronic Multi meters, Digital Voltmeter, Component Measuring Instruments, Q meter, Vector Impedance meter, RF Power & Voltage Measurements, Measurement of frequency.

UNIT 3: OSCILLOSCOPES: CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multi beam, multi trace, storage & sampling Oscilloscopes, Curve tracers.

UNIT 4: SIGNAL GENERATION: Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators, Signal Analysis, Measurement Technique, Wave Analyzers, Frequency- selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer.

UNIT 5: TRANSDUCERS: Classification, Selection Criteria, Characteristics, Construction, Working principles, Application of following Transducers; RTD, Thermocouples, Thermistors, LVDT, RVDT, Strain Gauges, Bourdon Tubes, Bellows, Diaphragms, Seismic Accelerometers, Tachogenerators, Load Cell and Piezoelectric Transducers. Ultrasonic Flow Meters, Instrument transformers CT and PT Ratio and phase angle errors, design considerations, testing of CT’s, Silsbee’s method and Variable mutual inductance methods.

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 analysis techniques.
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.

EEC-321 EMBEDDED SYSTEMS

UNIT 1: INTRODUCTION TO EMBEDDED SYSTEMS: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software in a system, Embedded System-on-chip (SOC), Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and Design Examples, Classification of Embedded Systems.

UNIT 2: DEVICE AND COMMUNICATION BUS FOR DEVICES NETWORK: IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol Parallel communication Network using ISA, PCI, PCI-X and advanced buses.

UNIT 3: DEVICE DRIVERS AND INTERRUPT SERVICES MECHANISM: Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Device Driver.

UNIT 4: INTER-PROCESS COMMUNICATION AND SYNCHRONIZATION OF PROCESSES: CPU Scheduling, Threads and Tasks, Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, 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 operating system service, Process management, process scheduling, co-operating processes, Timer function, Event function, Memory management, Device, File and I/O subsystem management, Real Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt routine in RTOS environment and handling of interrupt Sources calls, Interrupt Latency and Response of the Tasks as Performance Metrics.

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.

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-322 ARTIFICIAL NEURAL NETWORKS & FUZZY LOGIC

UNIT-1: Artificial Intelligence, Perceptron layer network, Difference between Artificial Neural Networks (ANN) and biological neural network(BNN), Applications of Neural network. Network Architecture, Taxonomy of neural networks: feed forward, feedback and recurrent networks, Advantages & disadvantages.

UNIT-2: Neural network learning, supervised, unsupervised, reinforced learning, Learning Laws : Hebb's rule, Delta rule, Widrow - Hoff (The Least-Mean-Square) learning rule, correlation learning rule, instar and outstar learning rules, Competitive learning, Credit Assignment Problem, Error Correction learning, Memory based learning, , Boltzmann learning.

UNIT-3: The Perceptron neural network (PNN), Classification of linearly separable patterns, Multi-Layer Perceptron, Supervised Learning, Back-Propagation Learning law. Feed forward networks, Recurrent Networks. Winner takes-all Networks, Competitive Learning, Kohonen's Self organizing Maps, and Introduction to Adaptive Resonance Theory

UNIT-4: Introduction to fuzzy set theory: Probabilistic reasoning, Fuzzy sets, mathematics of fuzzy set theory, operations on fuzzy sets, and comparison of fuzzy and crisp set theory.

UNIT-5: Fuzzy mapping: one to one mapping, max-min principle, extension principle, implication rules – mamdani implications. Membership functions: Universe of discourse, mapping inside fuzzy domain, fuzzy membership mapping methods, and application to real world problems, Case study

REFERENCE 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 problems related to neural networks.

EEC-323 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.

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-324 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, Debylength, 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, tunnel diodes and avalanche diodes.

UNIT 3: BIPOLAR JUNCTION TRANSISTORS: Transistor action and amplification, doping profiles, analysis of ideal diffusion BJT, static I-V characteristics, charge control equations, 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, 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, Junctionless Field-Effect Transistors and FinFETs 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.

PEC-351 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.
12. 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 team work, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to electromagnetic waves.

PEC-352 ELECTRONIC 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 weight using load cell module.
12. To determine and plot the characteristics of a light sensor.
13. Spectral analysis of signals- white noise, colour 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 team work, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems in the field of measurement and instrumentation.

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 team work, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems in the field of measurement and instrumentation.

EVALUATION SCHEME
B. TECH. ECE
III-YEAR (VI-SEMESTER)
(Effective from session: 2020-21)

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	40	40	80	120	200	4
2.	TEC-362	Digital Signal Processing	3	1	0	40	40	80	120	200	4
3.	TEC-363	Probability Theory and Stochastic Processes	3	1	0	40	40	80	120	200	4
4.	EEC-33X	Program Elective -3	2	1	0	30	30	60	90	150	3
5.	EEC-34X	Program Elective -4	2	1	0	30	30	60	90	150	3
PRACTICAL											
6.	PEC-361	Control Systems Lab	0	0	2	10	15	25	25	50	1
7.	PEC-362	Digital Signal Processing Lab	0	0	2	10	15	25	25	50	1
8.	PEC-363	Mini Project	0	0	4	20	30	50	50	100	2
9.	GPP-361	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**13**	**5**	**8**	**220**	**290**	**510**	**640**	**1150**	**22**

Program Elective-3
EEC-331 Multimedia Communication
EEC-332 Information Theory and Coding
EEC-333 Radar and Navigation
EEC-334 Wireless Communication
Program Elective-4
EEC-341 CMOS Design
EEC-342 Mixed Signal Design
EEC-343 Micro Electro-Mechanical Systems
EEC-344 Nano-electronics

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, 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 control system 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 concepts of 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, 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”, Prentice Hall (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 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. A. 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. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
6. 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-331 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: CODING: 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-4 Audio/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-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 5: 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, goniometer and 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 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 their applications.
2. Students will be able to understand concepts of cellular architecture and its application to traffic engineering problems.
3. Students will be able to understand various multiple access techniques used for proper utilization of bandwidth resource.
4. Students will be able to understand various modulation schemes used in wireless communication and to formulate the problem related to spectrum efficiency.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problems related to wireless communication.

EEC-341 CMOS DESIGN

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

UNIT 2: MOS INVERTER: Resistive Load inverter, Inverter with n-type MOSFET Load, CMOS Inverter; Basic Circuit and DC Operation, DC Characteristics, Noise Margins and their evaluation, Layout considerations, Inverter Switching characteristics, Switching Intervals, High to Low time, Low to High time, calculation of delay time, inverter design with delay constraints, RC Delay Modelling, Elmore Delay, Switching Power dissipation of CMOS inverter, BiCMOS.

UNIT 3 SWITCHING PROPERTIES OF MOSFETS: nMOSFET/pMOSFET Pass Transistors, Transmission Gate Characteristics, MOSFET Switch Logic, TG-based Switch Logic, D-type Flip Flop, Static CMOS Logic Elements; Complex Logic Functions, CMOS NAND Gate, CMOS NOR Gate, Complex Logic Gates, Exclusive OR and Equivalence Gates, Adder Circuits, Pseudo nMOS Logic Gates, SR and D type Latch.

UNIT 4: **DYNAMIC LOGIC CIRCUIT CONCEPTS:** Single and double phase dynamic nMOS dynamic circuits, Two phase clock generation, Two phase CMOS dynamic circuits, Voltage Bootstrapping, advantage and limitations of dynamic circuits.

UNIT 5: MEMORY AND ARRAY STRUCTURE: ROM, RAM, peripheral circuitry; address decoder, Sense amplifier, Driver/ Buffer, Voltage reference, memory reliability and yield, SRAM and DRAM design, flash memory.

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 of various MOS inverter circuits.
2. Students will be able to implement efficient techniques at circuit level for improving power and speed of combinational and sequential circuits.
3. Students will be able understand the pass transistors logic, transmission gates logic, static and dynamic CMOS 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 signalling and data transmission; Current-mode signalling 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,” Mc Graw Hill, 1998.
4. Marc F Madou, “Fundamentals of Micro Fabrication”, CRC Press, 2nd Edition, 2002.
5. Francis E.H. Tay and Choong .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 1: SHRINK-DOWN APPROACHES: Introduction to Nanoscale Systems, Length energy and time scales, Top down approach to Nanolithography, CMOS Scaling, Limits to Scaling, System Integration Limits - Interconnect issues, etc.

UNIT 2: 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 3: 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 4: 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 5: 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).
9. Mitin, V.V. and Kochelap, V.A., Introduction to Nanoelectronics: Science, Nanotechnology, Engineering and Application, Cambridge Press (2008).
10. Draoman, M. and Dragoman, D., Nanoelectronics: Principles and Devices, Artech House (2008).

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 a servomotor.
6. To determine the performance parameters of a dc servomotor.
7. To analyze the behaviour 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 operating conditions.
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 team work, 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 to obtain 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 function H(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 the effect 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 as MATLAB 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 valid conclusions.
4. Students will acquire skills of team work, technical communication and effective report writing.
5. Students will be capable of solving practical engineering problems related to digital signal processing.

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 is 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 is 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 is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work 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 submitted 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
IV-YEAR (VII-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.	EEC-45X	Program Elective -5	2	1	0	30	30	60	90	150	3
2.	TOE-XY	Open Elective -1	2	1	0	30	30	60	90	150	3
3.	THS-471	Engineering Economics	2	1	0	30	30	60	90	150	3
PRACTICAL											
4.	PEC-471	Project	0	0	16	100	100	200	200	400	8
5.	PEC-472	Summer Industry Internship	0	0	4	50	50	100	0	100	2
6.	GPP-471	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**6**	**3**	**20**	**240**	**290**	**530**	**470**	**1000**	**19**

Program Elective-5
EEC-451 Biomedical Signal Processing
EEC-452 Digital Image Processing & Applications
EEC-453 Advance Digital Signal Processing
EEC-454 Audio and Speech Processing
Open Elective -1
TOE-10 Chemical Applications
TOE-20 Nanotechnology and Nano-science
TOE-30 Metro System and Engineering
TOE-40 Database Management System
TOE-51 Non-Conventional Energy Systems
TOE-74 Non-Conventional Energy Resources

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 Cancelling, Wavelet Detection; Introduction, Detection by Structural features, Matched Filtering, Adaptive Wavelet Detection and 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, SVD Lossless compression; Variable length coding, LZ7, 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 and 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 multirate DSP, solve numerical problems and write algorithms
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.

EEC-454 AUDIO AND SPEECH PROCESSING

UNIT 1: INTRODUCTION: Review of digital signal and systems, Transform representation of signal and systems, Sampling Theorem, STFT, Goertzel algorithm, Chirp algorithm, Digital filters and filter banks.
DIGITAL MODELS FOR SPEECH SIGNALS: Speech production and acoustic tube modeling, acoustic phonetics, anatomy and physiology of the vocal tract and ear, hearing and perception.

UNIT 2: DIGITAL REPRESENTATION: Linear quantization, commanding, optimum quantization, PCM, effects of channel errors, vector quantization (VQ), Adaptive quantization, differential PCM, APCM, ADPCM, delta modulation, adaptive delta modulation, and CVSD.

UNIT 3: DIGITAL VOCODERS: Linear predictive coding (LPC), hybrid coders: voice excited vocoders, voice excited linear predictor, and residual excited linear predictor (RELP).

UNIT 4: SPEECH RECOGNITION: Isolated word recognition, continuous speech recognition, speaker (in) dependent, measures and distances (articulation index, log spectral distortion, Itakura-Saito, cepstral distance), Dynamic time warping (DTW), HMM, HMM networks, Viterbi algorithm, discrete and continuous observation density HMMs.

UNIT 5: SPEAKER RECOGNITION: Speaker verification/authentication *vs. s*peaker identification, closed *vs.* open set, feature vectors (e.g., line spectrum pair and cestrum), pattern matching (e.g., DTW, VQ, HMM), hypothesis testing, and errors. Emerging speech coding standards (e.g., 2400 bps MELP), Internet phone, voice and multimedia applications.

BOOKS:

1. Borden, G., and Harris, K., Speech Science Primer, Williams and Wilkins (2006).
2. Furui, S., Digital Speech Processing, Synthesis and Recognition, CRC (2001).
3. Rabiner, L., and Schafer, R., Digital Processing of Speech Signals. Signal Processing, Prentice-Hall (1978).
4. Owens, F. J, Signal Processing of Speech, McGraw-Hill (1993)
5. Parsons, T., Voice and Speech Processing: Communications and Signal Processing, McGraw-Hill.

COURSE OUTCOMES:

1. Student will be able to acquire knowledge about audio & speech signals.
2. Student will be able to understand speech generation models.
3. Student will have foster ability to understand speech recognition models.
4. Student will have understanding of audio & speech signal estimation & detection.
5. Student will be able to acquire knowledge about hardware to process audio & speech signals.

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. This 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 being evaluated 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
IV-YEAR (VIII-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-481	Advance Communication Engineering	3	1	0	40	40	80	120	200	4
2.	EEC-46X	Program Elective -6	2	1	0	30	30	60	90	150	3
3.	TOE-XY	Open Elective -2	2	1	0	30	30	60	90	150	3
4.	TOE-XY	Open Elective -3	2	1	0	30	30	60	90	150	3
5.	TOE-XY	Open Elective -4	2	1	0	30	30	60	90	150	3
PRACTICAL											
6.	PEC-481	Advance Communication Engineering Lab	0	0	2	10	15	25	25	50	1
7.	PEC-482	VLSI Design Lab	1	0	2	20	30	50	50	100	2
8.	GPP-481	General Proficiency*	0	0	0	0	50	50	0	50	0
SEMESTER TOTAL			**12**	**5**	**4**	**190**	**255**	**445**	**555**	**1000**	**19**

Program Elective-6
EEC-461 Internet of Things
EEC-462 Public Broadcast Engineering
EEC-463 Principles of Secure Communication
EEC-464 Computer Network

Open Elective -2
TOE-12 Nuclear and Particle Physics
TOE-18 Human Relation at Work
TOE-24 Biosensors and Bioelectronics
TOE-32 Environmental Impact Assessment
TOE-43 Software Engineering
TOE-52 Digital Control Systems
TOE-80 Maintenance and safety engineering

Open Elective-3
TOE-13 Astro Physics
TOE-25 Biomaterials
TOE-34 Disaster Preparedness and Planning Management
TOE-45 Java Programming
TOE-53 Power Station Practice
TOE-73 Quality management

Open Elective-4
TOE-14 Special Functions
TOE-19 Value and Ethics
TOE-27 Bio fuels and Bio energy
TOE-35 Hydropower Engineering
TOE-48 Mobile Computing
TOE-58 Advanced Instrumentation
TOE-76 Entrepreneurship development

TEC481 ADVANCE COMMUNICATION ENGINEERING

UNIT 1: 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 2: TRANSMISSION CHARACTERISTICS:
Attenuation: Material absorption losses, scattering losses, bending 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 3: 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 4: 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 5: 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 INTERNET OF THINGS

UNIT 1: INTRODUCTION TO IOT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs.
UNIT 2: IOT & M2M: Machine to Machine, Difference between IoT and M2M, Software define Network, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global.
M2M TO IOT-AN ARCHITECTURAL OVERVIEW: Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT 3: NETWORK & COMMUNICATION ASPECTS: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination, Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.
CHALLENGES IN IOT: Design challenges, Development challenges, Security challenges, other challenges.

UNIT 4: DEVELOPING IOTS: Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor-based application through embedded system platform, Implementing IoT concepts with python.

UNIT 5: IOT REFERENCE ARCHITECTURE: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
REAL-WORLD DESIGN CONSTRAINTS: Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

BOOKS:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle**,** “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti, Arsh deep Bahga, “Internet of Things: A Hands-On Approach”
3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

COURSE OUTCOMES:

1. Student will be able to understand the vision of IoT from a global context.
2. Student will be able to determine the market perspective of IoT.
3. Student will be able to use of devices, gateways and data management in IoT.
4. Student will be able to build state of the art architecture in IoT.
5. Student will be able to application of IoT in industrial and commercial building automation and real-world design constraints.

EEC-462 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 International Publishes, 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.

EEC-463 PRINCIPLES OF SECURE COMMUNICATION

UNIT 1: DIRECT SEQUENCE SPREAD SPECTRUM SYSTEMS: Model of SS digital communication system, direct sequence spread spectrum signal, error rate performance of the decoder, processing gain and jamming margin, un-coded DSSS signals, applications of DSSS signals in anti-jamming, low detect-ability signal transmission, code division multiple access and multipath channels, effect of pulsed interference on DSSS systems, Generation of PN sequences using m sequence and Gold sequences, excision of narrowband interference in DSSS systems, acquisition and tracking of DSSS system.

UNIT 2: FREQUENCY HOPPED SPREAD SPECTRUM SYSTEMS: Basic concepts, slow and fast frequency hopping, performance of FHSS in AW GN and partial band interference, FHSS in CDMA system, Time hopping and hybrid SS system, acquisition and tracking of FHSS systems.

UNIT 3: CRYPTOGRAPHIC TECHNIQUES: Classical encryption technique, Symmetric cipher model, cryptography and cryptanalysts, Substitution techniques, transposition techniques, quantum cryptography.

UNIT 4: BLOCK CIPHER AND DATA ENCRYPTION STANDARD: Block cipher principle, data encryption standard (DES) strength of DES, differential and linear cryptanalysts, block cipher design principles, simplified advanced encryption standard (S-AES), multiple encryption and triple DES, Block cipher modes of operation, stream ciphers and RC4 algorithm.

UNIT 5: PUBLIC KEY CRYPTOGRAPHY: Prime numbers, Fermat and Euler's theorem, Chinese remainder theorem, discrete algorithms, principles of public key cryptosystems, RSA algorithm, key management Diffie-Hellman key exchange, message authentication requirements and functions.

BOOKS:

1. Proakis, Digital Communication, McGraw Hill, 2007.
2. Stallings, Cryptography and Network Security, PHI, 2008.
3. Haykin, Digital Communication, Wiley, 2005.
4. Taub & Schilling, Principle of Communication systems, TMH, 2013.
5. Rhee, Cryptography and secure Communications, McGraw Hill, 1995.

COURSE OUTCOMES:

1. Students will be able to understand the phenomenon of spread spectrum and its mathematical modeling.
2. Students will be able to analyze the problems of secure communication.
3. Students will be able to understand different techniques of secure communication and their applications.
4. Students will be able to develop mathematical framework of encryption techniques.
5. Students will be capable of solving practical problems related to secure communication.

EEC-464 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, modelling TCP connection management, TCP congestion control and performance issues.

UNIT 5: APPLICATION LAYER: DNS and name 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 & copy right.

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.

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 MATLAB and Software Defined Radio.
2. Students will be able to design and implement the experiments related to RF communication link and optical communication
3. Students will be able to design the experiments, analyze and interpret the data.
4. Students will acquire skills of team work, technical communication and effective report writing.
5. Students will be capable of solving practical communication engineering problems.

PEC-482 VLSI DESIGN LAB

The experiments are to be performed using modern VLSI Tools

1. Draw resistive load inverter circuit schematic; perform transient and DC analysis of the inverter circuit.
2. Draw CMOS inverter circuit schematic; 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, draw schematic and perform transient and DC analysis.
5. Design a common drain amplifier (Source follower amplifier), perform transient and DC analysis.
6. Design a differential amplifier using MOSFETs; perform transient and DC analysis.
7. Design a current mirror circuit; perform transient and DC analysis.
8. Design a NAND gate circuit; 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 team work, technical communication and effective report writing.
5. Students will be capable of solving practical electronics circuits.

OPEN ELECTIVE SUBJECTS OFFERED BY ECED

S. No.	COURSE CODE	SUBJECT	OFFERED FOR	PERIODS			EVALUATION SCHEME					
							SESSIONAL EXAM			ESE	Subject Total	Credits
				L	T	P	CT	TA	Total			
THEORY												
1.	TOE-60	Communication Engineering	EE, CSE, BT, ME, CE, PE	2	1	0	30	20	50	100	150	3
2.	TOE-61	Signals and Systems	BT, ME, CE, PE	2	1	0	30	20	50	100	150	3
3.	TOE-62	IC Technology	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
4.	TOE-63	Wireless Communication	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
5.	TOE-64	Embedded systems	EE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
6.	TOE-65	Multimedia Communication	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
7.	TOE-66	Digital Image Processing	EE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
8.	TOE-67	Internet of things	EE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
9.	TOE-68	Audio and Speech Processing	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
10.	TOE-69	MEMS	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3
11.	TOE-70	Industrial Control & Automation	EE, CSE, BT, ME, CE, PE	3	0	0	30	20	50	100	150	3

TOE-60 COMMUNICATION ENGINEERING

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

UNIT 2: DIGITAL MODULATIONS: Sampling process. Pulse Amplitude and Pulse code modulation (PCM), Differential pulse code modulation, Digital modulation schemes like ASK, FSK and PSK.

UNIT 3: TRANSMISSION LINES AND EM WAVES: Basic principles of transmission lines, Losses in transmission lines, Electromagnetic radiation, Waves in free space, Polarization, Reception of EM waves, Reflection, Refractions and interference of EM waves.

UNIT 4: BROADBAND COMMUNICATION SYSTEMS: TDM**,** FDM**,** Fiber optic links**,** Microwave link**s,** Introduction of satellite communication, Applications of fiber optic, Microwave and satellite communications.

UNIT 5: CELLULAR COMMUNIACTIONS: Types of services, Requirements for the services, Multipath propagation, Spectrum limitations, Principles of cellular networks, Multiple access schemes, Generations of cellular communication.

BOOKS:

1. Haykin, Communication Systems, John Wiley & Sons, 2003.
2. George Kennedy, Electronic Communication System, Mc Graw Hill, 2011.
3. Lathi, Modern Digital and Analog Communication System, Oxford, 2012.
4. Taub & Schilling, Principles of Communication Systems, TMH, 2013.
5. Molisch, “Wireless Communications”, John Wiley, 2012.

COURSE OUTCOMES:

1. Student will be able to understand the analog modulation schemes.
2. Student will be able to understand the digital modulation schemes.
3. Students will acquire knowledge of transmission lines and EM wave.
4. Students will be able to understand the broadband and cellular communications systems.
5. Students will be capable of solving engineering problems related to communication systems.

TOE-61 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, 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.

UNIT-2: 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.

UNIT-3: Z-TRANSFORM: Z-transform, region of convergence, inverse Z-transform, analysis and characterization of LTI system, block diagram representation, unilateral Z-transform.

UNIT-4: STATIONARY RANDOM PROCESSES: Probability density and probability distribution functions of a random variable, expected value of random variable, Markov and Chebyshev inequalities, computer methods for generating random variables, multidimensional random variables, Chi-square tests of hypotheses concerning distribution, analysis of various probability distribution functions and their applications.

UNIT-5: 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).

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.

TOE-62 IC TECHNOLOGY

UNIT 1: INTRODUCTION: Classification of ICs, scale of integration, Semiconductor and Hybrid ICs, Features of ICs.
CRYSTAL GROWTH: Monolithic and Hybrid ICs, Crystal Growth**,** Czochralski Technique of Crystal Growth, Wafer Preparation and Specifications, Testing, Measurement of Parameters of Crystals, Fabrication Steps.
EPITAXIAL PROCESS: Epitaxy and its Concept, Growth Kinetics of Epitaxy, Epitaxial Growth, Low Temperature Epitaxy, Si Epitaxy Growth, Chemistry of Si Epitaxial Layer, Auto Doping Apparatus for Epitaxial Layer, Apparatus for Epitaxy, MBE System.

UNIT 2: OXIDATION: Oxidation Growth Kinetics, Calculation of SiO_2 Thickness, Oxidation Techniques: Dry, Wet, High Pressure and Plasma Oxidation, Oxide Properties, Defects Induced due to Oxidation.
LITHOGRAPHY: Photolithography and Pattern Transfer, Optical and Non-Optical Lithography, Contact/Proximity and Projection Printing, Types of Photo Resist, Polymer and Materials, Electron, Ion Beam and X-Ray Lithography.
ETCHING: Figure of Merit, Wet and Dry Etching, Reactive Ion Etching, Lift off Technique.

UNIT 3: DIFFUSION PROCESS: Diffusion Model of Solids, Fick's Theory of Diffusion, Solution of Fick`s Law, Diffusion Parameters Measurements Schemes.
ION IMPLANTATION: Scattering Phenomenon, Range Theory, Implantation Damage, Ion Implantation Systems, ChannelingandAnnealing.

UNIT 4: METALLIZATION: Applications and Choices, Physical Vapor Deposition, Patterning, Problem Areas.
VLSI PROCESS INTEGRATION: PMOS**,** NMOS and CMOS IC Technology, MOS Memory IC Technology, Bipolar IC Fabrication.

UNIT 5: ASSEMBLY TECHNIQUE AND PACKAGING: Package Types, Packaging Design Consideration, and VLSI Assembly Technologies.
YIELD AND RELIABILITY: Yield loss in VLSI, Yield Loss Modelling, Reliability Requirements, and Accelerated Testing.

BOOKS:

1. Sze, VLSI Technology, McGraw Hill, 2003.
2. Ghandhi, VLSI Fabrication Principles, John Wiley & Sons, 1994.
3. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press, 2011.
4. Sedra& Smith, Microelectronic Circuits, Oxford University Press, 2017.
5. Plummer, Silicon VLSI Technology: Fundamentals, Practice and Modeling, Pearson, 2009.

COURSE OUTCOMES:
1. Students will demonstrate the knowledge about current and future trends of IC manufacturing technology.
2. Students will be able to understand various processes used in IC technology.
3. Students will be able to understand working of various equipments used in fabrication of ICs.
4. Students will be able to understand the fabrication of various electronic components using semiconductor technology.
5. Students will be able to solve engineering problems related to fabrication of ICs.

TOE-63 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 their applications.
2. Students will be able to understand concepts of cellular architecture and its application to traffic engineering problems.
3. Students will be able to understand various multiple access techniques used for proper utilization of bandwidth resource.
4. Students will be able to understand various modulation schemes used in wireless communication and to formulate the problem related to spectrum efficiency.
5. Knowledge of this course is going to enhance the capability of students for solving engineering problems related to wireless communication.

TOE-64 EMBEDDED SYSTEMS

UNIT 1: INTRODUCTION TO EMBEDDED SYSTEMS: Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software in a system, Embedded System-on-chip (SOC), Complex Systems Design and Processors, Design Process in Embedded System, Formulization of System Design, Design Process and Design Examples, Classification of Embedded Systems.

UNIT 2: DEVICE AND COMMUNICATION BUS FOR DEVICES NETWORK: IO Types and examples, Serial communication devices, Parallel Device ports, Sophisticated Interfacing Feature in Devices Ports, Wireless Devices, Timer and Counting Devices, Watch dog timer, Real time clock, Network Embedded Systems, Serial Bus Communication Protocols, parallel Bus Devices protocol Parallel communication Network using ISA, PCI, PCI-X and advanced buses.

UNIT 3: DEVICE DRIVERS AND INTERRUPT SERVICES MECHANISM: Programmed-I/O Busy-wait Approach without Interrupt Services Mechanism, ISR Concept, Interrupt Sources, Interrupt Servicing (Handling) Mechanism, Multiple Interrupts, Context and the Periods for Context Switching, Interrupt Latency and Deadline, Classification of Processor Interrupt Service Mechanism from Context-Saving Angle, Device Driver.

UNIT 4: INTER-PROCESS COMMUNICATION AND SYNCHRONIZATION OF PROCESSES: CPU Scheduling, Threads and Tasks, Clear-cut Distinction between Functions, ISRS and Tasks by their Characteristics, Concept of Semaphores, 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 operating system service, Process management, process scheduling, co-operating processes, Timer function, Event function, Memory management, Device, File and I/O subsystem management, Real Time Operating Systems, Basic Design Using an RTOS, RTOS Task Scheduling Models, Interrupt routine in RTOS environment and handling of interrupt Sources calls, Interrupt Latency and Response of the Tasks as Performance Metrics.

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.

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.

TOE-65 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: CODING: 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-4 Audio/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.

TOE-66 DIGITAL IMAGE PROCESSING

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, SVD Lossless compression; Variable length coding, LZ7, 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 and compression and their practical use.
5. Students will be able to solve engineering problems related to digital image processing.

TOE-67 INTERNET OF THINGS

UNIT 1: INTRODUCTION TO IOT: Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs.
UNIT 2: IOT & M2M: Machine to Machine, Difference between IoT and M2M, Software define Network, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global.
M2M TO IOT-AN ARCHITECTURAL OVERVIEW: Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT 3: NETWORK & COMMUNICATION ASPECTS: Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination, Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.
CHALLENGES IN IOT: Design challenges, Development challenges, Security challenges, other challenges.

UNIT 4: DEVELOPING IOTS: Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor-based application through embedded system platform, Implementing IoT concepts with python.

UNIT 5: IOT REFERENCE ARCHITECTURE: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.
REAL-WORLD DESIGN CONSTRAINTS: Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

BOOKS:

4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle**,** “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
5. Vijay Madisetti, Arsh deep Bahga, “Internet of Things: A Hands-On Approach”
6. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

COURSE OUTCOMES:
6. Student will be able to understand the vision of IoT from a global context.
7. Student will be able to determine the market perspective of IoT.
8. Student will be able to use of devices, gateways and data management in IoT.
9. Student will be able to build state of the art architecture in IoT.
10. Student will be able to application of IoT in industrial and commercial building automation and real-world design constraints.

TOE-68 AUDIO AND SPEECH PROCESSING

UNIT 1: INTRODUCTION: Review of digital signal and systems, Transform representation of signal and systems, Sampling Theorem, STFT, Goertzel algorithm, Chirp algorithm, Digital filters and filter banks.
DIGITAL MODELS FOR SPEECH SIGNALS: Speech production and acoustic tube modeling, acoustic phonetics, anatomy and physiology of the vocal tract and ear, hearing and perception.

UNIT 2: DIGITAL REPRESENTATION: Linear quantization, commanding, optimum quantization, PCM, effects of channel errors, vector quantization (VQ), Adaptive quantization, differential PCM, APCM, ADPCM, delta modulation, adaptive delta modulation, and CVSD.

UNIT 3: DIGITAL VOCODERS: Linear predictive coding (LPC), hybrid coders: voice excited vocoders, voice excited linear predictor, and residual excited linear predictor (RELP).

UNIT 4: SPEECH RECOGNITION: Isolated word recognition, continuous speech recognition, speaker (in) dependent, measures and distances (articulation index, log spectral distortion, Itakura-Saito, cepstral distance), Dynamic time warping (DTW), HMM, HMM networks, Viterbi algorithm, discrete and continuous observation density HMMs.

UNIT 5: SPEAKER RECOGNITION: speaker verification/authentication *vs. s*peaker identification, closed *vs.* open set, feature vectors (e.g., line spectrum pair and cestrum), pattern matching (e.g., DTW, VQ, HMM), hypothesis testing, and errors. Emerging speech coding standards (e.g., 2400 bps MELP), Internet phone, voice and multimedia applications.

BOOKS:

1. Borden, G., and Harris, K., Speech Science Primer, Williams and Wilkins (2006).
2. Furui, S., Digital Speech Processing, Synthesis and Recognition, CRC (2001).
3. Rabiner, L., and Schafer, R., Digital Processing of Speech Signals. Signal Processing, Prentice-Hall (1978).
4. Owens, F. J, Signal Processing of Speech, McGraw-Hill (1993)
5. Parsons, T., Voice and Speech Processing: Communications and Signal Processing, McGraw-Hill.

COURSE OUTCOMES:

1. Student will be able to acquire knowledge about audio & speech signals.
2. Student will be able to understand speech generation models.
3. Student will have foster ability to understand speech recognition models.
4. Student will have understanding of audio & speech signal estimation & detection.
5. Student will be able to acquire knowledge about hardware to process audio & speech signals.

TOE-69 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, Microactuators types, micropump, micromotors, microvalves, microgrippers, and microaccelerometers.

UNIT-3: FABRICATION PROCESS: Substrates single crystal silicon wafer formation, Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Physical vapor 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 using intellisuite. 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," Mc Graw Hill, 1998.
4. Marc F Madou, "Fundamentals of Micro Fabrication", CRC Press, 2nd Edition, 2002.
5. Francis E.H. Tay and Choong .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**.**

TOE 70 INDUSTRIAL CONTROL & AUTOMATION

UNIT-:1 Introduction to Industrial Automation: Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, and measurement systems

UNIT-2: Actuators & sensors: Different types of actuators: Control valve, hydraulic, pneumatic, & electrical, Process I/O systems, Active & passive transducers/sensors, transducer/sensors for industrial parameters: flow, temperature, level and pressure, Local & remote I/O systems.

UNIT-3: Controllers: Different types of controllers, Single loop and Multi-loop controllers and their tuning, Direct controllers and their tuning, Direct controllers and their tuning, Direct controllers and their tuning, Direct controllers and their tuning, Direct controllers and their tuning, Direct controllers and their tuning, Direct Digital Controllers, Software implementation of Multi-loop Controllers.

UNIT-4: Advance control techniques: Sequence Control: Programmable Logic Controllers (PLC), Relay Ladder Logic, Programming. Supervisory Controllers: Functionally of Supervisory Control Level, Distributed Control Systems (DCS) and SCADA.

UNIT-5: Industrial communication system: Industrial Communication Systems: Characteristic features of industrial networks, VISA, Low level networks and their features, Field bus architecture, Performance aspects of Industrial Automation Systems.

REFERENCE BOOKS:

1. Webb J.W-Programmable controllers: Principle and Applications, PHI New Delhi
2. Parr A –Programmable Controllers :An Engineers' Guide, Newnes, Butterworth-Heinneman Ltd- 1993. 3. Liptak B.G (ED)-Process Control H andbook,vol-2 Chilton book Co.
4. Noltinc - Handbook for Instrumentation Engineers.
5. Bollinger J.G and Duffie N.A-Computer control of machines and processes, Reading M A, Addison-Wesley, 1988.

COURSE OUTCOMES:

1. Students will be able to understand the architecture of industrial automation systems and their applications.
2. Students will be able to understand different types of actuators and sensors**.**
3. Students will be able to understand the different types of controllers and control techniques.
4. Students will have knowledge of industrial communication systems**.**
5. Student will be capable of solving engineering problems related to industrial automation systems**.**