B.Tech.III Year I Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	Analog &Digital IC Applications	3	0	0	3
2	Professional Core	Digital communications	3	0	0	3
3	Professional Core	Antennas and Wave Propagation	3	0	0	3
4	Professional Elective - I	1. Digital System Design through HDL 2. Optical Communications 3. **Electronic Measurements and Instrumentation** 4. Computer Organization and Architecture	3	0	0	3
5	Open Elective-I	OR Entrepreneurship Development & Venture Creation	3	0	0	3
6	Professional Core	Analog & Digital IC Applications Lab	0	0	3	1.5
7	Professional Core	Analog and digital communications Lab	0	0	3	1.5
8	Skill Enhancement course	Applications of Lab view for Instrumentation &Communications	0	1	2	2
9	Engineering Science	Design of PCB& Antennas Lab	0	0	2	1
10	Evaluation of Community Service Internship		-	-	-	2
Total			**15**	**1**	**10**	**23**

B.Tech. III Year II Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	VLSI Design	3	0	0	3
2	Professional Core	Microprocessors & Microcontrollers	3	0	0	3
3	Professional Core	Digital Signal Processing	3	0	0	3
4	Professional Elective–II	1. Analog IC Design 2. Satellite Communication 3. Smart and Wireless Instrumentation 4. Machine Learning	3	0	0	3
5	Professional Elective–III	1. Bio Medical Instrumentation 2. Microwave Engineering 3. Embedded Systems 4. Artificial Intelligence	3	0	0	3
6	OpenElective–II		3	0	0	3
7	Professional Core	VLSI Design Lab	0	0	3	1.5
8	Professional Core	Microprocessors &Microcontrollers Lab	0	0	3	1.5
9	Skill Enhancement course	Machine Learning Lab	0	1	2	2
10	Audit Course	Research methodology and IPR	2	0	0	-
Total			**20**	**1**	**08**	**23**

List of open elective courses offered by department of ECE:

Pool1: OpenElective1 (Either of the 4subjects)

1. Electronic Devices and Circuits
2. Signals and Systems
3. Probability Theory and Random variables
4. Network Analysis

Pool2:OpenElective2(Eitherofthe4subjects)

1. Linear and Digital IC Applications
2. Principles of communications
3. Principles of Signal Processing
4. Microprocessors & Microcontrollers

Pool3:Open Elective3(Either of the 4subjects)

1. Fundamentals of VLSI Design
2. Digital Electronics
3. Electronic measurements and Instrumentations
4. Optical communications

Pool4:OpenElective4(Eitherofthe4subjects)

1. Principles of Cellular &Mobile communications
2. Fundamentals of Satellite Communications
3. Embedded Systems
4. Transducers and Signal Conditioning

III Year-I Semester	ANALOG & DIGITALIC APPLICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

CO1 Apply the operational principles and characteristics of op-amps to design and analyze analog circuits such as amplifiers and active filters.(K3: Apply)

CO2 Designwaveformgeneratorsandcomparatorcircuitsusingop-ampsforsignalprocessing applications.(K4: Analyze)

CO3 Implementandtroubleshootcombinationalandsequentiallogiccircuitsusingdigital ICs.(K4: Analyze)

CO4 Compare different data conversion techniques (DAC and ADC) and implement digital-to-analog and analog-to-digital conversion circuits in real-time applications.

CO5 Design and interface digital systems using programmable logic devices like PLDs and FPGAs.(K4: Analyze)

UNIT–I

Operational Amplifier: Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, features of 741 Op-Amp, Modes of Operation-Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT-II

Op-Amp, IC-555 & IC565 Applications: Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer-Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL-Block Schematic, principle and Applications.

UNIT-III

Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs – Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

UNIT-IV

Combinational Logic ICs: Specifications and Applications of TTL-74XX & CMOS 40XXSeries ICs - Code Converters, Decoders, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, De-multiplexers, Priority Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT-V

Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs - All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.

Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

TEXTBOOKS:

1. RamakanthA.Gayakwad-Op-Amps&LinearICs,PHI,2003.
2. FloydandJain-DigitalFundamentals,8[th]Ed.,PearsonEducation,2005.

REFERENCEBOOKS:

1. D.Roy Chowdhury–Linear Integrated Circuits, New Age International(p) Ltd,2[nd]Ed.,2003.
2. John.F.Wakerly–DigitalDesignPrinciplesandPractices,3[rd]Ed.,Pearson,,2009.
3. Salivahana-Linear Integrated Circuits and Applications,TMH,2008.
4. WilliamD.Stanley- Operational Amplifiers with Linear IntegratedCircuits,4[th]Ed.,Pearson EducationIndia, 2009

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III Year-I Semester	DIGITAL COMMUNICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

- To Describe basic components of Digital Communication Systems and to determine the performance of different pulse digital modulation techniques
- Todeterminetheperformanceofdigitalmodulationtechniquesforthegeneration and digital representation of the signals.
- To design optimum receiver for Digital Modulation techniques and to determine the probability of error for various digital modulation schemes
- Tocomputeandanalyzeerrordetectinganderrorcorrectioncodesblockcodes, cyclic codes.
- To compute and analyze convolution codes and Turbo codes.

UNITI

PULSE DIGITAL MODULATION :Elements of digital communication systems ,advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error, Companding in PCM systems. Differential PCM systems (DPCM). Delta modulation, its draw backs, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems, Time division multiplexing, Frequency division multiplexing.

UNITII

DIGITAL MODULATION TECHNIQUES:Introduction,ASK,FSK,PSK,DPSK,DEPSK, QPSK,M-aryPSK,ASK,FSK,similarity of BFSK and BPSK.

UNITIII

DATA TRANSMISSION: Base band signal receiver, probability of error, the optimum filter, matched filter, probability of error using matched filter, coherent reception, non-coherent detection of FSK, calculation of error probability of ASK, BPSK, BFSK, QPSK.

UNITIV

LINEAR BLOCK CODES: Introduction, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes, Algebraic structure, encoding, syndrome calculation, BCH codes

UNITV

CONVOLUTION CODES: Introduction, encoding of convolution codes, time domainapproach, transform domain approach. Graphical approach: state, tree and trellis diagram decoding using Viterbi algorithm, Turbo Codes.

TEXTBOOKS:

1. Digital communications-Simon Haykin,JohnWiley, 2005
2. Principles of Communication Systems–H.TaubandD.Schilling,TMH,2003
3. Digital Communications-J.Das,S.K.Mullick,P.K.Chatterjee,Johnwilly&sons,1986.

RERFERENCES:

1. Digital and Analog Communication Systems-SamShanmugam,JohnWiley,2005.
2. Digital Communications–JohnProakis,TMH,1983.CommunicationSystemsAnalog& Digital – Singh &Sapre, TMH, 2004
3. Modern Analog and Digital Communication–B.P.Lathi,Oxfordreprint,3rdedition,2004.

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IIIYear-ISemester	ANTENNASANDWAVE PROPAGATION	L	T	P	C
		3	0	0	3

Course Outcomes:

- Identify basic antenna parameters.
- Quantify the fields radiated by various types of antennas
- Design and analyze antenna arrays
- Design and analyze wire antennas, loop antennas, reflector antennas, lens antennas, horn antennas and micro-strip antennas
- Analyze antenna measurements to assess antenna's performance

UNIT-I:

ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – Single Wire, 2-Wire, dipoles, Current Distribution on a thin wire antenna.Antenna Parameters - Radiation Patterns, Patterns in Principal Planes, Field Regions, Main Lobe and Side Lobes, Beam width, Radiation Intensity,Directivity,AntennaEfficiency,Gain,BeamEfficiency,Bandwidth,Polarization,Input Impedance, Beam Area and Resolution, Antenna Apertures, Aperture Efficiency, Effective Height, illustrated Problems.

UNIT-II:

THIN LINEAR WIRE ANTENNAS: Retarded Potentials, Radiation from Small Electric Dipole, Quarter wave Monopole and Half wave Dipole – Current Distributions, Evaluation of Field Components, Power Radiated, Radiation Resistance, **Radiation Efficiency**, Beam width, Directivity,EffectiveArea and Effective Height. Natural current distributions,fields and patterns ofThin Linear Center-fedAntennas of different lengths, Radiation Resistance at a point which is not current maximum, Antenna Theorems – Applicability and Proofs for equivalence of directional characteristics, LoopAntennas: Small Loops - Field Components, Comparison of far fields of small loop and short dipole, Concept of short magnetic dipole, D and $R_r$relations for small loops

UNIT-III:

ANTENNAARRAYS: 2elementarrays–differentcases,PrincipleofPatternMultiplication,N element Uniform Linear Arrays – Broadside, End-fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison; Concept of Scanning Arrays. Directivity Relations (no derivations),Related Problems. Binomial Arrays, Effects of Uniform and Non-uniform Amplitude Distributions, Design Relations Arrays with Parasitic Elements, Yagi-Uda Arrays, Folded Dipoles and their characteristics

UNIT-IV

BROADBAND ANTENNAS: Log periodic antenna, Basic principle, Helical Antennas – Significance,Geometry,basicproperties;Designconsiderationsformonofilarhelicalantennasin Axial Mode and Normal Modes (Qualitative Treatment).

UHFANDMICROWAVEANTENNAS:

Horn Antennas– Types, Optimum Horns, Design Characteristics of Pyramidal Horns; **Paraboloidal Reflectors**: – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Case grain Feeds.

Microstrip Antennas-Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics, illustrated Problems.

UNIT-V

ANTENNA MEASUREMENTS: FRIIS Transmission Equation, Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).

WAVE PROPAGATION: TYPES of propagations. Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF and Skip Distance; Space Wave Propagation – Mechanism, LOS and Radio Horizon, Field strength equation, illustrated Problems.

TEXTBOOKS:

1. Antenna Theory: Analysis And Design- Constantine A. Balanis, 3rd Edition, A John Wiley & Sons, Inc., Publication
2. Antennas for All Applications – John D. Kraus and Ronald J. Marhefka, 3rd Edition, TMH,2003.
3. ElectromagneticWavesandRadiatingSystems–E.C.JordanandK.G.Balmain,PHI, 2nd Edition, 2000.

REFERENCES:

1. AntennasandWavePropagation-G.S.N.Raju,Pearsonpublications,2006.
2. TransmissionandPropagation–E.V.D.GlazierandH.R.L.Lamont,TheServices Text Book of Radio, vol. 5,Standard Publishers Distributors, Delhi.
3. Antennas–JohnD.Kraus, McGraw-Hill,2nd Edition,1988

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III Year I Semester	DIGITAL SYSTEM DESIGN THROUGH HDL (PE-I)	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the language constructs and programming fundamentals of Verilog HDL.
- Choose the suitable abstraction level for a particular digital design
- Construct Combinational and sequential circuits in different modeling styles using Verilog HDL
- Design and synthesize combinational and sequential logic circuits
- Analyze and Verify the functionality of digital circuits/systems using test benches.

UNIT-I:Introduction to Verilog HDL and Gate Level Modelling :
Verilog as HDL, Levels of Design Description Basics of Concepts of Verilog, Data Types, System Task, Compiler directives, modules and ports. AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instancesof Primitives, Additional Examples, Design of Flipflops with Gate Primitives, Delay.

UNIT-II:Behavioural Modelling:
Introduction, structured processors, procedural assignments, timing controls, conditional statements, multi-way branching, loops, sequential and parallel blocks, generate blocks, Design of Decoders, Multiplexers, Flip-flops, Registers & Counters in Behavioral model.

UNIT-III: Modelling at Data flowLevel:
Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment toVectors, Operators, Design of Decoders, Multiplexers, Flip-flops, Registers& Counters in dataflow model, Switch Level Modelling: Introduction, Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitive delays.

UNIT-IV:FSM Design:
Functions, Tasks, User-defined, Primitives: Introduction, Function, Tasks, User-Defined Primitives (UDP), FSM Design (Moore and Mealy Machines), Encoding Style: From Binary to One Hot. Introduction to Synthesis, Synthesis of combinational logic, Synthesis of sequential logic with latches and flip-flops, Synthesis of Explicit and Implicit State Machines

UNIT-V:Components Test and Verification:

Test Bench–Combinational Circuits Testing, Sequential Circuits Testing, Test Bench Techniques, Design Verification, Assertion Verification

Text Books:

1. Samir Palnitkar, "VerilogHDL A Guide to Digital and Synthesis" ,2nd Edition, Pearson Education,2006.
2. Michael,D.Ciletti,"Advanced digital design with theVerilogHDL",PearsonEducation India,2005.

Reference Books:

1. Padmanabhan,TripuraSundari-DesignthroughVerilogHDL,Wiley,2016
2. S.Brown,Zvonko–Vranesic,FundamentalsofDigitalLogicwithVerilogDesign,TMH, 3rd Edision 2014.
3. J.Bhasker,AVerilogHDLPrimer2nd edition,BSPublications,2001.

III Year-I Semester	OPTICAL COMMUNICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Choose necessary components required in modern optical communications systems.
- Design and build optical fiber experiments in the laboratory, and learn how to calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
- Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
- Choose the optical cables for better communication with minimum losses
- Design, build, and demonstrate optical fiber experiments in the laboratory.

UNITI

Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber waveguides-Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers-Cutoff wave length, Mode Field Diameter, Effective Refractive Index, Related problems.

UNITII

Fiber materials:- Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion:- Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.

UNITIII

Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing-Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss-Multimode fiber joints, single mode fiber joints.

UNITIV

Optical sources-LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors- Physical principles of PIN and APD, Detector response time, Comparison of Photo detectors, Related problems.

UNITV

Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation-Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration,Digitalreceiverperformance,ProbabilityofError,Quantumlimit,Analog

receivers. Optical system design - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.

TEXTBOOKS:

1. Optical Fiber Communications–GerdKeiser,McGraw-HillInternationaledition,3rdEdition,2000.
2. Fiber Optic Communications–JosephC.Palais,4thEdition,PearsonEducation, 2004.

RERFERENCES:

1. Fiber Optic Communications–D.K.Mynbaev,S.C.GuptaandLowell L.Scheiner,PearsonEducation,2005.
2. Text Book on Optical Fiber Communication and its Applications–S.C.Gupta,PHI,2005.
3. Fiber Optic Communication Systems–GovindP.Agarwal,JohnWiley,3rdEdiition,2004.

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III Year-I Semester	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the various Analog and Digital measuring Instruments
- Aware of the principles and operations of various oscilloscopes
- Learn measurements using various bridges
- Familiarize different Signal Generators and function generators
- Learn various transducers and Intelligent sensors

UNITI

Measuring Instruments: Introduction, Errors in Measurement,Accuracy, Precision, Resolution and Significant figures, Basic PMMC Meter- construction and working, DC andACVoltmeters-Multirange, Range extension,DC Ammeter, Multimeter for Voltage, Current and resistance measurements.

Digital Instruments: Digital Voltmeters – Introduction, DVM's based on V–T, V–F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multimeters,Digital frequency meters, Digital measurement of time.

UNITII

Oscilloscopes: Introduction, Block diagram of CRO, Basic principle of CRT, CRTConstruction and features, vertical amplifiers, horizontal deflection system- sweep, trigger pulse, delay line, sync selector circuits. Dual beam and dual trace CROs, Sampling and Digital storage oscilloscopes.

UNITIII

Bridges: DC Bridges for Measurement of resistance - Wheat stone bridge, Kelvin's Bridge,AC Bridges for Measurement of inductance- Maxwell's bridge, Hay's Bridge, Anderson bridge, Measurement of capacitance - Schearing Bridge, Wien Bridge, Errors and precautions in using bridges.

UNITIV

Signal Generators: Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator.

UNITV

Transducers: Introduction,Types ofTransducers, Electrical transducers, Selecting a transducer, Resistive transducer, Strain gauges, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Temperature transducers-RTD, LVDT.

Intelligent Sensors: definition of intelligent instrumentation, types of instruments,Classification, Smart sensors, Cogent Sensors, Soft or Virtual sensors, Self-Adaptive Sensors, Self-Validating Sensors, Temperature Compensating Intelligent Sensors, Pressure Sensor, Indirect Sensing. (**Text Book 3**)

TEXT BOOKS

1. H.S.Kalsi ,"Electronic Instrumentation",Thirdedition,TataMcGrawHill, 2010.
2. A.D.HelfrickandW.D.Cooper,"Modern Electronic Instrumentation and Measurement Techniques", PHI, 6th Edition, 2010.
3. ManabendraBhuyan,—Intelligent Instrumentation :Principles and Applications CRC Press, 2011.

REFERENCE BOOKS

1. A.K. Sawhney, DhanpatRai& Co., "A course in Electrical and Electronic Measurements and Instrumentation", 9th Edition, 2010.
2. DavidA.Bell,"Electronic Instrumentation&Measurements",PHI,2ndEdition,2006.

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III Year I Semester	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the representation of data, the register transfer language and Micro operations.
- Know the basic computer organization and design, programming the basic computer and design the micro programmer control unit.
- Know the development of central processing unit and explain various algorithms for computer arithmetic operations.
- Interface various Peripheral devices and various data transfer operations.
- Study the memory Hierarchy and different types of memories.

UNIT-1:

Introduction: Digital Computers, Von Neumann computers, Basic organization of a computer, **Data Representation:** Data types, Complements, Fixed-point representation, Conversion of fractions, Floating-point representation.

RegisterTransferandMicrooperations: Registertransferlanguage,Registertransfer,Busand Memory transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit

UNIT-2

Basic Computer Organization and Design : Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference instructions, Input-Output and Interrupt, Complete Computer Description, Design of Basic computer

Programming the Basic Computer : Introduction ,Machine Language, Assembly language, The Assembler, Program Loops, Programming Arithmetic and Logic Operations

Micro programmed Control: Control Memory,Address Sequencing, Micro program Example, Design of Control Unit (**Preferably from Reference Book 2**)

UNIT-3

Central Processing Unit: Introduction, General Register Organization, Stack organization, Instruction Formats, Addressing Modes, Data transfer and Manipulation, Program Control, Reduced Instruction Set Computer

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-Point Arithmetic Operations, Decimal Arithmetic Unit, Decimal Arithmetic Operations.

UNIT–4

Input-Output organization : Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor (IOP), Serial Communication.

UNIT–5

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Text Book

1. M.Morris Mano,"Computer System Architecture ,"Pearson Publishers,RevisedThird Edition

Reference Books

1. JohnPHayes, "Computer Architecture and Organization, "Mc-GrawHillPublishers, Third Edition
2. CarlHamacher,"Computer Organization,"TataMc-GrawHillPublishers,FifthEdition.

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III Year I Semester	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Apply the basic concepts of semiconductor physics.
- Understand the formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation.
- Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
- Understand the construction, principle of operation of transistors,BJT and FET with their V-I characteristics in different configurations.
- Know the need of transistor biasing ,various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.

UNIT-I:

Review of Semi Conductor Physics: Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

Junction Diode Characteristics: Energy band diagram of PN junction Diode, Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance.

UNIT-II:

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, UJT, PNPN Diode, SCR. Construction, operation and V-I characteristics.

Rectifiers and Filters: Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms, Filters, Inductor filter(Series inductor), Capacitor filter(Stunt inductor), π-Filter, comparison of various filter circuits in terms of ripple factors.

UNIT-III:Transistor Characteristics:

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of atransistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values.

FET: FET types, construction, operation, characteristicsμ, g_m, $r_d$parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT- IV: Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE}, Ic, and β, Stability factors, ($S,S^{'},S^{''}$), Bias compensation, Thermal runaway, Thermal stability.FET Biasing- methods and stabilization.

UNIT-V: Small Signal Low Frequency Transistor Amplifier Models:

BJT: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters,Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of transistor amplifiers.

FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

Text Books:

1. Electronic Devices and Circuits-J.Millman,C.Halkias,TataMc-GrawHill, SecondEdition,2007
2. Electronic Devices and Circuits by David A.Bell,OxfordUniversity Press
3. Electronics devices & circuit theory- Robert L.Boylestad and LouiNashelsky, Pearson/Prentice hall, tenth edition,2009

References:

1. Integrated Electronics-J.Millman, C.Halkias,TataMc-GrawHill,Second Edition,2009
2. Electronic Devices and Circuits-K.LalKishore,BSPublications,FourthEdition,2016.

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III Year I Semester	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Differentiate the various classifications of signals and systems
- Analyze the frequency domain representation of signals using Fourier concepts
- Classify the systems based on their properties and determine the response of LTI Systems.
- Know the sampling process and various types of sampling techniques.
- Apply Laplace and z-transforms to analyze signals and Systems (continuous &discrete).

UNIT- I: INTRODUCTION: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems, Complex exponential and sinusoidal signals ,Singularity functions and related functions: impulse function, step function signum function and ramp function.

UNIT–II:FOURIERSERIESANDFOURIERTRANSFORM:

Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum. Deriving Fourier transform from Fourier series, Fourier transform of standard signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Related problems

UNIT-III:

CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between Convolution and correlation, Detection of periodic signals in the presence of noise by correlation.

SAMPLING THEOREM: Graphical and analytical proof or Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Aliasing, Related problems.

UNIT–IV:

LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

UNIT–V:

Z–TRANSFORMS: Concept of Z-Transform of a discrete sequence. Region of convergence in Z- Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms, Distinction between Laplace, Fourier and Z transforms.

TEXTBOOKS:

1. Signals,Systems&Communications-B.P.Lathi,BSPublications,2003.
2. SignalsandSystems-A.V.Oppenheim,A.S.WillskyandS.H.Nawab,PHI,2ndEdn,1997
3. Signals&Systems-SimonHaykinandVanVeen,Wiley,2ndEdition,2007

REFERENCEBOOKS:

1. PrinciplesofLinearSystemsandSignals–BPLathi,OxfordUniversityPress,2015
2. Signals and Systems–TK Rawat, Oxford University press,2011.

PRAKASAM ENGINEERING COLLEGE (AUTONOMUS)
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B.TECH–ELECTRONICSANDCOMMUNICATIONENGINEERING
(R23 -III[rd] YEAR COURSE STRUCTURE & SYLLABUS)

III Year I Semester	PROBABILITYTHEORY AND RANDOM VARIABLES	L	T	P	C
		3	0	0	3

Course Outcomes:

- Mathematically model the random phenomena and solve simple probabilistic problems
- Identify different types of random variables and compute statistical averages of these random variables.
- Characterize the random processes in the time and frequency domains.
- Analyze the LTI systems with random inputs

UNITI

THE RANDOM VARIABLE: Introduction, Review of Probability Theory, Definition of a RandomVariable, Conditions for a Function to be a RandomVariable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Conditional Distribution, Conditional Density, Properties.

UNITII

OPERATION ON ONE RANDOM VARIABLE-EXPECTATIONS: Introduction ,Expected ValueofaRandomVariable,FunctionofaRandomVariable,MomentsabouttheOrigin,Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a ContinuousRandomVariable,Non-monotonicTransformationsofContinuousRandomVariable.

UNIT III

MULTIPLE RANDOM VARIABLES: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions.

OPERATIONS ON MULTIPLE RANDOM VARIABLES: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables :Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNITIV

RANDOMPROCESSES–TEMPORAL CHARACTERISTICS :The Random Process Concept, Classification of Processes, Deterministic and Non deterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, Nth-order and Strict -Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross- Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process

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UNITV

RANDOM PROCESSES-SPECTRAL CHARACTERISTICS : The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function.

LINEAR SYSTEMS WITH RANDOM INPUTS: Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output, Band pass, Band-Limited and Narrowband Processes, Properties.

TEXTBOOKS:

1. Probability ,Random Variables &RandomSignalPrinciples,PeytonZ.Peebles,TMH,4th Edition, 2001.
2. Probability ,Random Variables and Stochastic Processes, AthanasiosPapoulis and S.Unnikrisha, PHI, 4th Edition, 2002.
3. Probability Theory and Stochastic Processes–B. PrabhakaraRao,BS Publications.

REFERENCEBOOKS:

1. Probability and Random Processes with Applications to Signal Processing,HenryStarkand John W. Woods, Pearson Education, 3rd Edition.
2. Schaum's Outline of Probability, Random Variables ,and Random Processes.
3. AnIntroductiontoRandomSignalsandCommunicationTheory,B.P.Lathi,International Textbook, 1968.
4. Probability Theory and Random Processes,P.RameshBabu,McGrawHill,2015.

III Year I Semester	NETWORKANALYSIS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Gain the knowledge on basic network elements.
- Will analyze the RLC circuit's behavior in detailed.
- Analyze the performance of periodic waveforms
- Gain the knowledge in characteristics of two port network parameters (Z,Y,ABCD,h& g).
- Analyze the filter design concepts in real world applications.

UNIT–I

Introduction to Electrical Circuits : Network elements classification, Electric charge and current, Electric energy and potential, Resistance parameter – series and parallel combination, Inductance parameter – series and parallel combination, Capacitance parameter – series and parallelcombination.Energysources:Ideal,Non-ideal,Independentanddependentsources,

Source transformation ,Kirchoff's laws, Mesh analysis and Nodal analysis problem solving with Resistances only including dependent sources also.

Definitions of terms associated with periodic functions: Time period, Angular velocity and frequency, RMS value, Average value, Form factor and peak factor- problem solving, Phase angle,Phasorrepresentation,Additionandsubtractionofphasors,mathematicalrepresentationof sinusoidal quantities, explanation with relevant theory, problem solving. Principal of Dualitywith examples

Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule.

UNIT–II

Transients : First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, Evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots. Solutions using Laplace transform method.

UNIT–III

Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L-C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving.

Coupled Circuits : Coupled Circuits: Self inductance, Mutual inductance, Coefficient of coupling,analysisofcoupledcircuits,Naturalcurrent,Dotruleofcoupled circuits, Conductively coupled equivalent circuits- problem solving.

UNIT – IV Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti resonance, Bandwidthofparallelresonance,generalcase-resistancepresentinbothbranches,antiresonance at all frequencies.
NetworkTheorems: Thevinin's,Norton's,Milliman's,Reciprocity,Compensation,Substitution, Superposition,MaxPowerTransfer,Tellegens-problemsolvingusingdependentsourcesalso

UNIT–V Two-port Networks: Relationship of two port networks, Z-parameters,Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.

TEXT BOOKS:

1. Network Analysis–MEVanValkenburg ,Prentice HallofIndia,3rdEdition,2000.
2. Network Analysis by K.Satya Prasadand SSivanagaraju,Cengage Learning
3. Electric Circuit Analysis by HaytandKimmarle, TMH

REFERENCES:

1. Network lines and FieldsbyJohn.D.Ryder2[nd]edition,Asiapublishinghouse.
2. Basic Circuit Analysis by DR Cunninghan,Jaico Publishers.
3. Network Analysis and Filter Design by Chadha, UmeshPublications.

III Year-I Semester	ANALOG AND DIGITAL IC APPLICATIONS LAB	L	T	P	C
		0	0	3	1.5

PART-A:(Minimum **SIX** Experiments to be conducted):

1. OPAMP Applications–Adder, Subtractor ,Comparator Circuits.
2. Integrator and Differentiator Circuits using IC741.
3. Active Filter Applications–LPF,HPF(first order)
4. Active Filter Applications–BPF, Band Reject(Wideband)and Notch Filters.
5. IC741OscillatorCircuits–PhaseShiftandWienBridge Oscillators.
6. Function Generator using OPAMPs.
7. IC555Timer–Astable&Mono-stableOperationCircuit.
8. SchmittTriggerCircuits–usingIC741andIC 555.
9. IC565–PLLApplications.
10. IC566–VCOApplications.
11. 4bit DACusing OPAMP.

Equipment required for Laboratories:
1. RPS
2. CRO
3. Function Generator
4. Multi Meters
5. IC Trainer Kits(Optional)
6. Bread Boards
7. Components:-IC741, IC555, IC565, IC1496,IC723,7805,7809,7912etc.
8. Analog IC Tester

PART-B:(Minimum **SIX** Experiments to be conducted):

The students are required to design and draw the internal structure of the following Digital Integrated Circuits and to develop HDL(VHDL, Verilog HDL)source code, perform simulation using relevant simulator and analyze the obtained simulation results using appropriate synthesizer. Further, it is required to verify the logic with necessary hardware.

List of Experiments:

1. Realization of Logic Gates
2. 3to8Decoder- 74138
3. 8*1Multiplexer-74151and2*1De-multiplexer-74155
4. 4-BitComparator-7485.
5. DFlip-Flop-7474
6. DecadeCounter-7490
7. Universalshiftregister-74194/195
8. RAM(16*4)-74189(read and write operations)

Equipment Required:

1. Xilinix Vivado/ Equivalent Standard IDE
2. Personal computer with necessary peripherals
3. Hardware kits-Various FPGA families.

IIIYear-I Semester	ANALOGANDDIGITAL COMMUNICATIONS LAB	L	T	P	C
		0	0	3	1.5

List of Experiments:

(Fourteenexperimentstobedone-**Thestudentshavetocalculatetherelevantparameters**)–

(a.Hardware,b. MATLAB Simulinkc. MATLAB Communication toolbox)

Part-A

1. Amplitude Modulation-Modulation &Demodulation
2. AM-DSBSC-Modulation& Demodulation
3. Diode Detector
4. Pre-emphasis & De-emphasis
5. Frequency Modulation- Modulation &Demodulation
6. Verification of Sampling Theorem
7. Pulse Amplitude Modulation &Demodulation
8. PWM,PPM–Modulation & Demodulation

Part-B

1. Time division multiplexing.
2. Frequency Division Multiplexing
3. Pulse code modulation.
4. Differential pulse code modulation.
5. Delta modulation.
6. Frequency shift keying.
7. Phase shift keying.
8. Differential phase shift keying.
9. Companding
10. Source Encoder and Decoder
11. Linear Block Code-Encoder and Decoder and Binary Cyclic Code–Encoder and Decoder
12. Convolution Code–Encoder and Decoder

Note:All the above experiments are to be executed/completed using hardware boards and also to be simulated on Mat lab.

Equipment &

Software required:

Software:

i) Computer Systems with latest specifications
ii) Connected in LAN(Optional)
iii) Operating system (Windows/Linux software)
iv) Simulations software(Simulink &MATLAB)

Equipment:

1. RPS -0 –30V
2. CRO -0–20MHz.
3. Function Generators -0–1MHz
4. Components and Breadboards
5. Multi meters and other meters

III Year-I Semester	APPLICATIONS OF LAB VIEW FOR INSTRUMENTATION & COMMUNICATIONS	L	T	P	C
		0	1	2	2

Course Outcomes:

- Develop loops, case structures, arrays, and clusters.
- Realize real time applications using NIDAQ hardware
- Implement Coding techniques using Lab VIEW
- Design automation and process control application
- Apply Lab VIEW for data processing applications

Unit I:

Introduction to Lab VIEW & Virtual Instrumentation: Overview of LabVIEW: Graphical programming paradigm, Lab VIEW Environment: Front panel, block diagram, data flow programming, Creating simple Virtual Instruments (VIs), Debugging and troubleshooting techniques, Implementing loops, case structures, arrays, and clusters.

Unit II:

Data Acquisition & Signal Processing: Interfacing sensors (temperature, pressure, light, etc.) with LabVIEW, Real-time data acquisition using NI DAQ hardware, Signal generation: Sine, Square, Triangular waves, Fourier Transform (FFT) for frequency analysis, Filtering techniques: Low-pass, High-pass, Band-pass filters.

Unit III:

Communication System Implementation: AM and FM Modulation/Demodulation using LabVIEW,Simulation of Digital Modulation Schemes(ASK,PSK,FSK),Eye diagrams and

constellation plots for digital signals, Error detection and correction: Parity, CRC, Hamming Code.

UnitIV: Instrumentation & Automation Applications:
Real-time data logging and file handling (Excel/CSV), PID Controller Design for automationand process control, Motor speed control using LabVIEW and DAQ, Signal visualization and user interface design.

UnitV:Advanced Applications:
Image Processing using LabVIEW, Wireless communication using Bluetooth & Wi-Fi in LabVIEW, IoT Integration-Cloud-based monitoring and remote data access, Project-based learning-

Text books & References

1. R.W.Larsen,LabVIEWforEngineers,1sted.,PrenticeHall,2011.
2. G.W.Johnson and R.Jennings, Lab VIEW Graphical Programming,4thed.,McGraw-Hill, 2017.
3. National Instruments, "LabVIEW Tutorials & Documentation," Available: https://www.ni.com.J.Jerome,VirtualInstrumentationUsingLabVIEW,1sted.,PHI Learning Pvt

III Year- I Semester	DESIGN OF PCB & ANTENNAS LAB	L	T	P	C
		0	0	2	1

MeritsofPCB Machine:

1. CNC based for Better Accuracy and results.
2. Etching, Engraving and Drilling can be done with same Machine
3. Maintenance free machine compared to chemical method.
4. Compatible with multiples of tware Gerber/G code.
5. Reduction of time and Inventory.
6. Height mapping for bed level and depth sensing.
7. Surface mapping of bed
8. Power Optimized system ability to run on up systems unlike other Machines.
9. High precision leads crew
10. 5umeterre solution,0.001repeatability,2layerwith FR4
11. Scalability from a single proto type to abatchof10-50 PCBs.

Scope of learning:

1. In house PCB proto type manufacturing process.
2. How to convert simulation results in to real time Electronic boards/ Projects.
3. Designing according to project requirements.
4. AlongwithPCBotherMultimaterialssupportcarbonfibersheets,Droneframes, Engraved
5. Acrylic sheets. Engravingon aluminium.
6. LatestmultidomainprojectsextensionDprintingandAdditiveManufacturing.
7. Exposure to design the proto type products.

ANTENNAS LAB:

List of experiments:(Any Ten experiments using any simulation software)

1. Generation of EM-Wave
2. Impedance Matching using Smith Chart
3. Calculation of phase and group velocity calculation
4. Plot of Radiation pattern of dipole antenna
5. Plot of Radiation pattern of monopole antenna
6. Plot of Radiation pattern of Uniform Linear Array
7. Measurement of radiation pattern of all wired and aperture antennas
8. Measurement of radiation pattern of planar antennas
9. Measurement of radiation pattern of reflector antennas
10. Measurement of radiation pattern of array antennas
11. Analysis of co-polarization and cross polarization
12. Performance analysis of Yagi-Uda antenna
13. Performance analysis of Helix antenna
14. Radio wave propagation path loss calculations

III Year II Semester	VLSI DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes:

- Demonstrate aclear understanding of CMOS fabrication flow and technology scaling.
- Design MOSFET based logic circuit.
- Design basic building blocks in Analog IC design.
- Design various CMOS logic circuits for design of Combinational logic circuits.
- Analyze the behavior of static and dynamic logic circuits

UNIT-I:

INTRODUCTION AND BASIC ELECTRICAL PROPERTIES OF MOS CIRCUITS:VLSI Design Flow, Introduction to IC technology, Fabrication process: nMOS, pMOS and CMOS. I_{ds}versus V_{ds}Relationships, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit. nMOS Inverter, Pull-up to Pull-down Ratio for nMOS inverter driven by another nMOS inverter, and through one or more pass transistors. Alternative forms of pull-up, The CMOS Inverter, Latch-up in CMOS circuits, Bi-CMOS Inverter, Comparison between CMOS and BiCMOS technology, MOS Layers, Stick Diagrams, Design Rules and Layout, Layout Diagrams for MOS circuits

UNIT-II:

BASIC CIRCUIT CONCEPTS: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, some area Capacitance Calculations, The Delay Unit, Inverter Delays, driving large capacitive loads, Propagation Delays, Wiring Capacitances, Choice of layers.

SCALING OF MOS CIRCUITS: Scaling models and scaling factors, Scaling factors for device parameters,Limitationsofscaling,Limitsduetosubthresholdcurrents,Limitsonlogiclevelsand supply voltage due to noise and current density.

UNIT-III:

BASIC BUILDING BLOCKS OFANALOG IC DESIGN: Regions of operation of MOSFET, Modelling of transistor, body bias effect, biasing styles, single stage amplifier with resistive load, single stage amplifier with diode connected load, Common Source amplifier, Common Drain amplifier, Common Gate amplifier, current sources and sinks.

UNIT-IV:

CMOS COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUIT DESIGN:

Static CMOS Design: Complementary CMOS, Rationed Logic, Pass-Transistor Logic, design of Half adder, full adder, multiplexer, decoder.**Dynamic CMOS Design:**Dynamic Logic-Basic Principles ,Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates,Design examples of sequential circuits: Cross coupled NAND and NOR flipf lops, D flip flop, SR JK flip flop, SR Master Slave flip flop.

UNIT-V:

FPGADESIGN:FPGAdesignflow,BasicFPGAarchitecture,FPGATechnologies,Introduction to FPGA Families.

INTRODUCTION TO ADVANCED TECHNOLOGIES: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET, TFET.

TEXTBOOKS:

1. Essentials of VLSI Circuits and Systems-Kamran Eshraghian,Douglas andA.Pucknell
2. And Shole hEshraghian, Prentice-Hallof IndiaPrivateLimited,2005Edition.
3. DesignofAnalogCMOSIntegratedCircuitsbyBehzadRazavi,McGrawHill,2003
4. DigitalIntegratedCircuits,JanM.Rabaey,AnanthaChandrakasanandBorivojeNikolic, 2nd edition,2016.

REFERENCES:

1. "IntroductiontoVLSICircuitsandSystems",JohnP.Uyemura,JohnWiley&Sons,reprint2009.
2. IntegratedNanoelectronics:NanoscaleCMOS,Post-CMOSandAlliedNanotechnologies Vinod Kumar Khanna, Springer India, 1st edition, 2016.
3. FinFETsandothermulti-gatetransistors,ColingeJP,EditorNewYork,Springer,2008.

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III Year II Semester	MICROPROCESSOR AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the architecture of 8086 and its operation
- Develop the students to compose the assembly language program for 8086.
- Applying 8086 processor to interface with necessary peripherals.
- Understand the architecture of 8051andinterfacingwithnecessaryperipherals.
- Understand the introductory concepts of advanced processors, viz.,ARM processors.

Unit-I

Introduction: Basic Microprocessor architecture, Harvard and Von Neumann architectures with examples, Microprocessor Unit versus Microcontroller Unit, History and classifications of Microprocessor and Microcontroller.

8086Architecture: register organization ,internal architecture of 8086,pindescriptionof8086, minimum mode and maximum mode of 8086 operation and timing diagrams.

Unit-II

8086 Programming: instruction set, addressing modes, assembler directives, programming with an assembler, writing simple programs with an assembler, stack and stack structure, interrupts and interrupt service routines 8086 system,

Unit-III

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters, Need for 8259 programmable interrupt controllers.

Unit-IV

Intel 8051 MICROCONTROLLER and Interfacing

Architecture,Hardwareconcepts,Input/outputportsandcircuits,external memory ,counters/timers, serial datainput/output, interrupts. Assembly language programming: Instructions, addressing modes, simple programs. Interfacing to 8051: A/D and D/A Convertors, Stepper motor interface, keyboard, LCD Interfacing, Traffic light control.

Unit-V

ARM Architectures and Processors:

Introduction to CISC and RISC architectures, ARM Architecture, ARM Processors Families, ARM Cortex-M Series Family, ARM Cortex-M3 Processor Functional Description, Instruction set summary, System address map, write buffer, bit-banding. Programmers Model – Modes of operation and execution, stack pointer, exceptions and interrupt handling.

ARM Cortext-M3 programming – Software delay, Programming techniques, Loops, Stack and Stack pointer, subroutines and parameter passing, parallel I/O, Nested Vectored Interrupt Controller– functional description and NVIC programmers' model.

TEXTBOOKS:

1. Advanced microprocessors and peripherals by K.M.Bhurchandi,A.K.Ray3e
2. The8051Microcontrollers and Embedded systems Using Assembly andC,MuhammadAli Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; Pearson 2-Edition,2011.
3. The Definitive Guideto ARMCortex-M3andCortex-M4ProcessorsbyJosephYiu.,Newnes Third edition.

REFERENCE BOOKS:

1. Embedded Systems Fundamentals with Arm Cortex-Mbased Microcontrollers: APractical Approach in English, by Dr.Alexander G. Dean, Published byArm EducationMedia,2017.
2. Cortex-M3Technical Reference Manual.

III Year II Semester	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the concepts of discrete signals and discrete systems with its characteristics
- UnderstandthealgorithmsfortheefficientcomputationofDFTcoefficients of signals
- Design the FIR and IIR filters.
- Know the architectures of various DSP processors and its addressing modes,assembly language instructions.

UNIT-1:

Introduction: Signals, Systems, and Signal Processing, Classification of Signals, The Conceptof Frequency in Continuous Time and Discrete Time Signals

Discrete Time Signals and Systems: Discrete Time Signals, Discrete Time Systems, AnalysisofDiscreteTimeLinearTimeInvariantSystems,DiscreteTimeSystemsDescribedby Difference Equations, Implementation of Discrete Time Systems, Correlation of Discrete Time Signals.

Frequency Analysis of Signals: Frequency Analysis of Continuous Time Signals, Frequency Analysis of Discrete Time Signals, Frequency Domain and Time Domain Signal Properties, Properties of the Fourier Transform for Discrete Time Signals. **Frequency Domain Analysis of LTI Systems:** Frequency domain characteristics of LTI systems, Frequency response of LTI systems.

UNIT-2:

The z-Transform and Its Applications to the Analysis of LTI Systems: The z-Transform, Properties, Rational z Transforms, Inversion of the z-Transform, Analysis of Linear Time Invariant Systems in the z-Domain, The One sided z-Transform. (Review only for entirez – Transform topic).

The Discrete Fourier Transform: Its Properties and Applications: Frequency Domain Sampling: The Discrete Fourier Transform, Properties of the DFT, Linear Filtering Methods Based on the DFT, Frequency Analysis of Signals Using DFT

UNIT-3:

Efficient Computation of the DFT: Fast Fourier Transform Algorithms: Direct Computation of the DFT, Radix-2 FFT Algorithms.

Implementation of Discrete Time Systems: Structures for the Realization of Discrete Time Systems, **Structures for FIR Systems**: Direct Form Structure, Cascade Form Structures, Frequency Sampling Structures.

Structures for IIR Systems: Discrete Form Structures, Signal Flow Graphs and Transposed Structures, Cascade Form Structures, Parallel Form Structures.

UNIT-4:

Design of Digital Filters: General Considerations: Causality and Its Implications, Characteristics of Practical Frequency Selective Filters.

Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear Phase FIR Filters Using Windows, Design of Linear Phase FIR Filters by the Frequency Sampling Method.

Design of IIR Filters From Analog Filters: IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.

Frequency Transformations: Frequency Transformations in the Analog Domain, Frequency Transformations in

the Digital Domain

UNIT-5:

Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs ,Multiple Access Memory, Multi ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals.

Architecture of TMS320C5X: Introduction, Bus Structure, Central Arithmetic Logic Unit, Auxiliary Register ALU ,Index Register, Auxiliary Register Compare Register, Block Move Address Register, Block Repeat Registers, Parallel Logic Unit, Memory mapped registers, program controller, some flags in the status registers, On- chip memory, On-chip peripherals.TMS320C5X Assembly Language Instructions

TEXT BOOKS:

1. Digital Signal Processing, Principles ,Algorithms ,and Applications :JohnG.Proakis,DimitrisG.Manolakis, 4th Edition, Pearson Education,2007.
2. DigitalSignalProcessors–Architecture,ProgrammingandApplications,,B.Venkataramani,M.Bhaskar, TATA McGraw Hill, 2002

Reference Books:

1. DiscreteTimeSignalProcessing–A.V.OppenheimandR.W.Schaffer,3rdEdition,Pearson, 2014.
2. DigitalSignalProcessing-P.RameshBabu,5thEdition,SCITECHPublishers.

III Year II Semester	ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the concepts of MOS Devices and Modeling.
- Design and analyze any Analog Circuits in real time applications.
- Extend the Analog Circuit Design to Different Applications in Real Time.
- Understand of Open-Loop Comparators and Different Types of Oscillators

UNIT-I:

MOS Devices and Modelling: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modelling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT-II:

Analog CMOS Sub-Circuits:

MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference**.**

UNIT-III:CMOSAmplifiers:

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures. CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of OpAmps, Design ofTwo-Stage OpAmps, Power- Supply Rejection Ratio of Two-Stage OpAmps, Cascode OpAmps, Measurement Techniques of OPAmp.

UNIT-IV:

Comparators: Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

UNIT-V:

Oscillators & Phase-Locked Loops: General Considerations, Ring Oscillators, LC Oscillators, Voltage Controlled Oscillators. Simple PLL, Charge Pump PLLs, Non-Ideal Effects in PLLs, Delay Locked Loops, Applications.

TEXTBOOKS:

1. Design of Analog CMOS Integrated Circuits-BehzadRazavi, TMHEdition, Second Edition.
2. CMOS Analog Circuit Design –Philip E.Allen and DouglasR.Holberg, OxfordUniversity Press, International Second Edition/Indian Edition,2010.

REFERENCES:

1. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewisand R. G. Meyer, Wiley India, Fifth Edition,2010.
2. Analog Integrated Circuit Design-DavidA.Johns,KenMartin,WileyStudent Edn,2013.

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III YearII Semester	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the concepts, applications and sub systems of Satellite communications.
- Derive the expression for G/T ratio and to solve some analytical problems on satellite link design.
- Understand the various types of multiple access techniques and architecture of earth station design
- Understand the concepts of GPS and its architecture.

UNITI

INTRODUCTION: Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. **ORBITAL MECHANICS AND LAUNCHERS:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.

UNITII

SATELLITE SUBSYSTEMS: Attitude and orbit control system, telemetry, tracking,Command and monitoring system, power systems, communication subsystems, Satellite antennas, Equipment reliability and Space qualification.

UNITIII

SATELLITE LINK DESIGN: Basic transmission theory, link equation, C/N ratio, systemnoise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

UNITIV

MULTIPLE ACCESS: Frequency division multiple access (FDMA): Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA); Frame structure, Examples. Code Division Multiple access (CDMA): Spread spectrum transmission and reception.

EARTH STATION TECHNOLOGY: Introduction, basic architecture, Transmitters,Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

UNITV

LOW EARTH ORBIT AND GEO-STATIONARYS ATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs **GLOBAL NAVIGATION SATELLITE SYSTEM(GNSS):**

Introduction, various GNSS: GPS, GLONASS, GALILEO, BeiDou, QZSS, IRNSS. GPS-location principle, GPS navigation message, GPS receiver operation, differential GPS; IRNSS-introduction, IRNSS satellites, IRNSS constellation, IRNSS configuration, IRNSS services, navigation data, applications of IRNSS; multi GNSS.

TEXT BOOKS:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 3RD Edition, 2020.

2. Satellite Communications Engineering–WilburL.Pritchard,RobertA Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

REFERENCES:

1. Satellite Communications: Design Principles– M. Richharia, BS Publications, 2nd Edition,2003.
2. Satellite Communication -D.CAgarwal,KhannaPublications,5thEd.
3. Fundamentals of Satellite Communications –K.N.RajaRao,PHI,2004
4. SatelliteCommunications–DennisRoddy,McGrawHill,2ndEdition,1996

PRAKASAM ENGINEERING COLLEGE (AUTONOMUS)
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B.TECH–ELECTRONICSANDCOMMUNICATIONENGINEERING
(R23 -IIIrd YEAR COURSE STRUCTURE & SYLLABUS)

III Year II Semester	SMART AND WIRELESS INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Outcomes:

- Analyze Smart and Wireless Instrumentation with respect to various performance parameters.
- Design and develop Applications using WSN(Wireless sensor Network).
- Demonstration of various No de architectures.
- Demonstration of Fundamentals of wireless digital communication
- Analyze the power sources, Demonstrate an ability to design strategies as per needsand specifications

UNIT–1:Introduction:

Smart Instrumentation(Materials, automation systems, ensign and Sensors, Sensor Classifications, Wireless Sensor Networks, History of Wireless Sensor networks (WSN), Communication in a WSN, important design constraints of a WSN like Energy, Self Management, Wireless Networking, Decentralized Management, Design Constraints, Security etc.

UNIT – 2: Node architecture: The sensing subsystem, Analog to Digital converter, the processor subsystem, architectural overview, microcontroller, digital signal processor, application specific integrated circuit, field programmable gate array (FPGA), comparison, communicationinterfaces, serial peripheral interface, inter integrated circuit, the IMote node architecture, The XYZ node architecture, the Hog throb node architecture.

UNIT – 3: Fundamentals of Wireless Digital Communication: Basic components, source encoding, the efficiency of a source encoder, pulse code modulation and delta modulation, channel encoding, types of channels, information transmission over a channel, error recognition and correction, modulation, modulation types, quadratic amplitude modulation, signal propagation.

UNIT – 4: Frequency of Wireless Communication: Development of Wireless Sensor Network based on Microcontroller and communication device-Zigbee Communication device. Power sources- Energy Harvesting Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from vibration Thermal Energy Harvesting-Energy Management Techniques Calculation for Battery Selection.

UNIT–5:Applications:

Structural health monitoring - sensing seismic events, single damage detection using natural frequencies, multiple damage detection using natural frequencies, multiple damage detection using mode shapes, coherence, piezo electric effect, traffic control, health care- available sensors,

pipelinemonitoring,precisionagriculture,activevolcano,undergroundmining.

Text Books:

1. Fundamentals of wireless sensor networks: theoryandpractice-WaltenegusDargie, Christian Poellabauer, A John Wiley and Sons, Ltd., Publication.
2. Smart Sensors,Measurement and Instrumentation, Sub has Chandra Mukhopadhyay, Springer Heidelberg, New York, Dordrecht London, 2013.
3. Wireless Sensors and Instruments: Networks, Design and Applications, HalitEren, CRC Press, Taylor and Francis Group, 2006.

Reference Books:

1. UvaisQidwai, Smart Instrumentation :A data flow approach to Interfacing“,Chapman& Hall;1st Edn,December 2013.
2. Wireless Sensor Networks: Architectures and Protocols, EdgarH.CallawayJr.andEdgar H. Callaway.

III Year II Semester	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Outcomes:

- Define machine learning and its different types and understand their applications.
- Explain the various techniques involved in pre-processing of data for Data Analysis
- Apply various supervised learning algorithms including decision trees and k-nearest neighbours (k-NN) etc.
- Implement unsupervised learning techniques ,viz., K-means clustering etc.
- Learn about various performance metrics and explore them in various applications of implementing Machine learning Algorithms.

UNIT-I:Introduction to Machine Learning:

What is Machine Learning?, Traditional programming approach vs Machine learning approach, History and Evolution of Machine Learning, Learning by Rote vs Learning by Induction, **ParadigmsforML**-SupervisedML,UnsupervisedML,ReinforcementML,**DatatypesinML** - Quantitative data (Continuous, Discrete), Qualitative data (Structured, Semi structured, Unstructured), Nominal data, Ordinal data, Interval data, Ratio data, Stages involved in Machine Learning, Main challenges of ML, Applications of Machine Learning, **IDE's for ML Programming** - Jupyter Notebook, Spyder, PyCharm, Google Colab, RStudio,VS Code, **Basic packages to deal with ML** - Numpy, Scipy, Pandas, Scikit-learn, Matplotlib, Seaborn, **Programming Languages for Machine Learning** - Python, Java, R, JavaScript, C++

UNIT-II: Explorative DataAn alysis(EDA):

What is EDA? Why EDA is important?, **Types of EDA** - Univariate Analysis, Bivariate Analysis, Multivariate Analysis, **Data Cleaning** - Data Acquisition,Analyzing the data Dealing with duplicate data, Dealing with missing values, Dealing with outliers **Scaling and Transformations** - Feature Scaling and Transformation, Univariate nonlinear Transformations, **Dimensionality Reduction** - Principal Component Analysis (PCA), **Feature Engineering** - Handling Categorical attributes (One-Hot-Encoding), **Feature Expansion** - Interactions and Polynomials, **Automatic Feature Selection** - Univariate Statistics, Model-Based Feature Selection, Iterative Feature Selection

UNIT-III: Supervised Machine Learning:

What is Supervised Machine Learning?, General architecture of Supervised ML, **Types of SupervisedML**-ClassificationandRegression,**DifferentClassificationAlgorithms**- K-Nearest Neighbor (KNN) Classifier, Linear Models, Logistic Regression, Naive Bayes Classifiers, Decision Tree Classifier, **Ensemble learning and Decision Trees** - Voting, Bagging and pasting, Random Forests, AdaBoost, Gradient Boosting, Stacking, Support Vector Classifier (SVC)Neural Networks, **Different Regression Algorithms** - K-Neighbors Regressor, Linear Regression, Ridge Regression, Lasso Regression,Polynomial Regression, Support Vector Regressor (SVR), Decision Tree Regressor, Random Forest Regressor

UNIT-IV: Unsupervised Machine Learning –

What is Unsupervised Machine Learning?, General architecture of Unsupervised Machine Learning, Challenges in Unsupervised ML, **Clustering -** Introduction to Clustering, Soft clustering vs Hard Clustering, K-Means Clustering algorithm, Centroid-based clustering algorithm, Divisive Clustering and Agglomerative Clustering, DBSCAN

UNITV-Model Evaluation metrics, Fine tuning the model and Visualizations-
Evaluation Metrics for Classification - Confusion Matrices, Accuracy, Precision, Recall, F1-Score, Precision-recall curves, ROC (Receiver Operating Characteristics) curves, Confusion Matrix, **Evaluation Metrics for Regression** - R^2, Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), **Evaluation Metrics for clustering** -Adjusted Random Index (ARI), Normalized Mutual Information (NMI), **Cross Validation -** Cross-Validation in scikit-learn, benefits of cross-validation, stratified k-fold cross validation, **Grid Search**- Simple Grid search, Grid search with cross validation, Randomized search, **Visualization** - Univariate Analysis (Bar plot, Box plot, Count plot, Density plot, Histogram, Pieplot), Bivariate Analysis (Pair plot, Scatter plot, Bar plot, Stacked barplot, Multivariate Analysis (Heat Maps)

Text Books:

1. "Introduction to Machine Learning with Python",Andreas C.Muller&SarahGuido, O'Reilly Publications
2. "Hands-on Machine Learning with Scikit-Learn,Keras&TensorFlow",Aurelien Geron, O'ReillyPublications
3. "Machine Learning Theory and Practice", MNMurthy, VS Ananthanarayana, Universities Press(India),2024

Reference Books:

1. "MachineLearning",TomM.Mitchell,McGraw-HillPublication,2017
2. "Machine Learning in Action",PeterHarrington,DreamTech
3. "Introduction to Data Mining",Pang-NingTan,MichelStenbach,VipinKumar, 7th Edition, 2019.

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III Year II Semester	BIO-MEDICALINSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Outcomes:

- Demonstrate a foundational understanding of the anatomy and physiology ofthe human body.
- Apply knowledge of different techniques used for measuring various physiological parameters.
- Explain modern imaging techniques employed in medical diagnosis and identify the diverse therapeutic equipment utilized in the biomedical field.
- Understand and apply bio-telemetry principles for transmitting bio electrical variables.
- Analyze patient safety measures and evaluate recent advancements in themedical field.

UNIT – 1:Introduction: Factors to be considered in the design of medical instrumentation systems, Basic objectives of medical instrumentation system, Physiological systems of human body, Sources of Bioelectric potentials: Resisting and Action Potentials, Propagation of Action Potentials, The Bioelectric Potentials. Electrodes: Electrode theory, Bio Potential Electrodes, Biochemical Transducers, Introduction to bio-medical signals.

UNIT – 2: The Cardiovascular System: The Heart and Cardiovascular System, The Heart, Blood Pressure, Characteristics of Blood Flow, Heart Sounds, Cardio Vascular Measurements, Electrocardiography, Measurement of Blood Pressure, Measurement of Blood Flow and Cardiac output, Plethysmography ,Measurement of Heart Sounds ,Event detection, PQRS&T-Waves inECG, the first & second Heart beats, ECG rhythm analysis, the di-crotic notch in the carotid pulse detection of events and waves, analysis of exercise ECG, analysis of event related potentials, correlation analysis of EEG channels, correlation of muscular contraction.

UNIT – 3: Patient Care & Monitory and Measurements in Respiratory System: The elements of Intensive Care Monitory, Diagnosis, Calibration and reparability of Patient Monitoring equipment, other instrumentation for monitoring patients, pace makers, defibrillators,thephysiologyofrespiratorysystem,testsandinstrumentationformechanicsof breathing,respiratorytheoryequipment,analysisofrespiration.

UNIT – 4: Bio telemetry and Instrumentation for the Clinical Laboratory, Introduction to bio telemetry, Physiological parameters adaptable to bio telemetry, the components of bio telemetry system, implantable units, applications of telemetry in patient care – The blood, tests on blood cells, chemical test, automation of chemical tests.

UNIT – 5: X-ray and radioisotope instrumentation and electrical safety of medical equipment: Generation of Ionizing radiation, instrumentation for diagnostic X-rays, special techniques, instrumentation for the medical use of radioisotopes, radiation therapy - Physiological effects of electrical current, shock Hazards from electrical equipment, Methodsofaccidentprevention,ModernImagingSystems:Tomography,MagneticResonanceImaging
System, Ultrasonic imaging system, Medical Thermography.

Text Books:

1. Biomedical Instrumentation and Measurements C.Cromwell,F.J.Weibell,E.A.Pfeiffer – Pearson education.

2. Biomedical Signal Analysis – Rangaraj, M. Rangayya – Wiley Inter Science – JohnWilley & Sons Inc.

Reference Books:

1. Hand Book of Bio-Medical Instrumentation–R.S.Khandpur,TMH.
2. Introduction to Bio-Medical Engineering–Domach,Pearson.
3. Introduction to Bio-Medical Equipment Technology–Cart,Pearson.

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III Year II Semester	MICRO WAVE ENGINEERING	L	T	P	C
		3	0	0	3

Course Outcomes:

- Design different modes in waveguide structures
- CalculateS-matrixforvariouswaveguidecomponentsandsplittingthemicrowaveenergy in a desired direction
- Distinguish between Microwave tubes and Solid State Devices, calculation of efficiency of devices.
- Measure various microwave parameters using a Microwave test bench

UNIT-I

MICROWAVE TRANSMISSION LINES : Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Filter Characteristics, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations; Power Transmission and Power Losses in Rectangular Guide. Related Problems. MICROSTRIP LINES– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor

UNITII

MICROWAVE TUBES : Limitations and Losses of conventional tubes at microwave frequencies. Microwave tubes – O type and M type classifications. O-type tubes : 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process andApplegate Diagram, Bunching Process and SmallSignal Theory – Expressions for o/p Power and Efficiency. Reflex Klystrons – Structure, Applegate Diagram and Principle of working, Mathematical Theory of Bunching, Power Output, Efficiency, Electronic Admittance; Oscillating Modes and o/p Characteristics, Electronic and Mechanical Tuning. Applications.

UNIT-III

HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT andAmplification Process (qualitative treatment), Suppression of Oscillations, Nature of the four Propagation Constants, Gain Considerations(qualitative treatment).**M-type Tubes** Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling WaveMagnetron – Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics.

UNIT-IV

WAVEGUIDE COMPONENTS AND APPLICATIONS : Coupling Mechanisms – Probe, Loop,Aperture types. Waveguide Discontinuities – Waveguide irises, Tuning Screws and Posts, Matched Loads. WaveguideAttenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, Scattering Matrix– Significance, Formulation and Properties, S-Matrix Calculations for – 2,3,4 port Junctions: E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole,Bethe Hole types,S-Matrix Calculations Ferrite Components– Faraday Rotation, Gyrator, Isolator, Circulator, Related Problems.

UNIT-V

MICROWAVESOLIDSTATE DEVICES: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes

MICROWAVE MEASUREMENTS: Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement – Bolometer Method. Measurement of Attenuation, Frequency, Q- factor, Phase shift, VSWR, Impedance Measurement

TEXTBOOKS:

1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, JohnWiley, 2nd Edition, 2002.
2. MicrowaveEngineering-AnnapurnaDasandSisirK.Das,McGrawHillEducation,3rd Edition.

REFERENCES:

1. MicrowaveDevicesandCircuits–SamuelY.Liao,PHI,3rdEdition,1994.
2. Microwave Engineering –GSNRaju,IKInternational
3. MicrowaveandRadarEngineering-M.Kulkarni,UmeshPublications,3rdEditio

III Year II Semester	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Know basics of embedded system, classification, memories, different communication interface and what embedded firmware is and its role in embedded system, different system components.
- Distinguishallcommunicationdevicesinembeddedsystem,otherperipheraldevice.
- DistinguishconceptsofCversusembeddedCandcompilerversuscross-compiler.
- Choose an operating system, and learn how to choose an RTOS

Unit-I:

Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, PCB and passive components. Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system, Main processing elements of embedded system, hardware and software partitions.

Unit-II:

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watch dog timer, Real time clock.

Unit-III:

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

Unit-IV:

Real Time Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Threads, Processes and Scheduling, Task Scheduling, Communication, Synchronization, Device Drivers, How to choose an RTOS. Electronics and Communication Engineering

Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hard ware and Firm ware, ICE.

Unit-V:

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Dissembler/De-compiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools.

Embedded System Implementation And Testing: The main software utility tool,CADand the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools. Test and evolution of an embedded systems (Build in selftest etc).

Case study- typical embedded system design flow with an example.

Text Books:

1. Embedded Systems Architecture By TammyNoergaard,ElsevierPublications,2005
2. Embedded System Design, FrankVahid,Tony Givargis ,John Wiley Publications.

References:

1. Embed ding system building blocks By Labrosse,CMP publishers.

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III Year II Semester	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the concepts of computational intelligence like machine learning
- Ability to get the skill to apply machine learning techniques to address the real time Problems in different areas
- Understand the Neural Networks and its usage in machine learning application.
- Apply principles and algorithms evaluate models generated from data
- Apply the algorithms to a real world problems

UNIT-1

What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What areAITechniques,The LevelOfTheModel,CriteriaForSuccess,Some GeneralReferences, One Final

Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, ProductionSystem,CharacteristicsAndIssuesInTheDesignOfSearchPrograms,AdditionalProblems.

Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis.

UNIT-2

Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution.RepresentingKnowledgeUsingRules:ProceduralVersusDeclarative Knowledge,Logic Programming, Forward Versus Backward Reasoning.

UNIT-3

Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory

UNIT-4

Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC

UNIT-5

Game Playing: Overview, And Example Domain: Overview, Mini Max, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction

Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models:Introduction: Hopfield Network, Learning InNeural Network, Application OfNeural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI

Text Books:

1. Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill,2005.
2. Stuart Russel and Peter Norvig, “Artificial Intelligence:AModernApproach”,3rd Edition,PrenticeHall,2009.

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III Year II Semester	LINEAR AND DIGITAL IC APPLICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Analyze and design various configurations of operational amplifiers ,and applications such as instrumentation amplifiers, voltage regulators, comparators, and waveform generators.
- Design and implement active filters and wave form generators using op-amps,IC-555, and IC-565, and evaluate their performance for signal processing applications
- Compare different data conversion techniques (DACandADC)and implement digital-to-analog and analog-to-digital conversion circuits in real-time applications.
- Apply combinational logic ICs such as multiplexers,de-multiplexers,encoders,decoders, and arithmetic circuits to solve complex digital design problems.
- Develop sequential circuits using flip-flops, counters ,and shift registers, and analyze their use in digital memory systems, including ROM, RAM, and their variants

UNIT–I

Operational Amplifier: Ideal and Practical Op-Amp, Op-Amp Characteristics, DC and AC Characteristics, features of 741 Op-Amp, Modes of Operation-Inverting, Non-Inverting, Differential, Instrumentation Amplifier, AC Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Features of 723 Regulator, Three Terminal Voltage Regulators.

UNIT-II

Op-Amp, IC-555 & IC565 Applications: Introduction to Active Filters, Characteristics ofBandpass, Band reject and All Pass Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer-Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL-Block Schematic, principle and Applications.

UNIT-III

Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types ofADCs – Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

UNIT-IV

Combinational Logic ICs: Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs - Code Converters, Decoders, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, De-multiplexers, Priority Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT-V

Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs - All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers. Memories-ROMArchitecture,TypesofROMS&Applications,RAMArchitecture,Static&Dynamic RAMs.

TEXT BOOKS:

1. RamakanthA.Gayakwad-Op-Amps&LinearICs,PHI,2003.
2. Floyd and Jain-Digital Fundamentals,8[th]Ed.,Pearson Education,2005.

REFERENCE BOOKS:

1. D.Roy Chowdhury–Linear Integrated Circuits, NewAge International(p)Ltd ,2[nd]Ed.,2003.
2. John.F.Wakerly–DigitalDesignPrinciplesandPractices,3[rd]Ed.,Pearson,,2009.
3. Salivahana- Linear Integrated Circuits and Applications,TMH,2008.
4. William D.Stanley-Operational Amplifiers with Linear Integrated Circuits, 4[th]Ed.,Pearson Education India, 2009

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III Year II Semester	PRINCIPLES OF COMMUNICATIONS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Analyze the performance of an alogmodulation schemes in time and frequency domains.
- Analyze the performance of angle modulated signals.
- Characterize analog signals in time domain as random processes and noise
- Characterize the influence of channel on analog modulated signals
- Determine the performance of analog communication systems in terms of SNR
- Analyze pulse amplitude modulation, pulse position modulation, pulse code modulation and TDM systems.

UNIT1 :Basic tools for communication, Fourier Series/Transform ,Properties, Autocorrelation, Energy Spectral Density, Parsevals Relation, Amplitude Modulation (AM), Spectrum ofAM, Envelope Detection, Power Efficiency, Modulation Index.

UNIT2 :Double Sideband Suppressed Carrier (DSB-SC) Modulation, Demodulation, Costas Receiver, Single Sideband Modulation (SSB), Hilbert Transform, Complex Pre-envelope/ Envelope, Demodulation of SSB, Vestigial Sideband Modulation (VSB)

UNIT3:AngleModulation, Frequency Modulation (FM), PhaseModulation (PM), Modulation Index, Instantaneous Frequency, Spectrum of FM Signals, Carsons Rule for FM Bandwidth, Narrowband FM Generation, Wideband FM Generation via Indirect Method, FM Demodulation

UNIT 4: Introduction to Sampling, Spectrum of Sampled Signal, Aliasing, Nyquist Criterion, Signal Reconstruction from Sampled Signal, Pulse Amplitude Modulation**,** Quantization, Uniform Quantizers – Midrise and Midtread, Quantization noise, , Non uniform Quantizers, Delta Modulation, Differential Pulse Code Modulation (DPCM)

UNIT5::Basics of Probability, Conditional Probability, MAP Principle, Random Variables,

Probability Density Functions, Applications in Wireless Channels, Basics of Random Processes ,Gaussian Random Process, Noise.

TEXT BOOKS:

1. Simon Haykin, Communications Systems,4thEdition.JohnWileyandSons,Inc
2. Fundamentals of Wireless Communication by DavidTse

III Year II Semester	PRINCIPLES OF SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course Outcomes:

- Acquire the knowledge in signals and systems.
- Get familiarized with various transforms to analyze continuous time signals.
- Understand sampling theorem and z-transform.
- Get familiarized with the transforms of discrete time signals.
- Design the digital filter design

Unit-I: Introduction:

Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, Amplitude - scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals, impulse Function, step function, signum function and ramp function. Introduction, Linear system, impulse response, Linear time invariant (LTI) system, Linear time invariant(LTV)system,Conceptofconvolutionintimedomainandfrequencydomain,Graphical representation of convolution, Transfer function of a LTI system, Related problems.

Unit-II:Analysis of continuous time signals

Fourier Series and Fourier Transform:

Fourier series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series,. Deriving Fourier transform from Fourier series, Fourier transform of standard signals, properties of Fourier transforms, Related problems.

Laplace Transforms:

Introduction, Concept of region of convergence (ROC) for Laplace transforms, Properties of L.T's,InverseLaplacetransform,RelationbetweenLaplaceTransformandFourierTransformof a signal.

UnitIII:

Sampling Theorem: Graphical and analytical proof for Band Limited Signals, impulse sampling, Reconstruction of signal from its samples, Aliasing

Z–Transforms: Concept of Z-Transform of a discrete sequence. Region of convergence in Z-Transform,Inverse Z-transform, properties of Z-transforms

Unit IV:

Fourier Transforms of discrete signal: Fourier Transform of Discrete Signal, Properties, andInverse Fourier Transforms, related problems

DiscreteFourierTransforms:Definition,Properties,InverseDFT,relatedproblems.

Fast Fourier Transform: Decimation in Time domain and Decimation inFrequency Algorithms.

UnitV:

Digital Filters: **Structures of IIR filters and FIR filters**: Director form–1 and Direct form 2; cascade form; parallel form **Analog filter design** LPF, BPF, HPF and BEF filter design using Butterworth **Frequency Transformations:** Analog to Analog; Digital and Digital **IIR Filter Design:** IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation. **FIR Filter Design:** Filter design using windowing techniques. Rectangular Window, Hamming Window, Hanning Window

Text Books:

1. Signals,Systems&Communications-B.P.Lathi,BSPublications,2003.
2. Digital Signal Processing-P.RameshBabu,5[th]Edition,SCITECHPublishers.

Reference Books:

1. Signals&Systems–SimonHaykinandVanVeen,Wiley,2[nd]Edition,2007.
2. Signals and Systems-A.V.Oppenheim,A.S.WillskyandS.H.Nawab,PHI,2[nd]Edn,1997.
3. Discrete Time Signal Processing –A.V.Oppenheim and R.W. Schaffer, 3rd Edition, Pearson, 2014.

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III Year II Semester	MICRO PROCESSORS & MICRO CONTROLLERS	L	T	P	C
		3	0	0	3

Course Outcomes:

- Understand the architecture of 8086 and its operation.
- Develop the students to compose the assembly language program for 8086.
- Applying 8086 processor to interface with necessary peripherals.
- Understand the architecture o f8051and interfacing with necessary peripherals.
- Understand the introductory concepts of advanced processors, viz.,ARM processors.

UNIT-1:

Introduction: Microprocessor based system, Origin of microprocessors, Harvard and Von Neumann architectures with examples, Microprocessor Unit versus Microcontroller Unit.

8086 Architecture: internal architecture of 8086 microprocessor, register organization, physical memory organization, general bus operation.

UNIT-2:

8086 Programming: instruction set, addressing modes, assembler directives, programming with assembler, writing simple programs with an assembler, stack and stack structure, interrupts and interrupt service routines, interrupt cycle of 8086.

UNIT-3:

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Intel 8251 USART architecture and interfacing, stepper motor, A/D and D/A converters

UNIT-4:

Intel8051 MICRO CONTROLLER and Interfacing

Introduction to microcontrollers, internal architecture of 8051 microcontroller, I/O ports and memory organization, MCS51 addressing modes and instruction set, assembly language programming, simple programs, counters/timers, serial data input/output, interrupts. Interfacing to 8051: A/D and D/A Convertors, keyboard, LCD Interfacing.

UNIT-5:

ARM Architectures and Processors: introduction to CISC and RISC architectures, ARM Architecture, ARM Processors Families, Introduction to 16/32 bit processors, ARM7 architecture and organization, Thumb instructions, ARM Cortex-M3 Processor Functional Description.

TEXT BOOKS:

1. Advanced microprocessors and peripherals by K. M.Bhurchandi,A.K.Ray ee
2. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; Pearson 2-Edition,2011.
3. Microprocessors and Microcontrollers by N.SenthilKumar,M.SaravananandS. Jeevanathan Oxford higher education

REFERENCE BOOKS:

1. Embedded Systems Fundamentals with Arm Cortex-M based Microcontrollers: A Practical Approach in English, by Dr. Alexander G. Dean, Published by Arm EducationMedia,2017.
2. Cortex-M3TechnicalReferenceManual.
3. TheDefinitiveGuidetoARMCortex-M3andCortex-M4ProcessorsbyJosephYiu.,Newnes

Third edition

III Year II Semester	VLSI DESIGN LAB	L	T	P	C
		0	0	3	1.5

Laboratory Objective

The objective of this laboratory course is to enable students to design, simulate, and implement CMOS-based digital and analog circuits using industry-standard Electronic Design Automation (EDA) tools. Students are expected to develop a comprehensive understanding of schematic capture, layout design, and verification methodologies as per current CMOS technology standards.

List of Experiments:

Students shall design the schematic diagrams using CMOS logic, generate corresponding layout diagrams,andperformsimulationandanalysisusingthelatestCMOSprocesstechnologywith **theaid of** professional-grade EDA tools (Cadence/Synopsys/Mentor Graphics/Tanner/Microwind or any Industry Standard EDATools)**.**

The following experiments shall be carried out:

1. Design and implementation of an inverter
2. Design and implementation of universal gates
3. Design and implementation of full adder
4. Design and implementation of full Subtractor
5. Design and implementation of RS-latch
6. Design and implementation of D-latch
7. Design and implementation asynchronous counter
8. Design and Implementation of static RAM cell
9. Design and Implementation of differential amplifier
10. Design and Implementation of ring oscillator

Equipment Required:

1. Cadence/Synopsys/MentorGraphics/Tanner/MicrowindoranyIndustryStandardEDATools
2. Personal computer with necessary peripherals.

III Year-II Semester	MICROPROCESSOR AND MICROCONTROLLERSLAB	L	T	P	C
		0	0	3	1.5

List of Experiments:

PART-A:(Minimum of 5 Experiments has to be performed) 8086 Assembly Language Programming and Interfacing

1. Programsfor16-bit arithmetic operations (using Various AddressingModes).
   a. Addition and subtraction of n-BCDnumbers.
   b. Multiplication and Division operations.
   c. Addition of an array of numbers with over flow detection.
2. Program for sorting an array.
3. Program for Factorial of given n-numbers.
4. Interfacing ADCto8086
5. Interfacing DAC to8086.
6. Interfacing stepper motor to8086.
7. Interfacing Seven-Segment display to 8086
8. Key board interface with 8086

PART-B:(Minimumof5Experimentshastobeperformed)8051Assembly Language Programming and Interfacing

1. Findingnumberof1'sandnumberof0'sinagiven8-bit number
2. Average of n-numbers.
3. Program and verify Timer/Counterin8051.
4. InterfacingTrafficLightControllerto8051.
5. UARTOperationin8051
6. InterfacingLCDto8051.
7. Interfacing temperature sensor(LM35)with8051
8. Steppermotorcontrolwith8051

PART-C(Minimum of 2 Experiments has to be performed)Conduct the Following experiments using ARM CORTEXM3 PROCESSOR USING KEILMDKARM

1. Write an assembly program to multiply of 2 16-bit binary numbers.
2. Write an assembly program to find the sum of first10integers numbers.
3. Write a program to toggle LED every second using timer interrupt.
4. PWM signal generation
5. Analog signal measurement (ADC)
6. Interfacing with serial communication (UART)

Equipment Required:

1. Regulated Power supplies
2. Analog/ Digital Storage Oscilloscopes
3. 8086Microprocessor kits
4. 8051microcontrollerkits
5. ADC module, DAC module
6. Stepper motor module
7. Key board module
8. LED,7-Segemt Units, LCD display modules
9. Temperature sensor module
10. Digital Multimeters
11. ROM/RAM Interface module
12. Bread Boardetc.
13. ARMCORTEXM3
14. KEILMDKARM,Digital Multi-meter

PRAKASAM ENGINEERING COLLEGE (AUTONOMUS)
KANDUKURU –523105,AndhraPradesh,India
B.TECH–ELECTRONICSANDCOMMUNICATIONENGINEERING
(R23 -IIIrd YEAR COURSE STRUCTURE & SYLLABUS)

III Year I Semester	ANALOG AND DIGITAL CIRCUITS LAB	L	T	P	C
		0	0	3	1.5

Course Objectives:
To impart knowledge on

- Analysis of transistor amplifiers
- Analysis of feedback amplifiers and oscillators
- Realization of digital circuits such data routing, registers and counters.

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

CO1: Analyse diode clipper/clamper circuits and transistor biasing.
CO2: Illustrate the operation of feedback amplifiers and oscillator circuits.
CO3: Analyze the applications of linear IC's
CO4: Demonstrate the operation of digital circuits such as arithmetic, data routing, registers and counters.

Any 5 of the Following Experiments are to be conducted from each PART A.

1. Analysis of clipper and clamper circuits.
2. Analysis of self-bias to a transistor.
3. Analysis of voltage series and current series feedback amplifiers.
4. Analysis of Wien Bridge oscillator and RC-phase shift oscillator.
5. Analysis of Integrator and Differentiator Circuits using IC 741.
6. Analysis of Monostable and Astable multivibrator operation using IC 555 Timer.
7. Analysis of Schmitt Trigger Circuits using IC 741 and IC 555.
8. Verify the PLL characteristics using IC 565.
9. Analysis of 8 bit A to D and D to A circuits

PART-B

1. Design of Full adder and Full Subtractor using logic gates.
2. Realization of parallel adder/subtractor using IC 7483.
3. Implementation of 3 to 8 line decoder using logic gates and IC 7445.
4. Implementation of 8 to 1 multiplexer using logic gates and IC 74151.
5. Verify the operation of master-slave JK flip-flop using IC7476.
6. Realization of the following shift registers using IC7495.
    a) SISO
    b) SIPO
    c) PISO
    d) PIPO
7. Implementation ofMod-10 ripples counter using flip-flops and IC 7490.
8. Implementation of Mod-8 synchronous up/down counters using flip-flops.
9. Implementation of 4 bit Ring Counter and Johnson Counter using D flip-flops/J-K flip-flops.