JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURAJADA VIZIANAGARAM

JNTU-GV COLLEGE OF ENGINEERING VIZIANGARAM (A)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech. III-Year I Semester

S. No.	Category	Title	L	T	P	C
1	Professional Core	Analog and Digital IC Applications	3	0	0	3
2	Professional Core	Microprocessors and Microcontrollers	3	0	0	3
3	Professional Core	Antennas and Wave Propagation	3	0	0	3
4	Professional Elective - I	Electronic Measurements and Instrumentation	3	0	0	3
		CMOS Analog IC Design				
		Computer Architecture and Organization				
		Bio Medical Signal Processing				
5	Open Elective - I		3	0	0	3
6	Professional Core Lab-1	Analog and Digital IC Applications Lab	0	0	3	1.5
7	Professional Core Lab-2	Microprocessors and Microcontrollers Lab	0	0	3	1.5
8	Skill Enhancement course	Applications of Lab view for Instrumentation & Communications	0	1	2	2
9	Engineering Science	PCB Design Practice	0	0	2	1
10	Evaluation of Community Service Internship		-	-	-	2
11	Audit Course	Constitution of India	2	0	0	0
Total			**17**	**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	Microwave Engineering and Optical Communications	3	0	0	3
3	Professional Core	Digital Signal Processing	3	0	0	3
4	Professional Elective - II	Information Theory and Error Control Coding Wireless Sensor Networks CMOS Digital IC Design Satellite Communications	3	0	0	3
5	Professional Elective - III	Mobile and Cellular Communications Optimization Techniques Radar Engineering Communication Networks	2	0	0	2
6	Open Elective-II		3	0	0	3
7	Professional Core Lab-1	VLSI Design Lab	0	0	3	1.5
8	Professional Core Lab-2	Microwave Engineering and Optical Communications Lab	0	0	3	1.5
9	Skill Enhancement course	Machine Learning	0	1	2	2
10	Audit Course	Technical Paper Writing and IPR	2	0	0	0
		Total	**19**	**1**	**8**	**22**

Mandatory Industry Internship of 8 weeks duration during summer vacation

B.Tech. IV-Year I Semester

S.No.	Category	Title	L	T	P	C
1	Professional Core	Digital Image and Video Processing	3	0	0	3
2	Management Course– II	Management Science	2	0	0	2
3	Professional Elective - IV	Advanced Digital Communications Global Navigation Satellite systems Modern VLSI Design Embedded System	3	0	0	3
4	Professional Elective - V	Low Power VLSI Design Speech Signal Processing DSP Processors and Architectures Quantum Communications	2	0	0	2
5	Open Elective-III		3	0	0	3
6	Open Elective-IV		3	0	0	3
7	Professional Core Lab-1	Digital Signal and Image Processing Lab	0	0	3	1
8	Professional Core Lab-2	Advanced Communications Lab	0	0	3	1
9	Skill Enhancement course	Embedded Systems	0	1	2	2
10	Evaluation of Industry Internship		-	-	-	2
Total			**16**	**1**	**8**	**22**

B.Tech. IV-Year II Semester

S.No.	Category	Title	L	T	P	C
1	Internship and Project work	Internship and Project	**0**	**0**	**24**	**12**

Open elective courses offered by Dept of ECE

- **Open Elective 1 (III B. Tech – I Semester)**

1. Electronic Devices and Basic Circuits
2. Fundamentals of Signals and Systems
3. Digital Electronics
4. Principles of communications

- **Open Elective 2 (III B. Tech – II Semester)**

1. IC Applications
2. Principles of Signal Processing
3. Concepts of Microprocessors and Microcontrollers
4. Fundamentals of Antennas

- **Open Elective 3 (IV B. Tech – I Semester)**

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

- **Open Elective 4 (IV B. Tech – I Semester)**

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

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Honor Degree in Electronics and Communication Engineering

Note: A student must acquire an additional 18 credits and out of which at least 6 credits (i.e., 2 Courses of 3 Credits each) must be earned from NPTEL/SWAYAM MOOC Courses

(As per Proc.NoE1/JNTUGV/DAP/Guidelines for B. Tech Honors/2025 Dt: 20-02-2025)

1. VLSI Design

S. No	Subject Title	L	T	P	C
1	Digital System Design	3	0	0	3
2	Analog and Digital CMOS VLSI Design	3	0	0	3
3	VLSI Signal Processing	3	0	0	3
4	CAD for VLSI	3	0	0	3

2. Embedded Systems

S. No	Subject Title	L	T	P	C
1	Embedded System Design	3	0	0	3
2	Embedded Real Time Operating Systems	3	0	0	3
3	Embedded Networking	3	0	0	3
4	IoT based Embedded System Design	3	0	0	3

3. Communication Systems

S. No	Subject Title	L	T	P	C
1	Network Security and Cryptography	3	0	0	3
2	Advanced Communication Networks	3	0	0	3
3	Wireless and Mobile Communications	3	0	0	3
4	Machine Learning for Next Generation Communications	3	0	0	3

4. Signal Processing

S. No	Subject Title	L	T	P	C
1	Transform Techniques	3	0	0	3
2	Statistical Signal Processing	3	0	0	3
3	Advanced Digital Signal Processing	3	0	0	3
4	Deep Learning Techniques for Signal Processing	3	0	0	3

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JNTU-GV COLLEGE OF ENGINEERING VIZIANGARAM (A)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Minors offered by ECE department to Other Branches

Note: A student must acquire additional 18 credits, for the award of Minor by fulfilling at least 3 credits must be earned from NPTEL/SWAYAM MOOC Courses

(As per Proc.NoE1/JNTUGV/DAP/Guidelines for B. Tech Minors/2025 Dt: 20-02-2025)

- **Group-1**

S. No	Subject Title	L	T	P	C
1	Electronic Devices and Linear ICs	3	0	0	3
2	Fundamentals of Lab view	3	0	0	3
3	Geographic Information Systems	3	0	0	3
4	Principles of Communication Systems	3	0	0	3

- **Group-2**

S. No	Subject Title	L	T	P	C
1	Coding Theory and Practice	3	0	0	3
2	Fundamentals of Digital Signal Processing	3	0	0	3
3	Microcontrollers and Interfacing	3	0	0	3
4	Digital Design with Verilog HDL	3	0	0	3

- **Group-3**

S. No	Subject Title	L	T	P	C
1	Fundamentals of VLSI	3	0	0	3
2	VLSI Design Flow: RTL to GDS	3	0	0	3
3	Fundamentals of Quantum Communications	3	0	0	3
4	Fundamentals of Multimedia Networking	3	0	0	3

- **Group-4**

S. No	Subject Title	L	T	P	C
1	Ad-hoc and Wireless Sensor Networks	3	0	0	3
2	Digital Image Processing	3	0	0	3
3	Sensors and Data Acquisition System	3	0	0	3
4	Medical Robotics	3	0	0	3

	L	T	P	C
B. Tech III year I- Semester	3	0	0	3

Analog and Digital IC Applications

Course Objectives:

- To introduce the basic building blocks of analog and digital integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To teach the theoretical concepts of ADC and DAC.
- To introduce the concepts of waveform generators and some special function ICs.
- To understand and implement the applications of basic digital logic circuits using HDL.

Unit-1

Operational Amplifier (OP-AMP): Classification of Integrated Circuits (ICs), OP-AMP: Introduction, block diagram, ideal and practical OP-AMP, features of IC 741 OP-AMP, modes of operation of OP-AMP, DC and AC Characteristics of OP-AMP, OP-AMP as AC amplifier, differentiator, integrator, comparator, zero crossing detector, regenerative comparator and Instrumentation Amplifier.

Unit-2

IC-741, IC-555 & IC-565 Applications: Introduction to active filters, analysis of first order LPF & HPF Butterworth filters, square, triangular and saw-tooth waveform generators, RC-Phase-Shift and Wien-Bridge oscillators using OP-AMP, Introduction to IC-555 Timer: functional diagram, astable and monostable multivibrators using 555 Timer and IC-741, Introduction to PLL (IC-565): block diagram and operation principle, PLL as frequency multiplier.

Unit-3

Data Converters: Introduction, DAC Techniques: Weighted resistor DAC, R-2R ladder DAC and Inverted R-2R DAC, ADC Techniques: Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.

Unit-4

Digital Integrated Circuits-Combinational Logic ICs: Familiarity with commonly available TTL-74XX Series ICs pertaining to 4-bit parallel adder (74LS83A/74LS283), 8-bit/16-bit parallel adder using two/four 74LS283 ICs, 4-bit comparator (74HC85), 8-bit comparator using two 74HC85 ICs, 8X1 multiplexer (74LS151), 1-to-16 demultiplexer (74HC154), 4-line-to-16-line decoder (74HC154), BCD-to-7-Segment decoder (74LS47), 8-to-3 bit and 10-to-4 bit priority encoders (74HC147 & 74LS148), 9-bit parity generator (74LS280). (Qualitative approach of designing and modelling the logic circuits using HDL)

Unit-5

Digital Integrated Circuits-Sequential Logic ICs and Memories: Familiarity with commonly available TTL-74XX Series ICs pertaining to S-R latch (74LS279), quad gated D-latch (74LS75), dual D-Flip-flop (74AHC74), dual J-K Flip-flop (74HC112), 4-bit synchronous binary counter (74HC163), 4-bit synchronous decade counter (74F162) and various shift registers(74HC164/74HC165/74HC195) (Qualitative approach of designing and modelling the logic circuits using HDL)

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

Textbooks:

1. Linear Integrated Circuits: D. Roy Chowdhury, New Age International (p) Ltd, 2nd Edition, 2003.
2. Op-Amps & Linear ICs: Ramakanth A. Gayakwad, PHI, 2003.
3. Digital Fundamentals: Floyd and Jain, Pearson Education,8th Edition,2005.

Reference Books:

1. Linear Integrated Circuits and Applications- Salivahanan, TMH.
2. Modern Digital Electronics-RPJain-4/e-TMH,2010.
3. Digital design principles and practices-John. F. Wakerly3/e,2005.

Course Outcomes:

- A thorough understanding of operational amplifiers usage with linear and non-linear applications.
- Understanding the familiarity of various digital integrated circuits and their characteristics.
- The students will be able to design circuits using operational amplifiers and other specialized ICs for various applications.

	L	T	P	C
B. Tech III year I- Semester	3	0	0	3

Microprocessors and Microcontrollers

Course Objectives:

- To understand learn concepts of microprocessor, different addressing modes and programming of 8086.
- Understand interfacing of 8086, with memory and other peripherals.
- To learn concepts of PPI, DMA and programmable interrupt controller.
- Study the features of advanced processors, Pentium processors.
- Study the features of 8051 Microcontroller, its instruction set and also other controllers like PIC controllers.

Unit-I:

8086 Architecture: Main features, pin diagram/description, 8086 microprocessor family, 8086 internal architecture, bus interfacing unit, execution unit, interrupts and interrupt responses, 8086 system timing, minimum mode and maximum mode configuration.

8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

Unit-II:

8086 Interfacing : Semiconductor memories interfacing (RAM,ROM), 8254 software programmable timer/counter, Intel 8259 programmable interrupt controller, software and hardware interrupt applications, Intel 8237a DMA controller, Intel 8255 programmable peripheral interface, keyboard interfacing, alphanumeric displays (LED,7-segment display, multiplexed 7-segment display, LCD), Intel 8279 programmable keyboard/display controller, stepper motor, A/D and D/A converters.

Unit-III:

80386 And 80486 Microprocessors: Introduction, programming concepts, special purpose registers, memory organization, moving to protected mode, virtual mode, memory paging mechanism, architectural differences between 80386 and 80486 microprocessors. Introduction to Pentium and ARM Processors.

Unit-IV:

Intel 8051 Microcontroller: Architecture, hardware concepts, input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts.

Assembly language programming: Instructions, addressing modes, simple programs. Interfacing: keyboard, displays (LED, 7-segment display unit), A/D and D/A converters.

Unit-V:

Pic Microcontroller: Introduction, characteristics of PIC microcontroller, PIC microcontroller families, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.

Textbooks:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition.
2. The 8051 Microcontroller & Embedded Systems Using Assembly and C by Kenneth J. Ayala, Dhananjay V. Gadre, Cengage Learning, India Edition.

Reference Books:

1. The Intel Microprocessors-Architecture, Programming, and Interfacing by Barry B. Brey, Pearson, Eighth Edition-2012.
2. Microprocessors and Microcontrollers-Architecture, Programming and System Design by Krishna Kant, PHI Learning Private Limited, Second Edition, 2014.

Course Outcomes:

- Develop the assembly language programs for different addressing modes.
- Perform 8086 interfacing with different peripherals and implement programs.
- Describe the key features serial and parallel communication.
- Design Microcontroller for simple Applications.
- Distinguish between architectures of various processors and controllers.

B. Tech III year I- Semester	L	T	P	C
	3	0	0	3

Antennas and Wave Propagation

Course Objectives:

- Understand the applications of electromagnetic waves in free space.
- Learning the working principles of various types of antennas
- Understand the concept of antenna arrays
- Understand the major applications of antennas with an emphasis on how antennas are employed to meet electronic system requirements.
- Understand the concepts of radio wave propagation in the atmosphere.

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, Main Lobe and Side Lobes, Beamwidths, Polarization, Beam Area, Radiation Intensity, Beam Efficiency, Directivity, Gain 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, Beamwidths, Directivity, Effective Area and Effective Height. Natural current distributions, fields and patterns of Thin Linear Center-fed Antennas of different lengths, Radiation Resistance at a point which is not current maximum.

Unit III: Antenna Arrays

2 element arrays – different cases, Principle of Pattern Multiplication, N element Uniform Linear Arrays – Broadside, End-fire Arrays, 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. Loop Antennas: Small Loops - Field Components, Comparison of far fields of small loop and short dipole, Concept of short magnetic dipole, D and Rr relations for small loops.

UNIT IV:

Long wire antennas – field strength calculations and patterns Microstrip Antennas-Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics. Helical Antennas – Significance, Geometry, basic properties; Design considerations for helical antennas in Axial Mode and Normal Modes (Qualitative Treatment). **Reflector Antennas**: Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. **Horn Antennas**: Types, Optimum Horns, Design Characteristics of Pyramidal Horns; Lens **Antennas** – Geometry, Features, Dielectric Lenses and Zoning, Applications, Antenna Measurements – Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).

UNIT V

Wave Propagation: Concepts of Propagation – frequency ranges and types of propagations. Ground Wave Propagation–Characteristics, Parameters, Wave Tilt, Flat and Spherical Earth Considerations. Sky Wave Propagation – Formation of Ionospheric Layers and their Characteristics, Mechanism of Reflection and Refraction, Critical Frequency, MUF and Skip Distance – Calculations for flat and spherical earth cases, Optimum Frequency, LUHF, Virtual Height, Ionospheric Abnormalities, Ionospheric Absorption.

Fundamental Equation for Free-Space Propagation, Basic Transmission Loss Calculations. Space Wave Propagation – Mechanism, LOS and Radio Horizon. Tropospheric Wave Propagation – Radius of Curvature of path, Effective Earth's Radius, Effect of Earth's Curvature, Field Strength Calculations, M-curves and Duct Propagation, Tropospheric Scattering.

Textbooks:

1. Antennas for All Applications – John D. Kraus and Ronald J. Marhefka, 3rd Edition, TMH, 2003.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.

Reference Books:

1. Antenna Theory - C.A. Balanis, John Wiley and Sons, 2nd Edition, 2001.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.

Course Outcomes:

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

		L	T	P	C
B. Tech III year I- Semester	**Professional Elective-I**	3	0	0	3

Electronic Measurements and Instrumentation

Course Objectives:

- It provides an understanding of various measuring system functioning and metrics for performance analysis.
- Provides understanding of principles of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Understanding the concepts of various measuring bridges and their balancing conditions.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Unit I:

Basic Instruments: Block Schematics of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D'Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

Unit II:

Signal Generators and Analyzers: Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator, Video Signal Generators, and Specifications.

Unit III:

Cathode Ray Oscilloscope: Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications. Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

Unit IV:

Transducers: Transducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchronous, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers, gyroscopes, accelerometers.

Unit V:

Bridges and Measurement of Physical parameters.

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure - High Pressure, Vacuum level, Temperature - Measurements, Data Acquisition Systems.

Textbooks:

1. H.S.Kalsi, Electronic instrumentation, Tata McGraw Hill, 2nd Edition, 2004.
2. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, PHI,5th Edition, 2002.

Reference Books:

1. David A. Bell, Electronic Instrumentation & Measurements, PHI, 2nd Edition, 2003.
2. Robert A.Witte Electronic Test Instruments, Analog and Digital Measurements, Pearson Education, 2 Edition, 2004.
3. K. Lal Kishore, Electronic Measurements & Instrumentations, Pearson Education, 1
4. Bell Electronic measurements and Instrumentation – B. M. Oliver and J.M. Cage, TMH, 2009.

Course Outcomes:

- Measure electrical parameters with different meters and understand the basic definition of measuring parameters.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.
- Operate an Oscilloscope to measure various signals.
- Interpret the measurement of passive component values using bridges
- Measure various physical parameters by appropriately selecting the transducers.

		L	T	P	C
B. Tech III year I- Semester	**Professional Elective-I**	3	0	0	3

CMOS Analog IC Design

Course Objectives:

- To provide in-depth understanding of different types of MOS devices and modeling techniques
- To understand and design the operation of current mirror circuits
- To demonstrate the analysis and design of amplifiers using CMOS
- To design various stages of Operational amplifiers using CMOS devices. Design and construct the open loop and discrete time comparators using op-amp.

Unit –I: MOS Devices and Modeling:

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - 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: **CMOS Amplifiers:**

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

Unit –IV: CMOS Operational Amplifiers:

Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OPAmp.

Unit –V: Comparators:

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

Textbooks:

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

Reference Books:

1. David A. Johns, Ken Martin, Analog Integrated Circuit Design, Wiley Student Edn, 2013.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, TMH Edition.
3. Baker, Li , CMOS: Circuit Design, Layout and Simulation.

Course Outcomes:

- Model various components in CMOS process to estimate their performance in circuits.
- Analyze and design of MOS and different current mirror circuits including Wilson, cascode current mirror.
- Design of CMOS Amplifiers including Differential, Cascode and high gain amplifier architectures.
- Design of CMOS Operational amplifiers and measure the characteristics of cascode operational amplifier.
- Apply and analyze the performance of open loop and discrete time capacitor circuits

		L	T	P	C
B. Tech III year I- Semester	**Professional Elective-I**	3	0	0	3

Computer Architecture and Organization

Course Objectives

- To impart basic concepts of computer architecture and organization,
- To explain key skills of constructing cost-effective computer systems.
- To familiarize the basic CPU organization.
- To help students understand various memory devices.
- To facilitate students in learning IO communication

Unit – I:

Structure of Computers: Computer types, Functional units, Basic operational concepts, VonNeumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Data representation, Fixed and Floating point, Error detection and correction codes.

Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations.

Unit – II:

Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC

Unit - III

Register Transfer and Micro-Operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. **Micro-Programmed Control:** Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit.

Unit - IV

Memory Management System: Memory Hierarchy, Semiconductor Memories, RAM (Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID.

Unit – V

Input Output Organization: I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA. MULTIPROCESSORS: Characteristics of multiprocessors, Interconnection structures, Inter Processor Arbitration, Inter processor Communication and Synchronization, Cache Coherence.

Textbooks:

1. M. Moris Mano (2006), Computer System Architecture, 3rd edition, Pearson/PHI, India.
2. David A. Patterson and John L. Hennessey, "Computer organization and design: The hardware /software interface", Morgan Kauffman / Elsevier, Fifth edition, 2014.

Reference books:

1. Carl Hamacher, Zvonks Vranesic, SafeaZaky (2002), Computer Organization, 5th edition, McGraw Hill, New Delhi, India.
2. William Stallings (2010), Computer Organization and Architecture- designing for performance, 8th edition, Prentice Hall, New Jersy.
3. Anrew S. Tanenbaum (2006), Structured Computer Organization, 5th edition, Pearson Education Inc,
4. John P. Hayes (1998), Computer Architecture and Organization, 3rd edition, Tata McGrawHill.

Course Outcomes:

- Identify various components of computers and their interconnection
- Identify basic components and design of the CPU: the ALU and control unit.
- Compare and select various Memory devices as per requirement.
- Compare various types of IO mapping techniques
- Critique the performance issues of cache memory and virtual memory.

		L	T	P	C
B. Tech III year I- Semester	**Professional Elective-I**	3	0	0	3

Bio Medical Signal Processing

Course Objectives

- ❖ Understand the nature and sources of key biomedical signals such as ECG, EEG, and EMG.
- ❖ Apply signal processing techniques to analyze and extract features from cardiological and neurological signals.
- ❖ Learn methods for the classification and interpretation of biomedical signals using statistical and modeling techniques.
- ❖ Explore adaptive filtering techniques for noise and artifact removal in biomedical signals.
- ❖ Gain insight into diagnostic imaging technologies and their role in biomedical signal analysis.

Unit I:

Introduction to Biomedical Signals: The nature of biomedical signals, action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis, Basic electrocardiography, the brain and its potentials, the electrophysiological origin of brain waves, EEG signals and its characteristics, EEG analysis. Basic EMG. Electroneurogram, Phono cardiogram

Unit II:

Cardiological Signal Processing: Basic ECG, Electrical Activity of the heart, ECG data acquisition, ECG lead system, ECG parameters & their estimation, Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, arrhythmia analysis monitoring, long-term continuous ECG recording, direct ECG data compression techniques. Cardiotocography

Unit III:

Neurological Signal Processing: Basic EEG, Linear prediction theory, the autoregressive method, spectral error measure, adaptive segmentation, Sleep EEG: data acquisition and classification of sleep stages, the markov model and markov chains, template matching for EEG-spike-and-wave detection. Dynamics of sleep-wake transitions, Hypnogram model parameters

Unit IV:

Adaptive Interference/Noise Cancellation: The wiener filtering problem, principle of an adaptive filter, the Widrow Hoff least mean square adaptive algorithm, Adaptive noise canceller: cancellation of 50/60hz interference in ECG, cancelling donor heart interference in heart-transplant ECG, cancellation of high frequency noise in electro-surgery.

Unit V:

Diagnostic Imaging and Integration: Overview of diagnostic imaging modalities: X-ray imaging, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Role of signal processing in imaging, Integration of biomedical signals and imaging data, Data formats, storage, and ethical considerations in biomedical analysis

Textbooks:

1. D. C. Reddy, Biomedical Signal Processing: Principles and Technique's Tata McGraw Hill, 2005.
2. E. N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley and Sons, 2007.
3. Metin Akay, Biomedical Signal Processing, Academic Press, 2012.

Reference Books:

1. Sörnmo, Bioelectrical Signal Processing in Cardiac & Neurological Applications, Academic Press,2005.
2. Rangayyan, Biomedical Signal Analysis, Wiley 2002.
3. I Enderle, Introduction to Biomedical Engineering, Elsevier, 2nd Edition, 2005

Course Outcomes:

- ❖ Explain the nature and origin of common biomedical signals and the physiological systems that generate them.
- ❖ Understand cardiological signals such as ECG and fetal heart rate using signal acquisition and processing techniques.
- ❖ Apply modeling and prediction techniques for processing neurological signals like EEG, including sleep stage classification.
- ❖ Design and implement adaptive filters for biomedical noise removal using LMS and Wiener filtering methods.
- ❖ Discuss and compare diagnostic imaging modalities and evaluate their integration with biomedical signal analysis in clinical settings.

	L	T	P	C
B. Tech III year I- Semester	0	0	3	1.5

Analog and Digital IC Applications LAB

Course Objectives:

- To introduce the basic building blocks of analog and digital integrated circuits.
- To observe the input and output waveforms of various applications of analog and digital integrated circuits.
- To determine the performance parameters of various applications of analog and digital integrated circuits.
- To understand the design concepts and simulation process of analog and digital integrated circuits.
- To teach the qualitative approach of designing and modelling various logic circuits using HDL.

LIST OF EXPERIMENTS

Part-A: Analog Integrated Circuits Applications

1. Operational Amplifier (OP-AMP) Frequency Response in Inverting and Non-Inverting configurations using IC 741
2. OP-AMP as an Integrator and Differentiator using IC 741
3. First order LPF & HPF Active Filters using OP-AMP. (IC 741)
4. OP-AMP as an Astable and Monostable Multivibrators using IC 741
5. Astable and Monostable Multivibrators using 555 Timer
6. Schmitt trigger using IC 741 OP-AMP & IC 555 Timer
7. PLL Characteristics using IC 565
8. R-2R ladder type DAC using OP-AMP. (IC 741)

Part-B: Digital Integrated Circuits Applications

1. 4-bit Parallel Adder using IC 74LS83A/IC 74LS283
2. 4-bit Comparator using IC 74HC85
3. 8 X 1 Multiplexer using IC 74LS151
4. 4-line-to-16-line Decoder using IC 74HC154
5. 8-to-3-bit Priority Encoder using IC 74LS148
6. 9-bit Parity Generator using IC 74LS280
7. The S-R Latch using IC 74LS279
8. Dual JK Flip-Flop using IC 74HC112
9. 4-bit Synchronous Decade Counter using IC 74F162 or Decade Counter using IC 74LS90 or 4-bit Counter using IC 74LS93.

10. Shift Register using IC 74HC164/IC 74HC165/IC 74HC195.
11. RAM (16 X 4) using IC 74LS189 (Read and Write Operations)
12. ALU

Note: The students are required to verify the applications of analog and digital integrated circuits using necessary hardware and perform the simulation using appropriate EDA tools available. (licensed/perpetual/opensource EDA tools).

Course Outcomes:

- A thorough understanding of functionality of both analog and digital integrated circuits and their applications.
- Understanding the concepts that are required to design a specific application using respective integrated circuits.
- The students will be able to design, simulate and made analysis through various software environment EDA tools.

	L	T	P	C
B. Tech III year I- Semester	0	0	3	1.5

Microprocessors and Microcontrollers Lab

Course Objectives

- ❖ Introduction of assembly level programming
- ❖ Acquire skills to program microprocessors and micro controllers.
- ❖ To be able to understand the addressing modes of microprocessors.
- ❖ To be able to understand the micro controller capability.
- ❖ To introduce interfacing of microprocessors and micro controllers.

List of Experiments

PART- A: (Minimum of 5 Experiments has to be performed)
8086 Assembly Language Programming using Assembler Directives

1. Sorting.
2. Multibyte addition/subtraction
3. Sum of squares/cubes of a given n-numbers
4. Addition of n-BCD numbers
5. Factorial of given n-numbers
6. Multiplication and Division operations
7. Stack operations
8. BCD to Seven segment display codes

PART- B: (Minimum of 3 Experiments has to be performed) 8086 Interfacing

1. Hardware/Software Interrupt Application
2. A/D Interface through Intel 8255
3. D/A Interface through Intel 8255
4. Keyboard and Display Interface through Intel 8279
5. Generation of waveforms using Intel 8253/8254

PART- C: (Minimum of 3 Experiments has to be performed) 8051 Assembly Language Programs

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Addition of even numbers from a given array
3. Ascending / Descending order
4. Average of n-numbers

PART-D: (Minimum of 3 Experiments has to be performed) 8051 Interfacing

1. Switches and LEDs
2. 7-Segment display (multiplexed)

3. Stepper Motor Interface
4. Traffic Light Controller

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. ADC module
6. DAC module
7. Stepper motor module
8. Keyboard module
9. LED
10. 7-Segemt Units
11. Digital Multimeters
12. ROM/RAM Interface module

Course outcomes

- To be able to understand the microprocessor capability in general and explore the evolution of microprocessors.
- To be able to program microprocessors and micro controllers.
- To be able to understand the addressing modes of microprocessors.
- To be able to understand the micro controller capability.
- To be able to develop interrupt handling through devices and to interface microprocessors and micro controllers electronic devices.

		L	T	P	C
B. Tech III year I- Semester	**Skill enhancement Course**	0	1	2	2

Applications of Lab view for Instrumentation & Communications

Course Objectives:

- To introduce LabVIEW programming and simulation of real time applications like instrument control, Signal processing, image processing, Data acquisition etc.

Unit - I

Virtual Instrumentation: An introduction Historical perspective, advantages, block diagram and architecture of a virtual instrument, data-flow techniques, graphical programming in data flow, comparison with conventional programming. Development of Virtual Instrument using GUI, Real-time systems.

Unit - II

VI programming techniques: VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

Unit - III

Data acquisition basics: Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques, and buses. ADC, DAC, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements.

Unit - IV

VI Interface requirements: Common Instrument Interfaces: Current loop, RS 232C/ RS485, GPIB. Bus Interfaces: USB, PCMCIA, VXI, SCSI, PCI, PXI, Firewire. PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

Unit - V

VI toolsets: Distributed I/O modules. Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control.

Textbooks:

1. LabVIEW Graphical Programming, Gary Johnson, Second edition, McGraw Hill, Newyork, 1997.
2. LabVIEW based Advanced Instrumentation Systems, S. Sumathi and P. Surekha, Spinger.

Reference Books:

1. PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Kevin James, Newnes, 2000.
2. WEB RESOURCES: www.ni.com
3. LabVIEW for everyone, Lisa K. wells & Jeffrey Travis Prentice Hall, New Jersey, 1997.

Course Outcomes:

- ❖ Upon completion of this course the student shall be able to develop their own GSD and interface them with real world instruments.

B. Tech III year I- Semester	L	T	P	C
	0	0	2	1

PCB Design Practice

Course Objectives:

- ❖ To introduce students to the fundamentals of PCB design, layout, and fabrication processes using industry-standard EDA (Electronic Design Automation) tools.
- ❖ To develop competency in schematic capture, circuit simulation, and PCB layout creation for analog and digital circuits such as power supplies, amplifiers, filters, and control systems.
- ❖ To enable students to understand the practical aspects of PCB design, including parameter setting, component placement, routing, and thermal management.
- ❖ To promote hands-on experience in designing real-world application circuits, such as sensor-based systems and security circuits, using both simulation and physical prototyping.
- ❖ To provide exposure to thermal design concepts and heat dissipation techniques in PCB design to ensure circuit reliability and performance.

List of experiments:

1. Introduction to PCB DESIGN and EDA Tool Software
2. Parameter setting for PCB Design.
3. Design of a ±5V Power supply.
4. Schematic Creation and simulation of an electronic circuit
5. Design and Simulate ON/OFF Switches Circuits
6. Design and simulation of a Half and Full Wave Rectifier
7. Design of a PCB layout of Low pass filter
8. Design of a PCB layout of CE Amplifier
9. Design and Simulate Simple 7 Segment Circuits
10. Design of an IR Proximity Sensor – Touchless Doorbell using Zero PCB
11. Design of a Laser Light Security Alarm.
12. Design of a Mobile Phone Detector Circuit.
13. Study of PCB Thermal management techniques.
14. Study of Transistor Heat dissipation using PCB.

Textbooks:

1. Simon Monk, “Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards (Electronics)” 2017

Reference books:

1. S. Yogesh, "OSCAD: An Open-Source EDA Tool for Circuit Design, Simulation, Analysis and PCB Design", Shroff Publishers & Distributors Pvt. Ltd, 2013.

e-resources:

1. https://www.udemy.com/course/circuit-design-simulation-and-pcb-manufacturing-bundle

2. https://www.allaboutcircuits.com/technical-articles/pcb-thermal-management-techniques/

Course Outcomes:

- Determine appropriate components to make circuits.
- Design of a Power Supply Module
- Design of types of Rectifiers
- Analyze the Design of a Security System
- Design of an electronic printed circuit board for a specific application using standard software.

		L	T	P	C
B. Tech III year I- Semester	**Audit Course**	2	0	0	0

Constitution of India

Course Objectives

- ❖ Understand the historical development and philosophy behind the Indian Constitution.
- ❖ Gain insights into the structure, functioning, and powers of Union and State Governments.
- ❖ Comprehend the scope of fundamental rights, duties, and directive principles.
- ❖ Recognize the functioning of constitutional bodies and their roles in governance.
- ❖ Appreciate the significance of local self-governance and recent constitutional amendments.

Unit I:

Constitutional Foundation and Historical Background: Constitutional history and the making of the Indian Constitution, Role of the Constituent Assembly, Salient features of the Indian Constitution, Significance of the Preamble, Process of constitutional amendments (Article 368)

Unit II:

Fundamental Rights, Duties, and Directive Principles: Citizenship provisions under the Constitution, Fundamental Rights (Articles 12–35), Directive Principles of State Policy (Articles 36–51), Fundamental Duties (Article 51A)

Unit III:

Union Government: President and Vice President: election, powers, and removal, Prime Minister and Council of Ministers, Structure and functions of Parliament, Judiciary: Structure and powers of the Supreme Court, Centre-State relations: legislative, administrative, and financial, Emergency provisions (Articles 352, 356, 360)

Unit IV:

State Government and Local Governance: Governor: Appointment, powers, and functions, State Legislature and Chief Minister, Role of High Courts, Rural and Urban Local Governments, 73rd and 74th Constitutional Amendment Acts (Panchayati Raj and Municipalities)

Unit V:

Constitutional and Statutory Bodies: Comptroller and Auditor General (CAG), Election Commission of India, Finance Commission, Attorney General and Advocate General, Union and State Public Service Commissions (UPSC & SPSC), Tribunals and National Human Rights Commission (NHRC)

Textbooks:

1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009.
2. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", 2012, MIT Press (Unit-2&3)
3. M. V. Pylee, Introduction to the Constitution of India, 5th Ed., Vikas Publishing House, Mumbai, 2007.

Reference Books:

1. D.D. Basu, Introduction to the Indian Constitution, 21st Ed., Lexis Nexis, Gurgaon, India, 2011. 2. Subhas C. Kashyap, Our Constitution, 2nd Ed., National Book Trust India, New Delhi, 2013

e-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_lw02/preview Evaluation of Industry Internship

Course Outcomes (COs):

- Explain the evolution and salient features of the Indian Constitution.
- Describe the structure of the Indian Government and its functioning at the Union and State levels.
- Analyze the significance of the Preamble, Fundamental Rights, and Duties.
- Evaluate the role of statutory and constitutional bodies in democratic governance.
- Interpret the importance of decentralization through Panchayati Raj and urban local bodies.

	L	T	P	C
B. Tech III year II- Semester	3	0	0	3

VLSI Design

Course Objectives:

- To introduce the basic concepts of MOS technology and electrical properties of MOS circuits.
- To teach the MOS and Bi-CMOS circuit design processes.
- To teach the basic MOS circuit concepts and their scaling parameters.
- To discuss various VLSI design issues.
- To understand the concepts of FPGA design and its implementation.

Unit-1

Introduction to MOS Technology: The IC Era, MOS transistor theory, fabrication processes of nMOS, CMOS and BiCMOS technologies. Basic Electrical Properties of MOS Circuits: Ids versus Vds relationships, MOS transistor threshold voltage, MOS transistor parameters, the pass transistor, the nMOS inverter, Pull-up to Pull-down ratios for various nMOS inverter configurations, alternative forms of pull-up, the CMOS inverter,the Bi-CMOS inverter, latch-up in CMOS circuits, Comparison between CMOS and BiCMOS technology.

Unit-2

MOS and Bi-CMOS Circuit Design Processes: MOS layers, stick diagrams, design rules and layout, general observations on the design rules, 2µm double metal, double poly, CMOS/BiCMOS rules, 1.2µm double metal, single poly CMOS rules, layout diagrams of CMOS based inverter, NAND and NOR gates, symbolic diagrams-translation to mask form.

Unit-3

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, limitations of scaling, limits due to sub threshold currents, limits on logic levels and supply voltage due to noise and current density.

Unit-4

VLSI Design Issues: Advantages and challenges in VLSI Technology, VLSI design methodologies, VLSI design process, design for testability-DUT, fault model, fault coverage, the single stuck-at fault model, technology options, power calculations, package selection, clocking mechanism, introduction to ASIC design, mixed signal design and SoC design.

Unit-5

FPGA Design: FPGAs: elements, types, advantages and limitations, basic FPGA architecture, FPGA design flow, the FPGA design cycle, FPGA routing terminology, basic concepts on verification and testing, simulation, synthesis, programming methods and programming issues of FPGA design.

Textbooks:

1. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, PHI Learning Private Limited, 2012.
2. VLSI Design: Dr. K. V. K. K. Prasad, K. Shyamala, Kogent Learning Solutions Inc.,2012.

Reference Books:

1. CMOS Digital Integrated Circuits Analysis and Design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Education, 2003.
2. VLSI Design: A.Shanthi, A.Kavita, New age international Private Limited, 2006.

Course Outcomes:

- A thorough understanding of MOS technology and the electrical properties of MOS circuits.
- Understanding of MOS and Bi-CMOS circuit design process, basic circuit concepts and the effect of scaling parameters.
- The students will be able to design the basic VLSI circuits along with FPGA design concepts and its implementation.

	L	T	P	C
B. Tech III year II- Semester	3	0	0	3

Microwave Engineering and Optical Communications

Course objectives

- To get familiarized with microwave frequency bands, their applications and to understand the limitations and losses of conventional tubes at these frequencies.
- To distinguish between different types of microwave tubes, their structures and principles of microwave power generation.
- To impart the knowledge of Scattering Matrix, its formulation and utility, and establish the S-Matrix for various types of microwave junctions.
- Understand the utility of Optical Fibers in Communications.

Unit - I

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 and Applegate Diagram, Bunching Process and Small Signal Theory Expressions for O/P Power and Efficiency. Reflex Klystrons Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics. Helix TWTs: Types and Characteristics of Slow Wave Structures; Structure of TWT and Amplification Process (qualitative treatment), Suppression of Oscillations, Gain Considerations.

Unit - II

M-Type Tubes: Introduction, Cross-field Effects, Magnetrons Different Types, Cylindrical Traveling Wave Magnetron Hull Cut-off and Hartree Conditions, Modes of Resonance and PI-Mode Operation, Separation of PIMode, o/p characteristics, Microwave Solid State Devices: Introduction, Classification, Applications. TEDs Introduction, Gunn Diodes Principle, RWH Theory, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices.

Unit - III

Waveguide Components: Coupling Mechanisms Probe, Loop, Aperture types. Waveguide Discontinuities Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Phase Shifters Types, Dielectric and Rotary Vane Phase Shifters, Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites Composition and Characteristics, Faraday Rotation, Ferrite Components Gyrator, Isolator.

Unit - IV

Scattering matrix: Scattering Matrix Properties, Directional Couplers 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator. Microwave Measurements: Description of Microwave Bench Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

Unit - V

Optical Fiber Transmission Media: Optical Fiber types, Light Propagation, Optical fiber Configurations, Optical fiber classifications, Losses in Optical Fiber cables, Light Sources, Optical Sources, Light Detectors, LASERS, WDM Concepts, Optical Fiber System link budget.

Textbooks:

1. Microwave Devices and Circuits Samuel Y. Liao, Pearson, 3rd Edition, 2003.
2. Electronic Communications Systems- Wayne Tomasi, Pearson, 5th Edition.

Reference Books:

1. Optical Fiber Communication Gerd Keiser, TMH, 4thEd., 2008.
2. Microwave Engineering - David M. Pozar, John Wiley & Sons (Asia) Pvt Ltd., 1989, 3r ed., 2011 Reprint.
3. Microwave Engineering - G.S. Raghuvanshi, Cengage Learning India Pvt. Ltd., 2012.
4. Electronic Communication System George Kennedy, 6th Ed., McGraw Hill.

Course outcomes:

- Able to Know the power generation at microwave frequencies and derive the performance characteristics.
- Realize the need for solid state microwave sources and understand the principles of solid-state devices.
- Distinguish between the different types of waveguide and ferrite components, and select proper components for engineering applications
- Understand the utility of S-parameters in microwave component design and learn the measurement procedure of various microwave parameters.
- Understand the mechanism of light propagation through Optical Fibers.

B. Tech III year II- Semester	L	T	P	C
	3	0	0	3

Digital Signal Processing

Course Objectives:

- To introduce the frequency analysis of discrete time LTI systems.
- To identify different hardware structures for IIR systems.
- To explain the numerical computation of DFT / FFT along with their properties and applications.
- To expose the design of IIR filters.
- To expose the design of FIR filters.

Unit I:

Discrete Time Systems: Transform Analysis of Discrete Time LTI Systems: Frequency response of LTI systems. System Functions for Systems Characterized by Linear Constant Coefficient Difference Equations: Stability, causality, impulse response for rational system functions. Structures for IIR Discrete Time Systems: Direct, parallel and cascade form.

Unit II:

Discrete And Fast Fourier Transform: The Discrete Fourier Transform (DFT): Representation of periodic sequences. The discrete Fourier series, Fourier representation of finite duration sequences, the discrete Fourier Transform (DFT), computation of DFT, properties of the DFT, circular convolution and linear convolution using DFT, overlap-add method, overlap-save method. Fast Fourier Transform (FFT): Radix-2 decimation-in-time and decimation-in-frequency FFT algorithms, inverse FFT.

Unit III:

Design Of IIR Filters: Design of IIR Filters: Design of analog prototypes from digital filter specifications using Butterworth and Chebyshev approximations, design of IIR filters from analog filters, Butterworth filters and Chebyshev filters design using impulse invariance, bilinear transformation.

Unit IV:

Design Of FIR Filters: Design of FIR Filters: Linear discrete time systems with generalized linear phase, design of linear phase FIR filters using window functions (rectangular, Hanning, Blackman and Kaiser) frequency sampling technique.

Unit V:

Multirate Digital Signal Processing: Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters**.**

Processor Fundamentals: Features of DSP processors - DSP processor packaging (Embodiments)- Fixed point Vs floating point DSP processor data paths - Fixed point Vs floating point DSP processor data paths – pipelining - TMS320 family of DSPs (architecture of C5x)- Memory architecture of a DSP processor (Von Neumann - Harvard) - Addressing modes.

Textbooks:

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing, Prentice Hall of India, 2004
2. John G. Proakis, Dimitris G. Manolakis "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education / PHI, 2007.
3. K. Deergha Rao & MNS swamy, "Digital Signal Processing: Theory and Practice", Springer, 2018.

Reference Books:

1. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011.
2. Andreas Antoniou, "Digital Signal Processing", TATA McGraw Hill, 2006
3. Ifeachor E.C, Jervis B.W, Digital Signal Processing – A Practical Approach, 2/e, Pearson Education, 2002.
4. Fundamentals of Digital Signal Processing using MATLAB – Robert J. Schilling, Sandra

Course Outcomes:

- Apply the difference equations concept in the analyzation of Discrete time systems.
- Use the FFT algorithm for solving the DFT of a given signal
- Design a Digital filter (IIR) from the given specifications Realize the IIR structures from the designed digital filter.
- Design a Digital filter (FIR) from the given specifications Realize the FIR structures from the designed digital filter.
- Use the Multirate Processing concepts in various applications

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - II**	3	0	0	3

Information Theory and Error Control Coding

Course Objectives:

- To introduce the fundamental principles of source coding and channel coding for efficient and reliable data transmission.
- To understand the construction and performance of linear block codes and cyclic codes for error detection and correction.
- To explain the principles of convolutional codes and their decoding techniques, including ARQ protocols.
- To provide a comprehensive understanding of turbo codes, their structure, encoding and iterative decoding mechanisms.
- To study the theory and implementation of LDPC codes and their applications in modern communication systems.

Unit I: Information Theory:

Amount of information, Entropy, Joint entropy, Conditional entropy, Relative entropy, Mutual information, Relationship between entropy and mutual information, capacity of a noiseless binary channel, binary symmetric channel, Gaussian channel, Bandwidth-SNR trade-off.

Unit II: Source Coding:

Classification of codes, Kraft inequality, Coding efficiency, Shannon-Fano coding, Huffman coding, Arithmetic coding, The Lempel-Ziv coding, Run-length encoding, The JPEG Standard for Lossy Compression.

Unit III:

Algebra of Finite Fields: Group, Ring & Field, Vector Spaces, GF addition, multiplication rules, Construction of Galois Fields of Prime Order, Primitive elements, Minimal polynomials.

Linear Block Codes: Linear clock codes, systematic codes and its encoding circuit, syndrome and error detection, minimum distance, error detecting and correcting capabilities of block code, decoding circuit, probability of undetected error for linear block code in BSC, Hamming code and their applications.

Unit IV:

Cyclic Codes and BCH Codes: Basic properties of cyclic codes, generator and parity check matrix of cyclic codes. Encoding and decoding circuits, syndrome computation and error detection, error location and correction, burst error correction, CRC codes, BCH and RS

Codes. Examples of BCH codes, Decoding of BCH codes, R S codes, Implementation of RS encoders and decoders.

Unit V: Convolutional and Turbo Codes:

Encoding of Convolutional codes, state table, trellis structure, decoding using Viterbi algorithm, Iterative design of Turbo codes, Decoding of Turbocodes : Iterative map method, The BCJR algorithm.

Textbooks:

1. Simon Haykin, "Digital communications" John Wiley, 2005.
2. Charles Lee, "Error-control Block Codes for Communications Engineers", Artech House, 2000.
3. Shu Lin, Daniel J.Costello, Jr, "Error Control Coding- Fundamentals and Applications", Prentice Hall, Inc.,

Reference Books:

1. K. Deergha Rao, Channel coding Techniques for wireless communications, 2nd edition, Springer, 2019.
2. John G. Proakis, Digital Communication, 5th edition, McGraw Hill, 2014.
3. William Stallings, Cryptography and Network Security: Principles and Practices, 7th edition, Pearson education, 2019.

Course Outcomes:

- Apply fundamental source coding techniques such as Huffman and Lempel-Ziv coding and analyze channel capacity for different types of channels.
- Construct and analyze linear block codes and cyclic codes and implement error detection and correction techniques using syndrome decoding.
- Explain convolutional encoding techniques, decode using Viterbi algorithm.
- Design and decode turbo codes using iterative decoding and interleaving techniques for robust communication.
- Construct and decode LDPC codes using belief propagation and analyze their performance in high-throughput applications

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - II**	3	0	0	3

Wireless Sensor Networks

Course Objectives:

- Explain the Fundamental Concepts of Wireless Sensor Networks.
- Describe the MAC Protocol Issues for Wireless Sensor Networks
- Describe Routing Protocols Wireless Sensor Networks
- Describe transport layer and security Protocols for Wireless Sensor Networks
- Discuss the security in WSN and applications.

Unit I

Introduction to Wireless Networks, Architectures and Technologies: Key definitions of sensor networks, Advantages, challenges, Driving Applications, Enabling Technologies for Wireless Sensor Networks. Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. Physical Layer and Transceiver Design Considerations, Personal area networks (PANs), hidden node and exposed node problem, Topologies of PANs, MANETs, WANETs.

Unit-II

MAC Protocols for Wireless Sensor Networks: Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals, Classifications of MAC Protocols, Contention - Based Protocols, with reservation Mechanisms, Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

Unit-III

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols, Proactive Routing.

Unit-IV

Transport Layer and Security Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

Unit- V

Security in WSNs: Security in Ad Hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management,

Applications of WSN:S-Ultra-wide band radio communication, Wireless fidelity systems. Future directions, home automation, smart metering Applications

Textbooks:

1. C. Siva Ram Murthy and B.S.Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", 2004, PHI
2. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.

References Books:

1. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
2. C.K. Toh, "Ad- Hoc Mobile Wireless Networks: Protocols & Systems", ,1 ed. Pearson Education.
3. C. S. Raghavendra, Krishna M. Sivalingam, "Wireless Sensor Networks", 2004, Springer

Course Outcomes:

- ❖ Understand and explain common wireless sensor node architectures.
- ❖ Demonstrate knowledge of MAC protocols developed for WSN.
- ❖ Demonstrate knowledge of routing protocols developed for WSN.
- ❖ Demonstrate knowledge of transport and security protocols developed for WSN
- ❖ Be familiar with WSN standards and applications.

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - II**	3	0	0	3

CMOS Digital IC Design

Course Objectives:

- To discuss basic CMOS logic gates, implementation of AOI and OAI gates.
- Design MOS logic circuits using Transmission gates
- To analyze different delays and power dissipation in number of stages.
- To understand the design of combinational circuits using ratioed, cascade and dynamic logic.
- Designing different types of Semiconductor Memories

Unit –I:

MOS Design: Pseudo NMOS Logic – Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

Unit –II:

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

Unit –III:

Sequential MOS Logic Circuits: Behavior of Bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered Flip-flop.

Unit –IV:

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOST Transmission gate logic, High performance Dynamic CMOS circuits.

Unit –V:

Semiconductor Memories: Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.

Textbooks:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2 nd Ed., PHI.

Course Outcomes:

- ❖ Able to apply mathematical methods and transistor physics in the analysis of CMOS circuits and design CMOS inverter with different loads for given levels noise margins and propagation delay's.
- ❖ Can execute moderately sized digital logic designs with OAI, AOI, and transmission gates.
- ❖ Able to design static and dynamic CMOS circuits (both Combinational and sequential) at transistor level and layout level.
- ❖ Able to design memory architectures that aids the growth of VLSI designs with reduced access time and reduced power consumption.

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - II**	3	0	0	3

Satellite Communication

Course Objectives

- ❖ Understand the basic concepts, applications, frequencies used and types of satellite communications.
- ❖ Understand the various satellite subsystems and its functionality.
- ❖ Understand the concepts of satellite link design and calculation of C/N ratio.
- ❖ Understand the concepts of multiple access and various types of multiple access techniques in satellite systems.
- ❖ Understand the concepts of satellite navigation, architecture and applications of GPS.

UNIT I

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.

UNIT II

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

Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.

UNIT III

Multiple Access: Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.

UNIT IV

Earth Station Technology: Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods.

Low Earth Orbit and Geo-Stationary Satellite Systems: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs.

UNIT V

Satellite Navigation & The Global Positioning System: Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS.

Textbooks:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.Suyderhoud, 2nd Edition, Pearson Publications, 2003.

Reference Books:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

Course Outcomes:

- Ability to know the knowledge of satellite communication and orbital importance.
- To know the importance of different kinds of subsystems and satellite link design.
- Ability to know the effect of atmospheric effect on satellite communication
- Able to calculate the multiple access technique like TDMA, CDMA, FDMA and DAMA.
- Able to demonstrate the impact of GPS, Navigation for tracking and launching the satellite.

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - III**	2	0	0	2

Mobile and Cellular Communication

Course Objectives:

- ❖ To provide the students with an understanding of the cellular concept frequency reuse, handoff strategies.
- ❖ To enable the students to analyze and understand wireless and mobile cellular communication systems over stochastic fading channels.
- ❖ To provide the students with an understanding of Co-channel and Non-Co channel Interference.
- ❖ To give students an understanding of cell coverage for signal and traffic diversity techniques and mobile antennas.
- ❖ To give the students an understanding of frequency management channel assignment and types of handoff.

UNIT I:

Cellular Systems: Limitations of Conventional System, Basic Cellular Mobile System, First, second, third and fourth Generation cellular wireless systems. Operation of Cellular System. Uniqueness of Mobile Radio Environment –Fading, coherence bandwidth, Doppler Spread. Fundamentals of cellular Radio System Design: concept of frequency reuse channels, Co-channel Interference, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system. Trunking and grade of service.

UNIT II:

Co-Channel & Non-Co-Channel Interference: Measurement of Real Time Co-Channel Interference, design of Antenna system, Antenna parameters and their effects, diversity techniques: Space Diversity, Polarization diversity, frequency diversity and time diversity. Non-co channel interference-adjacent channel interference, Near End far end interference, effect on coverage and interference by power decrease, antenna height decrease

UNIT III:

Cell Coverage for Signal and Traffic: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation.

UNIT IV:

Cell Site and Mobile Antennas: Space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, Mobile Antennas. Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, sectorization, overlaid cells, non-fixed channel assignment

UNIT V:

Handoffs: Handoff Initiation, types of handoff, delaying handoff, advantages of Handoff, power difference handoff, forced handoff, mobile assisted and soft handoff. Intersystem handoff.

Textbooks:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2rd Edn., 2006.
2. Wireless Communications - Theodore. S. Rapport, Pearson education, 2nd Edn., 2002.

Reference Books:

1. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2001.
2. Modern Wireless Communication –Simon Haykin Michael Moher, Persons Eduction,2005.
3. Wireless Communication theory and Techniques, Asrar U.H .Sheikh ,Springer,2004.

Course Outcomes:

- Understand impairments due to multipath fading channel
- Understand the fundamental techniques to overcome the different fading effects
- Understand co-channel and non-co-channel interferences
- Demonstrate cell coverage/signal and traffic, diversity techniques and mobile antennas
- Understand the frequency management, channel assignment and types of handoffs

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - III**	2	0	0	2

Optimization Techniques

Course Objectives:

- Understand the basic principles of optimization and formulate real-world problems using design variables, constraints, and objective functions.
- Apply linear programming methods and analyze optimal solutions using classical techniques like Simplex and duality.
- Explore numerical methods for single-variable optimization and understand convergence behavior.
- Learn and implement multivariable and constrained optimization techniques using gradient-based and direct search approaches.
- Examine and apply intelligent optimization algorithms such as Genetic Algorithms, PSO, and Simulated Annealing for complex problem-solving.

Unit-I

Introduction to optimization: Introduction to Classical Methods & Linear Programming Problems Terminology, Design Variables, Constraints, Objective Function, Problem Formulation. Calculus method, Kuhn Tucker conditions, Method of Multipliers.

Unit-II

Linear Programming Problem: Linear Programming Problem, Simplex method, Two-phase method, Big-M method, duality, Integer linear Programming, Dynamic Programming, Sensitivity analysis.

Unit-III

Single Variable Optimization: Problems Optimality Criterion, Bracketing Methods, Region Elimination Methods, Interval Halving Method, Fibonacci Search Method, Golden Section Method. Gradient Based Methods: Newton-Raphson Method, Bisection Method, Secant Method, Cubic search method.

Unit-IV

Multivariable and Constrained Optimization Techniques: Multi Variable and Constrained Optimization Technique, Optimality criteria, Direct search Method, Simplex search methods, Hooke-Jeeve's pattern search method, Powell's conjugate direction method, Gradient based method, Cauchy's Steepest descent method, Newton's method, Conjugate gradient method. Kuhn - Tucker conditions, Penalty Function, Concept of Lagrangian multiplier, Complex search method, Random search method

Unit-V

Intelligent Optimization Techniques: Introduction to Intelligent Optimization, Genetic Algorithm: Types of reproduction operators, crossover & mutation, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO), Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Textbooks:

1. S. S. Rao, Engineering Optimization: Theory and Practice, Wiley, 2008.
2. K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall, 2 nd edition 2012.

Reference Books

1. C.J. Ray, Optimum Design of Mechanical Elements, Wiley, 2007.
2. R. Saravanan, Manufacturing Optimization through Intelligent Techniques, Taylor & Francis Publications, 2006.
3. D. E. Goldberg, Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Longman Publishing, 1989.

Course Outcomes:

- ❖ Formulate optimization problems with appropriate objective functions and constraints for engineering and applied science domains.
- ❖ Solve linear and integer programming problems using methods like Simplex, Big-M, and Dynamic Programming, and interpret dual solutions.
- ❖ Apply bracketing and gradient-based methods to identify optimal solutions in single-variable optimization problems.
- ❖ Implement multivariable and constrained optimization techniques, including search methods and penalty approaches for nonlinear problems.
- ❖ Employ intelligent optimization techniques like GA, PSO, and GP to solve complex, non-deterministic, or large-scale optimization problems.

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - III**	2	0	0	2

Radar Engineering

Course Objectives:

- Understand the basic principles, types, and performance metrics of radar systems.
- Explore the concepts of Continuous Wave (CW) radar and Frequency Modulated Continuous Wave (FM-CW) radar systems for range and velocity measurements.
- Analyze Moving Target Indicator (MTI) and Pulse Doppler radar systems for target detection in the presence of clutter.
- Understand the principles of tracking radars and compare various tracking techniques.
- Learn the methods for detecting radar signals in noise using matched filters and evaluate detection performance.

Unit I: Introduction

Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar Block Diagram and Operation, Simple form of Radar Equation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise and SNR, Integration of Radar Pulses, Transmitter Power, Radar Cross Section of simple Targets, PRF and Range Ambiguities. Radar Cross Section of complex Targets

Unit II: CW and MTI Radars

CW and Frequency Modulated Radar: Doppler Effect, CW Radar-Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Applications of CW radar, FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics for approaching and receding Targets, FM-CW altimeter, Multiple Frequency CW Radar.

Unit III: MTI and Pulse Doppler Radar:

Introduction, Principle, MTI Radar with Power Amplifier Transmitter, Delay Line Cancellers, Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs, Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, Non-coherent MTI, MTI versus Pulse Doppler Radar. *MTI Radar with Power Oscillator Transmitter*

Unit IV: Tracking Radar

Sequential Lobing, Conical Scan, Amplitude Comparison monopulse radar using one coordinate system and Phase Comparison methods, Target Reflection Characteristics and Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers, Radomes, Frequency scan Arrays, Radar Display types, Branch type and Balanced type duplexers, Circulators as Duplexers.*Amplitude Comparison using two coordinate system*

Unit V: Detection of Radar Signals in Noise

Matched Filter Receiver: Response Characteristics and Derivation, Correlation detection, Detection criteria, Detector Characteristics, Automatic Detection, Constant False Alarm Rate Receiver. Matched filter with non-white noise

Textbooks:

1. Merrill I. Skolnik Introduction to Radar Systems, McGraw-Hill, Second Edition, 1981
2. G.S.N.Raju, Radar Engineering and fundamentals of Navigational Aids-, I.K International, 2008.

Reference Books:

1. Gottapu Sasibhushana rao, Microwave & Radar Engineering, Pearson Education, 2013.
2. Byron Edde, Radar: Principles, Technologies, Applications-, Pearson Education

Course Outcomes:

- ❖ Explain the operational principles of radar systems, including radar waveforms, radar equation, performance parameters, and target radar cross section.
- ❖ Demonstrate the working of CW and FM-CW radar systems and evaluate their use in speed and altitude measurements.
- ❖ Analyze MTI and Pulse Doppler radar systems, including blind speed mitigation, Doppler filtering, and their limitations in real-world scenarios.
- ❖ Compare different tracking radar techniques, including monopulse and conical scanning methods, and understand angular tracking accuracy and radar display systems.
- ❖ Apply matched filter and correlation detection techniques for radar signal detection in noisy environments and evaluate system performance using detection theory.

		L	T	P	C
B. Tech III year II- Semester	**Professional Elective - III**	2	0	0	2

Communications Networks

Course Objectives:

- To introduce the basics of computer network technology, typical network scenarios, layering models and service descriptions
- To demonstrate the data link layer aspects and physical layer technologies enabling the internet.
- To acquaint the unicast and multicast routing aspects of network layer
- To acquaint the principles and design issues of transport layer services and the protocols supporting the services for different network applications
- To familiarize the principles and usage of networking applications including web, HTTP, DNS

Unit 1:

Overview Of Communication and Networking: Analog and digital signal, Data communications, Networks, Circuit switching, Packet switching, The Internet, Protocols and standards, Layered tasks, OSI model, TCP/IP protocol Architecture.

Unit 2:

Physical Layer: Guided media, Unguided media, baseband and passband transmission of signals(briefly), Telephone modems, FDM, WDM, TDM, Telephone networks, DSL technology, Cable modem, Bluetooth, SONET, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet, IEEE802.11, Connecting devices, Backbone network, Virtual LAN

Unit 3:

Data Link Layer: Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Random access, Controlled access, Channelization

Unit 4:

Network And Transport Layer: Network Layer: Internetworks, Addressing, Routing, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols. Transport layer: Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP)

Unit 5:

Application Layer: DNS (ARP and RARP), Mail protocol (SMTP, POP, IMAP), DHCP, Web services (WWW, HTTP, HTTPS, FTP), telnet, DHCP, Client server and P2P application, Relation between Application layer and Transport Other technologies overview: PSTN, ISDN and its type, Frame relay, DSL and ADSL, VoIP, Bluetooth, Wi-Fi, Overview of GSM, Wi-Max, 3G and 4G(LTE), Near field Communication (NFC).

Textbooks:

1. Ferouzan, Behrouz A., Data Communications and Networking, 5/e, TATA McGraw Hill, 2017
2. Stallings William, Data and Computer Communication, 10/e, Pearson Education, 2017

Reference Books:

1. Black, Ulylers D, Data Communication and Distributed Networks, 3/e, PHI, 1999.
2. Tanenbaum, Andrew S., Computer Networks, 6/e, PHI, 2022.

Course Outcomes:

- Distinguish Analog and digital signal in communication, and explain basics of networks and,
- role of each layer of OSI model and TCP/IP model.
- Explain transmission media and network devices, multiplexing, data networks.
- Apply channel allocation, framing, error and flow control techniques.
- Describe about addressing, subnetting & Routing Mechanism in network layer, and process to process communication in transport layer with TCP and UDP protocols.

	L	T	P	C
B. Tech III year II- Semester	0	0	3	1.5

VLSI Design Lab

Course Objectives:

- To Introduce an appropriate EDA tool to learn technology mapping.
- To teach various design rules for basic cell building blocks.
- To introduce various layout tools related to adoptable technology.
- To teach to draw stick diagrams, layout diagrams as per the specifications.
- To understand the design concepts, simulation process and modelling of various combinational and sequential logic circuits.

Note: The students are required to design and implement the following combinational and sequential logic circuits using CMOS technology with the aid of logic diagram, schematic diagram, stick diagram, design rules and layout diagram by using industry standard EDA Tools.

List of Experiments

1. NAND, NOR and EX-OR Gates
2. Inverter
3. Full Adder & Full subtractor
4. Parallel Adder
5. Magnitude Comparator
6. Multiplexer & Demultiplexer
7. Decoder & Encoder
8. Parity Generator
9. R-S Latch & D-Latch
10. D Flip-Flop & J-K Flip Flop
11. Asynchronous Counter
12. Synchronous Counter
13. Shift Register
14. Static RAM Cell.

Software & Hardware Required:

1. Industry standard Front-end & Back-end VLSI Design EDA tools. (licensed/perpetual/opensource EDA tools)
2. Personal Computer and other necessary peripherals.
3. PLD/FPGA or equivalent hardware environment kit.

Course Outcomes:

- A thorough understanding of functionality of both combinational and sequential logic circuits.
- Understanding the concepts that are required to design and implementation using stick diagram, design rules and layout diagram to the logic circuits.
- The students will be able to design, simulate, analyse and implementation of a given logic using various VLSI design front-end and back-end EDA tools.

	L	T	P	C
B. Tech III year II- Semester	0	0	3	1.5

Microwave Engineering and Optical Communications Lab

Course Objectives:

- Defining the range of frequencies for operation in microwave engineering.
- Understand the functioning of microwave components
- Verify the various Characteristics of Active and Passive Microwave Devices Practically.
- Measure the characteristics of optical devices.
- Measure the various parameters of the optical sources.

List of Experiments

1. To verify Reflex Klystron Characteristics and to determine the frequency and tuning range of reflex klystron.
2. To verify Gunn Diode Characteristics.
3. To analyze the fixed and variable attenuator and plot the micrometer reading Vs attenuation.
4. To determine the coupling factors and directivity of directional coupler.
5. To measure the power distribution of various wave guide Tee i.e. E plane, H plane.
6. To measure the power distribution in Magic Tee.
7. VSWR Measurement and load impedance calculations using Smith chart.
8. Scattering parameters of Circulator.
9. Characterization of LED.
10. Characterization of Laser Diode.
11. Intensity modulation of Laser output through an optical fiber.
12. Measurement of Data rate for Digital Optical link.
13. Measurement of Numerical Aperture of fiber cable.
14. Measurement of losses for Analog Optical link.

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

- Verify characteristics of Reflex Klystron.
- Analyze various parameters of Waveguide Components.
- Estimate the power measurements of RF Components such as directional Couplers.
- Demonstrate characteristics of various optical sources.
- Measure data Rate, Numerical Aperture and Losses in Optical Link.

		L	T	P	C
B. Tech III year II- Semester	**Skill Enhancement Course**	0	1	2	2

Machine Learning

Course objectives:

- Make use of Data sets in implementing the machine learning algorithms
- Implement the machine learning concepts and algorithms in any suitable language of choice.

List of Experiments

1 The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)

2 Extract the data from database using python

3 Implement k-nearest neighbours classification using python

4 Given the following data, which specify classifications for nine ombinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5 The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium skiing design single twenties no ->highRisk
high golf trading married forties yes ->lowRisk
ow speedway transport married thirties yes ->medRisk
medium football banking single thirties yes ->lowRisk
high flying media married fifties yes ->highRisk
ow football security single twenties no ->medRisk
medium golf media single thirties yes ->medRisk

medium golf transport married forties yes ->lowRisk
high skiing banking single thirties yes ->highRisk
ow golf unemployed married forties yes ->highRisk
Input attributes are (from left to right) income, recreation, job, status, agegroup, home-owner. Find the unconditional probability of `golf' and the conditional probability of `single' given `medRisk' in the dataset?

6 Implement linear regression using python.

7 Implement Naïve Bayes theorem to classify the English text

8 Implement an algorithm to demonstrate the significance of genetic algorithm

9 Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a.CSV file.

10 For a given set of training data examples stored in a .CSV file, implement and demonstrate the candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.

11 Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

12 Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

13 Write a program to implement the naïve Bayesian classifier for a sample training dataset stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

14 Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

15 Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

16 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

17 Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

18 Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course outcomes:

- Understand the implementation procedures for the machine learning algorithms.
- Design Java/Python programs for various Learning algorithms.
- Apply appropriate data sets to the Machine Learning algorithms.
- Identify and apply Machine Learning algorithms to solve real world problems.

B. Tech III year II- Semester **Audit Course**	**L**	**T**	**P**	**C**
	2	0	0	0

Technical Paper Writing and IPR

Course Objectives

- Introduce students to research fundamentals, including topic selection, literature review, and the structured components of a technical paper.
- Familiarize students with research design, data collection methods, and statistical analysis, alongside proper citation and referencing styles.
- Develop students' skills in writing clear and concise technical papers and delivering professional presentations of research findings.
- Provide a comprehensive overview of intellectual property rights, covering patents, copyrights, trademarks, and trade secrets.
- Raise awareness of ethical considerations in research, emerging issues in IPR (such as digital rights and open access), and the importance of protecting intellectual property in collaborative settings.

Unit -I

Introduction to Research and Technical Writing: Fundamentals of Research: Definition, objectives, types (basic and applied), and research methodology. Types of Technical Documents: Research papers, theses, and technical reports. Literature Review: Importance, methods for conducting surveys, and reviewing scholarly articles. Research Topic Selection: Identifying research gaps and formulating research questions.

Unit -II

Research Design and Data Collection: Research Design: Types (exploratory and descriptive) and planning research. Data Collection: Primary vs. secondary data, qualitative and quantitative methods. Visual Data Representation: Graphs, tables, and charts. Citation Styles: Overview of APA and IEEE formats.

Unit -III

Writing and Presenting Technical Papers: Writing Skills: Clarity, conciseness, and coherence in technical writing. Abstract and Conclusion: Techniques for writing effectively. Presentation Skills: Preparing presentations and using visual aids.

Unit -IV

Intellectual Property Rights (IPR): Fundamentals of IPR: Introduction to patents, copyrights, and trademarks. Patents: Basic criteria for patentability. Case Studies: Real-world applications of IPR in engineering.

Unit -V

Ethical Considerations in Research: Ethical Issues: Plagiarism avoidance, responsible authorship, and ethical use of data.

Open Access: Introduction to Creative Commons and open-source research.

Textbooks:

1. Kumar, R. (2018). Research methodology: A step-by-step guide for beginners (5th ed.). SAGE Publications.
2. Goold, P. R. (2022). A Critical Introduction to Intellectual Property Law. Cambridge University Press.
3. Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approach (5th ed.). SAGE Publications.
4. Glasman-Deal, H. (2020). Science Research Writing: For Native and Non-Native Speakers of English (2nd ed.). World Scientific Publishing Company.

Reference Books:

1. Alred, G. J., Brusaw, C. T., &Oliu, W. E. (2020). The Handbook of Technical Writing (12th ed.). Bedford/St. Martin's.
2. Day, R. A., &Gastel, B. (2016). How to write and publish a scientific paper (8th ed.). Cambridge University Press.
3. Kothari, C. R., & Garg, G. (2019). Research methodology: Methods and techniques (4th ed.). New Age International Publishers.
4. Menell, P. S., Lemley, M. A., Merges, R. P., &Balganesh, S. (2020). Intellectual Property in the New Technological Age 2020: Vol. II Copyrights, Trademarks, and State IP Protections.
5. Singh, A. K. (2018). Intellectual property rights: Unleashing the knowledge economy. Springer.

	L	T	P	C
B. Tech IV year I- Semester	3	0	0	3

Digital Image and Video Processing

Course objectives:

- ❖ Understand the fundamentals of image processing including pixel relationships, sampling, quantization, and key image transforms.
- ❖ Explore image enhancement and segmentation techniques in spatial and frequency domains.
- ❖ Study various image compression techniques and standards including both lossy and lossless methods.
- ❖ Learn the basics of digital video processing, including video signal models and filtering.
- ❖ Understand motion estimation methods and their applications in video coding and compression.

UNIT I:

Fundamentals of Image processing and Image Transforms: Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms

UNIT II:

Image Processing Techniques: Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation Image Compression Image compression fundamentals – coding Redundancy, spatial and temporal redundancy.

UNIT III:

Compression models: Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding, wavelet coding, JPEG standards

UNIT IV:

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models: 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations

UNIT V:

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Textbooks

1. Gonzaleze and Woods," Digital Image Processing ", 3rd edition, Pearson
2. Yao wang, Joem Ostarmann and Ya – quin Zhang," Video processing and communication ",1st edition, PHI.

Reference Books:

1. M. Tekalp," Digital video Processing", Prentice Hall International
2. Relf, Christopher G., "Image acquisition and processing with LabVIEW", CRC press
3. Aner ozdemi R, "Inverse Synthetic Aperture Radar Imaging with MATLAB Algorithms", JohnWiley & Sons
4. Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing A Practical Approach with Examples in MATLAB", John Wiley & Sons,

Course Outcomes:

- ❖ Explain the fundamental concepts of digital image processing, including image representation, sampling, quantization, and key image transforms like DFT, DCT, and DWT.
- ❖ Apply spatial and frequency domain enhancement techniques and perform image segmentation using edge detection, thresholding, and region-based methods.
- ❖ Compare and implement image compression algorithms, including Huffman, arithmetic, LZW, and JPEG compression standards.
- ❖ Describe the structure of analog and digital video systems and apply models for time-varying image formation and basic video sampling and filtering.
- ❖ Implement 2D motion estimation techniques such as block matching and optical flow and apply them in video compression and motion analysis tasks.

		L	T	P	C
B. Tech IV year I- Semester	**Management Course-II**	2	0	0	2

Management Science

Course Objectives:

- To familiarize with the process of management and to provide basic insight into select contemporary management practices
- To provide conceptual knowledge on functional management and strategic management.

Unit I

Introduction to Management: Concept –nature and importance of Management –Generic Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process-Designing organization structure- Principles of organization – Organizational typology

Unit II

Operations Management: Principles and Types of Management – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and C-chart) Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).

Unit III

Functional Management: Concept of HRM, HRD and PMIR- Functions of HR Manager – Job Evaluation and Merit Rating - Marketing Management-Functions of Marketing – Marketing strategies based on product Life Cycle, Channels of distributions.

Unit IV

Strategic Management: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy Alternatives. Global strategies, theories of Multinational Companies.

Unit V

Contemporary Management Practice: Basic concepts of MIS, MRP, Justin- Time (JIT) system, Total Quality Management (TQM), Six sigma and Capability Maturity Model (CMM) Levies, Logistics and Supply Chain Management, Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.

Project Management: (PERT/CPM): Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems)

Textbooks

1. Dr. A. R. Aryasri, *Management Science'* TMH 2011.
2. Dr. N. V. S. Raju Industrial Management Cengage Learning 2013

References:

1. Koontz & Weihrich: Essentials *of management'* TMH 2011
2. Seth & Rastogi: Global Management Systems, Cengage learning, Delhi, 2011
3. Robbins: Organizational Behaviour, Pearson publications, 2011
4. Kanishka Bedi: Production & Operations Management, Oxford Publications, 2011
5. Philip Kotler & Armstrong: Principles of Marketing, Pearson publications
6. Biswajit Patnaik: Human Resource Management, PHI, 2011
7. Hitt and Vijaya Kumar: Strategic Management, Cengage Learning.
8. Prem Chadha: Performance Management, Trinity Press (An imprint of Laxmi Publications Pvt. Ltd.) Delhi 2015.
9. Anil Bhat& Arya Kumar: Principles of Management, Oxford University Press, New Delhi, 2015.

Course Outcomes:

- After completion of the Course the student will acquire the knowledge on management functions Will familiarize with the concepts of functional management project management and strategic management.

B. Tech IV year I- Semester	**Professional Elective-IV**	**L**	**T**	**P**	**C**
		3	0	0	3

Advanced Digital Communications

Course Objectives:

- Provide an in-depth understanding of advanced digital modulation techniques and their performance in various channel conditions.
- Introduce the fundamental principles of information theory including entropy, mutual information, and channel capacity.
- Explore the architecture and implementation of multicarrier communication systems like OFDM.
- Study spread spectrum techniques and their role in modern wireless communication systems.
- Analyze the behavior of communication systems over fading channels and introduce diversity and MIMO techniques to enhance performance.

Unit I:

Advanced Modulation Techniques: Review of basic digital modulation, M-ary Modulation Techniques: M-ASK, M-PSK, M-QAM, Power spectra and bandwidth efficiency, Performance analysis in AWGN and fading channels, Coherent vs Non-coherent detection.

Unit II:

Spread Spectrum Communications: Spreading sequences- Properties of Spreading Sequences, Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, Complementary Codes Direct sequence spread spectrum: DS-CDMA Model, Conventional receiver, Rake Receiver, Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser detector, Liner multiuser detection

Unit III:

Digital Communication over Fading Channels: Channel models: Rayleigh, Rician, Nakagami, Diversity techniques: Time, Frequency, Spatial diversity, Equalization techniques: Linear, Decision feedback, Performance analysis with fading, MIMO systems and spatial multiplexing

Unit IV:

Orthogonal Frequency Division Multiplexing: Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, OFDM Signal Mathematical Representation, Selection parameter for Modulation, Pulse shaping in OFDM Signal and spectral Efficiency, Window in OFDM Signal and Spectrum, Synchronization in OFDM, Pilot Insert in OFDM Transmission and Channel Estimation, Amplitude Limitations in OFDM, FFT Point Selection Constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

Unit V:

MIMO Systems: Introduction, Space Diversity and System Based on Space Diversity, Smart Antenna system and MIMO, MIMO Based System Architecture, MIMO Exploits Multipath, Space – Time Processing, Antenna Consideration for MIMO, MIMO Channel Modelling, MIMO Channel Measurement, MIMO Channel Capacity, Cyclic Delay Diversity (CDD), Space Time Coding, Advantages and Applications of MIMO in Present Context, MIMO Applications in 3G Wireless System and Beyond, MIMO-OFDM

Textbooks:

1. Simon Haykin, *Digital Communications*, Wiley India, 3rd Edition, 2005.
2. John G. Proakis and Masoud Salehi, *Digital Communications*, McGraw-Hill Education, 5th Edition, 2007.
3. Ke-Lin Du & M N S Swamy, "Wireless Communication System", Cambridge University Press, 2010

Reference Books:

1. Bernard Sklar and Fredric J. Harris, *Digital Communications: Fundamentals and Applications*, Pearson, 2nd Edition, 2020.
2. Andrea Goldsmith, *Wireless Communications*, Cambridge University Press, 1st Edition, 2005.
3. Theodore S. Rappaport, *Wireless Communications: Principles and Practice*, Pearson, 2nd Edition, 2010.
4. S. Haykin and Michael Moher, *Modern Wireless Communications*, Pearson Education, 1st Edition, 2005.
5. Robert G. Gallager, *Information Theory and Reliable Communication*, Wiley, 1st Edition, 1968.

Course Outcomes:

- Analyze and compare the performance of M-ary modulation techniques in both AWGN and fading environments.
- Apply the principles of information theory to compute entropy, mutual information, and determine channel capacity for various channels.
- Understand and implement multicarrier modulation systems like OFDM, including practical concerns such as PAPR.
- Explain the functioning of spread spectrum techniques and their applications in CDMA and modern wireless standards.
- Evaluate and improve digital communication system performance over fading channels using diversity and equalization techniques.

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective-IV**	3	0	0	3

Global Navigation Satellite Systems

Course Objectives:

- Explain the basic principle of operation of GPS, GPS ephemerides and signal structure.
- Make the students to understand various coordinate systems and highlight the effect of various
- errors affecting GPS signals.
- Make the students to appreciate the significance of other GNSS systems, principle of DGPS and augmentation systems.

Unit -I

GPS Fundamentals: Introduction to Radio Navigation system: VOR, ILS. GPS System Segments: space, control and user segments, Principle of operation, Current status of GPS satellite constellation. Orbital Mechanics: GPS ephemeris data, algorithm for computation of satellite's position from ephemeris data. Time References: solar and sidereal days, UTC time, GPS time.

Unit -II

GPS Signals: Legacy GPS signals: Signal structure, Operating frequencies, C/A and P-Code, Navigation message, Modernized GPS signals: list of signals and their significance. Range measurements: code and carrier measurements, User position estimation with PRN codes.

Coordinate Systems: Earth Cantered Earth Fixed (ECEF) coordinate system, Earth Centered Inertial (ECI) coordinate system, Geodetic coordinate system, Ellipsoid and Geoid, Regional and Global Datum, World Geodetic System (WGS-84).

Unit -III

GPS Error Sources: Satellite clock error, ephemeris error, Receiver clock errors, satellite and receiver instrumental bias, Multipath error, receiver measurement noise, ionospheric error and tropospheric error, Klobuchar model, ionospheric delay estimation using dual frequency measurements and UERE.

Dilution of precision: HDOP, VDOP, TDOP, PDOP & GDOP.

Unit -IV

Data Formats: RINEX Observation and Navigation Data formats, NMEA format.

GNSS: Architecture, operation and signals of other navigational satellite systems Galileo, Beidou and GLONASS, QZSS. **IRNSS:** Architecture and signals.

Unit -V

Differential GPS (DGPS): Principle of DGPS, Types of DGPS: Local Area DGPS (LADPS), Wide Area DGPS (WADGPS). **GPS Augmentation Systems:** Principle of operation of Satellite Based Augmentation system (SBAS) and Ground Based Augmentation System (GBAS).

GNSS Applications: Surveying, Mapping, Marine, air and land Navigation, Military and Space Application.

Textbooks:

1. Elliot D Kaplan and Christopher J Hegarty, "Understanding GPS principles and applications",
2. Artech House Publishers, 2/e Boston & London 2005.
3. Pratap Misra and Per Enge, "Global Positioning System Signals, Measurement, and Performance", Ganga- Jamuna Press, 2/e, Massachusetts, 2010.

Reference Books:

1. B. Hofmann-Wellenhof, H. Lichtenegger, and J. Collins, "GPS Theory and Practice", Springer Verlog, 5/e, 2008.
2. Ahmed El-Rabbany, "Introduction to GPS", Artech House Publishers, 2/e, Boston 2006.
3. Bradford W. Parkinson and James J. Spilker, "Global Positioning system: Theory and
4. Application", Vol.II, American Institution of Aeronautices and Astronautics Inc., Washington, 1996.

e-Resources:

1. https://archive.nptel.ac.in/content/syllabus_pdf/105107194.pdf

Course Outcomes:

- Demonstrate the fundamental concepts of communications in understanding of GPS architecture, operation and signal structure.
- Apply the principles of orbital mechanics, time references, coordinate systems and range
- measurements in estimating user position.
- Examine the effect of various error sources and satellite geometry on position estimates and analyze the suitability of a given data format.
- Compare the architecture and working of other GNSS systems and make use of GNSS systems in a variety of civilian and defense applications.
- Relate the knowledge of DGPS techniques in understanding augmentation systems

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective-IV**	3	0	0	3

Modern VLSI Design

Course Objectives:

- Understand MOS, CMOS, and BiCMOS Technologies
- Master Layout Design Techniques
- Analyze and Optimize Combinational Circuits
- Design Robust Sequential Circuits
- Implement Floor Planning and System Design

Unit – I:

Review of Microelectronics and Introduction to MOS Technologies: MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS &BiCMOS Circuits: Ids-Vds relationships, Threshold Voltage Vt, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

Unit – II:

Layout Design and Tools: Transistor structures, Wires and Bias, Scalable Design rules, Layout Design and Tools.

Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

Unit – III:

Combinational Circuit Design: Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Circuit Families, Circuit Pitfalls, Low-power Logic Design, Comparison of Circuit Families, Silicon-on-Insulator Circuit Design.

Unit –IV:

Sequential Circuit Design: Introduction, Sequencing Static Circuits, Circuit Design of Latches and Flip-flops: Conventional CMOS Latches and Flip-Flops, Pulsed Latches, Resettable Latches and Flip-Flops, Enabled Latches and Flip-flops. Static Sequencing Element Methodology: Choice of Elements, Low-power Sequential Design. Synchronizers: A simple synchronizer, arbiter.

UNIT – V:

Floor Planning and System Design: Floor planning methods, Global interconnect, Floor Plan design, off-chip connections, Register Transfer Design, Pipelining

Textbooks:

1. Essentials of VLSI Circuits and Systems, K. Eshraghian. D, A.Pucknell, 2005, PHI.
2. Modern VLSI Design - Wayne Wolf, fourth edition, Pearson Education.
3. CMOS VLSI Design A Circuits and systems perspective Third Edition Neil H.E.Weste

Reference Books:

1. Introduction to VLSI systems – A Logic, Circuit and System Perspective- Ming Bo, Liu, CRC Press, 1st Edition 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K.Eshraghian, 2nd ed., Adisson Wesley.

Course Outcomes:

❖ Explain the Electrical Properties of MOS, CMOS, and BiCMOS Circuits
❖ Design and Analyze CMOS and BiCMOS Logic Gates
❖ Optimize Combinational Circuits for Performance and Power
❖ Develop Sequential Circuits with Low Power Consumption
❖ Apply Floor Planning Techniques in System Design

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective - IV**	3	0	0	3

Embedded Systems

Course objectives:

- Introduce the fundamental concepts and architecture of embedded systems.
- Explain the various elements of embedded hardware and their design principles.
- Elaborate on the design and development process of embedded firmware.
- Discuss the internal structure and functioning of Real-Time Operating Systems (RTOS)
- Familiarize students with various Integrated Development Environments (IDEs)

Unit-I:

Introduction: Embedded System-Definition, history of embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

Unit-II:

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

Unit-III:

Embedded Firmware: 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, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization, Device Drivers.

Unit-V:

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

Textbooks:

1. Embedded Systems Architecture-ByTammyNoergaard, ElsevierPublications, 2013.
2. Embedded Systems-ByShibu.K.V-TataMcGrawHill Education PrivateLimited, 2013.

References Books:

1. Embedded System Design, FrankVahid, TonyGivargis, John WileyPublications, 2013.
2. Embedded Systems-LylaB.Das-Pearson Publications, 2013.

Course Outcomes:

- ❖ Understand the fundamental concepts and characteristics of embedded systems and apply appropriate design approaches to develop systems for specific applications.
- ❖ Analyze the essential hardware components of embedded systems and evaluate different hardware design methodologies.
- ❖ Differentiate between various embedded firmware design approaches and select suitable development techniques for embedded applications.
- ❖ Demonstrate the ability to integrate embedded hardware and firmware using real-time operating systems, including task management and synchronization.
- ❖ Understand the process of embedded system development, including the use of development tools, debugging techniques, and deployment on target hardware.

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective - V**	2	0	0	2

Low Power VLSI Design

Course Objectives:

- Known the low power low voltage VLSI design
- Understand the impact of power on system performances.
- Known about different Design approaches.
- Identify suitable techniques to reduce power dissipation in combinational and sequential circuits.
- To gain Knowledge on low power design and power estimation techniques in CMOS circuits.
- To understand the synthesis and software design for low power.

Unit – I

Fundamentals: Need for Low Power Circuit Design, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

Unit II

Power Dissipation in CMOS Sources of power dissipation – Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET, gate induced drain leakage– Power dissipation in CMOS: short circuit dissipation, dynamic dissipation, load capacitance– Low power VLSI design: Limits – principles of low power design, hierarchy of limits, fundamental limit, material limit.

Unit III

Power Optimization Using Special Techniques Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques - CMOS Floating Node: Tristate Keeper Circuit, Blocking Gate, Low Power Bus: Low Swing Bus, Charge Recycling Bus, Delay Balancing - Low Power Techniques for SRAM: SRAM Cell, Memory Bank Partitioning.

Unit IV

Design Of Low Power Circuits Transistor and Gate Sizing: Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction - Network Restructuring and Reorganization: Transistor Network Restructuring, Transistor Network Partitioning and Reorganization - Special Latches and Flip-flops : Self-gating Flip-flop, Combinational Flip-flop, Double Edge Triggered Flip-flop - Low Power Digital Cell Library: Cell Sizes and Spacing.

Unit V

Power Estimation Modelling of signals - signal probability calculation - Statistical techniques - estimation of glitching power Sensitivity analysis-Power estimation using input vector compaction, power dissipation in Domino logic, circuit reliability, power estimation at the circuit level, Estimation of maximum power: test generation-based approach.

Textbooks:

1. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering.
2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer,1995
3. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998
4. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic, 1997
5. Neil H. E. Weste, David Money Harris "CMOS VLSI Design 4e: A circuits and systems",Pearson, 2015

Reference Books:

1. Dimitrios Soudris, Christians Pignet, Costas Goutis, "Designing CMOS Circuits for Low Power", Kluwer, 2002
2. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley 1999
3. Abdelatif Belaouar, Mohamed.I.Elmasry, "Low power digital VLSI design", Kluwer, 1995
4. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", John Wiley and sons, inc. 2001
5. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing

Course Outcomes:

- ❖ Explain the sources of power dissipation in CMOS
- ❖ Classify the special techniques to mitigate the power consumption in VLSI circuits
- ❖ Demonstrate the power optimization techniques and power dissipation in CMOS circuits
- ❖ Outline the low power circuits
- ❖ Summarize the power optimization and trade-off techniques in digital circuits.
- ❖ Illustrate the power estimation at circuit level

B. Tech IV year I- Semester	**Professional Elective - V**	**L**	**T**	**P**	**C**
		2	0	0	2

Speech Signal Processing

Course Objectives:

- ❖ Understand the fundamentals of human speech production and its relevance to automatic speech recognition (ASR).
- ❖ Apply signal processing techniques to analyze and extract features from speech.
- ❖ Explore various pattern comparisons and matching techniques in speech signal analysis.
- ❖ Understand and implement Hidden Markov Models (HMMs) for speech recognition.
- ❖ Design components of large vocabulary continuous speech recognition systems using statistical language models and subword units.

Unit I: The Speech Signal:

Fundamentals of Speech recognition, the process of speech production and perception in human beings, the speech production process, representing speech in time and frequency domains, speech sounds and features.

Unit II: Signal Processing and Analysis methods for Speech Recognition:

Spectral analysis models, The Bank-of-filters front-end processor, Linear predictive coding model for Speech recognition, Vector quantization.

Unit III: Pattern Comparison Techniques:

Introduction, Speech detection, Distortion measures- Mathematical considerations, Distortion measures- Perceptual considerations, Spectral distortion measures.

Unit IV: Theory and Implementation of Hidden Markov Models:

Introduction, Discrete time Markov processes, Extensions to Hidden Markov models, Three basic problems for HMMs, Types of HMMs, Continuous observation densities in HMMs, comparison of HMMs, Implementation issues for HMMs, HMM system for isolated word recognition.

Unit V: Large Vocabulary continuous speech recognition:

Introduction, Sub word speech units, sub word unit models based on HMMs, Training of sub word units, Language models for Large vocabulary speech recognition, Statistical language modelling, Perplexity of the language model, and Overall recognition system based on sub word units.

Textbooks:

1. Lawrence Rabiner and Biing-Hwang Juang, Fundamentals of Speech Recognition, Pearson Education, 2007.

Reference Books:

1. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, Fundamentals of Speech Recognition, Pearson Education, 2009.

2. Claudio Becchetti and Lucio Prina Ricotti, Speech Recognition, John Wiley and Sons, 1999.

3. Frederick Jelinek, Statistical Methods of Speech Recognition, MIT Press, Cambridge, MA; London, England, 1997.

4. Daniel Jurafsky and James H Martin, Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Pearson Education, 1 st Ed., 2000.

e- Resources:

1. https://nptel.ac.in/courses/117105145

2.https://ocw.mit.edu/courses/6-345-automatic-speech-recognition-spring-2003/

3. https://www.classcentral.com/course/youtube-digital-speech-processing-47859

Course Outcomes: After completion of the course, the student will be able to

- Explain the process of speech production and describe the time and frequency domain representations of speech signals.
- Apply and evaluate signal processing methods such as spectral analysis, linear predictive coding, and vector quantization in speech recognition systems.
- Compare various pattern comparison techniques and distortion measures used in speech detection and recognition.
- Implement and optimize Hidden Markov Models (HMMs) for isolated word speech recognition systems.
- Design and evaluate large vocabulary continuous speech recognition (LVCSR) systems using subword units and statistical language models.

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective - V**	2	0	0	2

DSP Processors and Architectures

Course objectives

- To introduce architectural features of programmable DSP Processors of TI and Analog Devices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Unit - I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Unit - II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

Unit - III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

Unit – IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

Unit – V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Textbooks:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

2. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009

3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI
5. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005

Course Outcomes:

- To distinguish between the architectural features of general-purpose processors and DSP processors
- Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices
- Able to write assembly language programs using instruction set of TMS320C54XX
- Can interface various devices to DSP Processors

		L	T	P	C
B. Tech IV year I- Semester	**Professional Elective - V**	2	0	0	2

Quantum Communications

Course Objectives:

- ❖ Understand Quantum Optics Fundamentals
- ❖ Analyze Quantum Decision Theory
- ❖ Master Quantum Bit Operations
- ❖ Explore Quantum Communication Techniques
- ❖ Delve into Quantum Information Theory

Unit I:

Quantum optics: Elementary introduction to quantum fields and photons. Light-matter interactions and the Jaynes-Cummings model. Generation and detection of non-classical states of light: parametric down conversion and photon entanglement, photon action at a beam splitter, bubonic statistics. Berry and Pancharatnam phases.

Unit II:

Quantum decision theory: Analysis of a quantum communication system, introduction to the Helstrom decision theory of quantum binary communication systems, decision theory of K-ary Quantum communication systems, Holevo's theorem, constellation of quantum states.

Unit III:

Quantum mechanics and Quantum Bits: Two level systems as quantum bits. Superposition states, the Bloch sphere, mixed states, density matrices, Pauli matrices. Single qubit dynamics (gates): NOT, square root of NOT-gate, Hadamard, phase shift, networks of gates, the measurement gate.

Unit IV:

Quantum communication systems: Introduction to Glauber's representation of coherent quantum states, Quantum binary communication systems and different modulation schemes: OOK, BPSK, QAM, PSK, PPM, overview of quantum squeezed states.

Unit V:

Quantum Information Theory: Notion of density operators, partial trace, reduced density operator, Schmidt rank, purification of mixed states, entanglement, quantum teleportation. Introduction to classical information theory: Shannon entropy, classical channels and channel coding. Notion of VonNeumann entropy, quantum channels, accessible information and Holevo bound, transmission through a noisy quantum channel. Introduction to Quantum Cryptography and Quantum Key Distribution.

Textbooks:

1. Gianfranco Cariolaro, “Quantum Communications”, Springer, 2015.
2. Ivan B. Djordjevic, “Quantum Communication, Quantum Networks, and Quantum Sensing”, Academic Press, 2022.

Reference Books:

1. Sumeet Khatri, and Mark M. Wilde, “Principles of Quantum Communication Theory: A Modern Approach”, 2021, Pre-release version, available freely at https://www.markwilde.com/teaching/2021-fall-qit/.
2. Michael Nielsen and Isaac Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2010.

Course Outcomes: Photon Interaction and Entanglement

- Quantum Decision Analysis
- Qubit Representation and Gate Implementation
- Quantum Communication Modulation
- Quantum Information Processing

	L	T	P	C
B. Tech IV year I- Semester	0	0	3	1

Digital Signal and Image Processing Lab

Course Objectives:

- ❖ Enable students to represent and analyze discrete-time signals in both time and frequency domains.
- ❖ Equip students with the skills to design and implement FIR and IIR filters using various techniques.
- ❖ Familiarize students with linear and circular convolution, as well as auto and cross-correlation of sequences.
- ❖ Familiarize students with pixel-based operations, image transformations, and enhancement techniques.
- ❖ Explore compression techniques for image and video data.
- ❖ Develop skills in basic video acquisition, processing, and restoration methods.

PART-A:

1. To Verify Linear and Circular Convolution.
2. To Verify Discrete Fourier Transform (DFT) And Inverse Discrete Fourier Transform (IDFT).
3. Design Frequency Response of IIR Low Pass and High Pass Butterworth Filter
4. Design Frequency Response of IIR Low Pass and High Chebyshev Filter
5. Design Frequency Response of FIR Low Pass Filter Using Rectangle Window
6. Design Frequency Response of FIR Low Pass Filter Using Triangle Window
7. To verify N-Point FFT Algorithm.
8. To Compute Power Density Spectrum of a Sequence.

PART-B:

1. Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale)
2. Implementation of Relationships between Pixels
3. Implementation of Transformations of an Image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization
5. Computation of Mean, Standard Deviation, Correlation coefficient of the given Image
6. Implementation of Image Smoothening Filters (Mean and Median filtering of an Image)
7. Image Compression by DCT, DPCM, HUFFMAN coding
8. Implementation of image restoring techniques

Textbooks:

1. A.V. Oppenheim, R. W. Schafer, Digital Signal Processing, Prentice Hall of India, 2004
2. Gonzaleze and Woods," Digital Image Processing ", 3rd edition, Pearson

Reference Books:

1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007
2. Sanjay K. Mitra, Digital Signal Processing- A Computer Based Approach, 4/e, Tata Mc Graw Hill Publications, 2011
3. Chris Solomon, Toby Breckon, "Fundamentals of Digital Image Processing A Practical Approach with Examples in MATLAB", John Wiley & Sons,

Course Outcomes:

After completion of the course, the student will be able to

- Students will be able to represent and analyze discrete-time signals in both time and frequency domains.
- Students will be capable of designing and implementing FIR and IIR filters to meet specified requirements.
- Apply contrast enhancement, histogram equalization, and filtering techniques for image smoothing and sharpening.
- Implement edge detection methods (e.g., gradient filters, Canny) and image compression techniques such as Huffman and DPCM.
- Acquire and manipulate video sequences, perform dejittering, inpainting, and evaluate video quality improvements using restoration techniques.

	L	T	P	C
B. Tech IV year I- Semester	0	0	3	1

Advanced Communications Lab

Course Objectives:

- Study of various line coding schemes
- Investigate the generation and detection of digital modulation techniques
- Develop skills in Pulse Code Modulation (PCM), Delta Modulation (DM), and Adaptive Delta Modulation (ADM) to understand their applications in digital signal processing.
- Study Direct Sequence Spread Spectrum (DSSS) and Frequency Hopping Spread Spectrum (FHSS) methods to evaluate their effectiveness in secure and robust communication systems.
- Implement and analyze error control coding schemes such as Huffman Coding, Shannon-Fano Coding, Linear Block Codes, Cyclic Codes, and Convolutional Codes to enhance data integrity in communication systems.

List of Experiments:

1. Study The Various Data Format.
   (NRZ-L, NRZ-M, NRZ-S, RZ, Bi Phase-L, Bi Phase-M, Bi Phase-Differential Manchester, RZ-AMI)
2. Pseudo Noise sequence and recovery of the clock.
3. ASK generation and Detection.
4. FSK and Minimum Shift Keying generation and Detection.
5. Phase shift keying methods (BPSK, QPSK) generation and Detection.
6. Linear & Adaptive Delta Modulation and Demodulation
7. Differential Phase Shift Keying (DPSK)
8. BER of QPSK in AWGN channel
9. Designing an equalizer in the context of baseband binary data transmission
10. 8-QAM generation & detection
11. Direct Sequence Spread Spectrum
12. Frequency Hopping Spread Spectrum
13. Huffman Coding
14. Shannon Fano Coding
15. Linear Block Codes
16. Cyclic Code Encoder
17. Convolutional Codes

Course Outcomes:

- Students will be able to generate and analyze various line coding schemes,
- Students will demonstrate the ability to generate and detect digital modulation schemes.
- Students will analyze the performance of different modulation techniques, including the calculation of Bit Error Rate (BER) in Additive White Gaussian Noise (AWGN) channels.
- Students will design and simulate DSSS and FHSS systems,
- Students will implement and decode Huffman and Shannon-Fano codes, and design encoders and decoders for Linear Block Codes, Cyclic Codes, and Convolutional Codes, demonstrating their application in error correction.

		L	T	P	C
B. Tech IV year I- Semester	**Skill Enhancement Course**	0	1	2	2

Embedded Systems

Course Objectives:

- To develop applications using task scheduling, timers, and event-driven programming in embedded systems.
- To implement and analyze inter-task communication mechanisms such as message queues, mailboxes, and interrupts.
- To demonstrate task synchronization, time slicing, and priority-based scheduling.
- To interface and control peripherals like LEDs, LCDs, serial ports, and audio processing units.
- To enhance practical understanding of real-time operating systems (RTOS) concepts through hands-on experiments.

Note: The following programs to understand the use of RTOS with ARM Processor on IDE Environment using ARM Tool chain and Library:

1. Create an application that creates two tasks that wait on a timer whilst the main task loops.
2. Write an application that creates a task which is scheduled when a button is pressed, which illustrates the use of an event set between an ISR and a task.
3. Write an application that Demonstrates the interruptible ISRs(Requires timer to have
4. higher priority than external interrupt button)
   a). Write an application to Test message queues and memory blocks.
   b). Write an application to Test byte queues.
5. Write an application that creates two tasks of the same priority and sets the time slice period to illustrate time slicing.

Interfacing Programs:

6. Write an application that creates a two task to Blinking two different LEDs at different Timings
7. Write an application that creates a two-task displaying two different messages in LCD display in two lines.
8. Sending messages to mailbox by one task and reading the message from mailbox by another task.
9. Sending message to PC through serial port by three different tasks on priority Basis.
10. Basic Audio Processing on IDE environment.

Course Outcomes:

- Understand and implement task scheduling, timers, and event-driven programming in embedded systems.
- Apply inter-task communication techniques such as message queues, mailboxes, and interrupts for efficient data exchange.
- Demonstrate task synchronization and scheduling through time slicing and priority-based execution.
- Develop and interface embedded applications using peripherals like LEDs, LCDs, serial communication, and audio processing.
- Analyze and evaluate real-time operating system (RTOS) concepts through practical hands-on experiments.

	L	T	P	C
B. Tech – Open Elective - 1	3	0	0	3

Electronic Devices and Basic Circuits

Course objectives:

- **Understand** the working principles and characteristics of semiconductor diodes, including special purpose diodes like Zener, Tunnel, Varactor, SCR, and Photodiode.
- **Explain** the operation of various rectifier circuits and filter configurations and analyze their performance in terms of voltage regulation and ripple content.
- **Analyze** the input and output characteristics of Bipolar Junction Transistors (BJTs) in different configurations and understand their small signal models.
- **Explore** transistor biasing techniques and stability analysis to ensure consistent operation under varying temperature and manufacturing conditions.
- **Examine** the construction, characteristics, and amplifier applications of Field Effect Transistors (JFET and MOSFET), including small-signal modeling and biasing techniques.

Unit-I

P-N Junction Diode: Qualitative Theory of P-N Junction, P-N Junction as a diode, diode equation, volt-ampere characteristics temperature dependence of V-I characteristic, ideal versus practical –resistance levels (static and dynamic), transition and diffusion capacitances, diode equivalent circuits, load line analysis, breakdown mechanisms in semiconductor diodes, Zener diode characteristics.

Unit -II

Rectifiers, Filters: P-N Junction as a rectifier, Halfwave rectifier, full wave rectifier, Bridge rectifier, Harmonic components in a rectifier circuit, Inductor filter, Capacitor filter, Voltage regulation using Zener diode.

Unit -III

Bipolar Junction Transistor: The Junction transistor, Transistor current components, Transistor as an amplifier, Transistor construction, Input and Output characteristics of transistor in Common Base, Common Emitter, and Common collector configurations. α and β Parameters and the relation between them, BJT Specifications.

Unit -IV

Transistor Biasing and Stabilization: Operating point, the D.C and A.C Load lines, Need for biasing, criteria for fixing, operating point, B.J.T biasing, Fixed bias, Collector to base bias, Self bias techniques for stabilization, Thermal run away, Condition for Thermal stability.

Unit -V

Field Effect Transistor: JFET (Construction, principal of Operation and Volt –Ampere characteristics). Pinch- off voltage-small signal model of JFET. FET as Voltage variable resistor, Comparison of BJT and FET. MOSFET (Construction, principal of Operation and symbol), MOSFET characteristics in Enhancement and Depletion modes.

Textbooks:

1. Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGraw Hill.
2. Electronic Devices and Circuits Theory, Boylsted, Prentice Hall Publications.

Reference Books:

1. Electronic Devices and Circuits, S. Salivahanan, N. Sureshkumar, McGraw Hill.
2. Electronic Devices and Circuits, Balbirkumar, shailb. jain, PHI Privated Limted, Delhi.

Course Outcomes:

- ❖ Understand and apply the characteristics and equivalent models of PN junction diodes and special-purpose electronic devices in basic circuits.
- ❖ Analyze and design rectifier and filter circuits using diodes and evaluate their voltage regulation capabilities using Zener diodes.
- ❖ Interpret BJT characteristics and configurations (CB, CE, CC), and evaluate performance parameters such as gain and impedance using h-parameter models.
- ❖ Design biasing circuits for BJTs and analyze the stability of the operating point against variations in temperature and transistor parameters.
- ❖ Compare and utilize different FET devices (JFET and MOSFET) in amplifier configurations and analyze their behavior using small-signal models.

B. Tech – Open Elective - 1	L	T	P	C
	3	0	0	3

Fundamentals of Signals and Systems

Course Objectives:

- ❖ Understanding the fundamental characteristics of signals and systems.
- ❖ Understanding the concepts of vector space and orthogonal series.
- ❖ Understanding signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- ❖ Development of mathematical skills to solve problems involving
- ❖ convolution, correlation and sampling.

Unit -I

Signals & Systems: definition of signal & system, basic operations on signals, classification of signals, basic continuous time signals and continuous time systems, classification of discrete time signals and systems. Analogy between vectors and signals, Orthogonality, mean square error, complete set of orthogonal functions.

Unit -II

Linear Time Invariant (LTI) Systems: Time-Domain representation & Characterization of LTI systems, Impulse response representation, Convolution integral & Convolution sum, properties of LTI systems, Stability criteria for LTI systems, Elements of Continuous time & Discrete-time LTI systems. Circular Convolution. Concepts of Correlation of signals, properties, applications.

Unit -III

Sampling: Graphical & Analytical proof of Band-limited signals, Low pass and band pass sampling theorems, sampling and reconstruction of band limited signals, Aliasing, Anti-aliasing filter.

Unit -IV

Fourier Representation of Signals: Fourier representation of Signals, Continuous -time Fourier series and their properties, Application of Fourier series to LTI systems, Fourier Transform & its properties, Applications of Fourier Transform to LTI systems, Discrete-time Fourier Transform & its properties, Relationship to other transforms. Hilbert transforms and its properties.

Unit -V

Laplace Transform: Introduction & Definition, Region-of- convergence, Properties of Laplace transform, Inverse Laplace Transform, Applications of Laplace Transform in analysis of LTI systems.

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

Textbooks:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, “Signals and Systems”, 2nd Edition, PHI, 2009.
2. Signals, Systems & Communications - B.P. Lathi, B S Publications, 2003.
3. S.Haykin and B.VanVeen “Signals and Systems, Wiley, 1998.

Reference Books:

1. Signals and Systems – K Deergha Rao, Springer International Edition, 2018.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015.
3. Hwei Hsu, “Schaum's Outline of Signals and Systems”, 4thEdition, TMH, 2019.
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.

Course Outcomes:

- ❖ Understand the mathematical description and representation of continuous-time and discrete-time signals and systems.
- ❖ Classify systems based on their properties and determine the response of LTI system using convolution.
- ❖ Apply sampling theorem to convert continuous-time signals to discrete-time signals and reconstruct back, different transform techniques to solve signals and system related problems.
- ❖ Analyze the frequency spectra of various continuous-time signals using Fourier analysis.
- ❖ Apply the Laplace transform and Z- Transform for analyzation of continuous-time and discrete-time signals and systems.

	L	T	P	C
B. Tech – Open Elective - 1	3	0	0	3

Digital Electronics

Course Objectives:

- ❖ To solve a typical number of base conversions and analyze new error coding techniques
- ❖ To optimize logic gates for digital circuits using various techniques
- ❖ To understand concepts of Adders and Sub tractors and analyze different types of decoders, encoders, code converters, multiplexers and comparators.
- ❖ To understand the basic concept flip flops and analyze basic counters and shift registers
- ❖ To understand the basic concepts of PLDs.

Unit-I:

Number system and codes: Binary, octal, hexadecimal and decimal Number systems and their inter conversion, BCD numbers (8421- 2421). Gray code, excess–3 code, cyclic code, code conversion, ASCII, EBCDIC codes. Binary addition and subtraction signed and unsigned binary numbers, 1's and 2's complement representation.

Unit -II:

Boolean Algebra and Minimization Techniques: Basic logic circuits: Logic gates (AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR and their truth tables,), Universal Gates, Laws of Boolean algebra, De-Morgan's theorem, Min term, Max term, POS, SOP, KMap, Simplification by boolean theorems, don’t care condition.

Unit -III

Combinational Logic circuits: Adders and their use as subtractors, parallel binary adder, carry look ahead adder, BCD adder, binary multiplier and divider, multiplexers, de-multiplexers, decoders, encoders, code converters, parity circuits, comparators and their applications.

Unit -IV

Sequential Logic circuits: Flip flop and Timing circuit: set-reset laches, D-flipflop, R-S flip flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop.

Registers & Counters: Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter, Serial in/Serial out shift register. Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.

Unit -V

Memories and Programmable Logic Devices: Classification of memories, RAM, types of RAM, ROM, EEPROM, ROM as PLD, Programmable Logic Array, Programmable Array Logic, qualitative theoretical/architectural concepts of Complex Programmable Logic Devices and Field-Programmable Gate Array.

Textbooks:

1. Digital Design - Morris. M. Mano, Michael D. Ciletti - Fourth Edition - PrenticeHall India, 2008.
2. Modern Digital Electronics – R.P.Jain - Fourth Edition – Tata McGraw Hill Education Private Limited, 2010.

References:

1. Digital Design: Principles and Practices - J.F. Wakerly - Fourth Edition - Prentice Hall, 2005.
2. Fundamentals of Logic Design - Charles. H. Roth - Fifth Edition - Thomson Brooks/ Cole, 2005.

Course Outcomes:

- Classify different number systems and apply to generate various codes.
- Use the concept of Boolean algebra in minimization of switching functions.
- Design different types of Adders and Subtractors.
- Design different types of decoders, encoders, code converters, multiplexers and comparators.
- Understand the concept of Memories and Programmable Logic Devices.

	L	T	P	C
B. Tech – Open Elective - 1	3	0	0	3

Principles of Communications

Course Objectives:

- To understand the basic algorithms of communication
- To improve Mathematical analytical skills
- To understand the Role of Noise in Communication
- To understand the principles of Analog & Digital Modulation Techniques
- To explore time and frequency domain representations of communication signals for system analysis.

Unit-I:

Introduction to Communication Systems: Elements of a communication system, Types of communication: Analog and Digital, Need for modulation, Baseband and pass band signals, and Electromagnetic spectrum and frequency bands, Frequency Division Multiplexing.

Unit- II:

Amplitude Modulation (AM): Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector. **(Qualitative treatment only)**

Unit – III

Angle Modulation (FM and PM): Frequency Modulation (FM) and Phase Modulation (PM), Time and frequency domain analysis, Bandwidth requirements (Carson's Rule), Narrowband and wideband FM, FM generation and demodulation techniques, Comparison of AM and FM **(Qualitative treatment only)**

Unit-IV

Noise Performance and Information Theory: Noise in AM and FM systems, SNR calculations, Probability of error in digital modulation, Introduction to Information Theory, Channel capacity, entropy, and bandwidth-efficiency tradeoffs **(Qualitative treatment only).**

Unit- V

Pulse Modulation: Introduction to Pulse Modulation: Time Division Multiplexing, Types of Pulse modulation, PAM, PWM, PPM - Generation and demodulation, Introduction to PCM. **(Qualitative treatment only)**

Textbooks:

1. Simon Haykin, “Communication Systems” - John Wiley& Sons, 2nd Edition.
2. H Taub & D. Schilling, Gautam Sahe, (2007). Principles of Communication Systems. TMH.
3. B. P. Lathi, (2006). Communication Systems. B S Publication

References Books:

1. Simon Haykin, Michael Moher (2007). Introduction to Analog and Digital Communications, John Wiley.
2. R.P. Singh, S P Sapre, (2017). Communication Systems: Analog and Digital, TMH.
3. George Kennedy and Bernard Davis. (2004). Electronics & Communication System. TMH

Course Outcomes:

- ❖ Analyze the performance of analog modulation schemes in time and frequency domains.
- ❖ Analyze the performance of angle modulated signals
- ❖ 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.

	L	T	P	C
B. Tech – Open Elective - 2	3	0	0	3

IC Applications

Course Objectives:

- **Understand the fundamentals of integrated circuits** including Op-amp characteristics, internal circuits, and modes of operation.
- **Explore various applications of operational amplifiers,** such as amplifiers, comparators, and waveform shaping circuits.
- **Analyze and design active filters and oscillators** using operational amplifiers for frequency-selective applications.
- **Examine the functional working of timers and phase-locked loops**, specifically the 555 timer and IC 565 PLL.
- **Learn the architecture and working principles of digital-to-analog and analog-to-digital converters** and their specifications.

Unit 1:

Integrated Circuits: Classification, chip size and circuit complexity, basic information of Op-amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC Characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

Unit -2

OP-Amp and Applications: Basic information of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, Sample & hold circuits, multipliers and dividers, differentiators and integrators, comparators, Schmitt trigger, Multivibrators, introduction to voltage regulators, features of IC723.

Unit -3

Active Filters & Oscillators: Introduction, 1st order LPF, HPF filters, Band pass, Band reject and all pass filters. Oscillator types and principle of operation - RC, Wien and quadrature type, waveform generators - triangular, sawtooth, square wave and VCO.

Unit -4

Timers & Phase Locked Loops: Introduction to 555 timer, functional diagram, monostable and astable operations and applications, Schmitt Trigger. PLL - introduction, block schematic, principles and description of individual blocks of IC565.

Unit -5

D-A and A-D Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC dual slope integration type ADC, DAC and ADC specifications.

Textbooks:

1. Linear Integrated Circuits, D. Roy Chowdhury, New Age International(p) Ltd.
2. Op-Amps & Linear ICs, Ramakanth A. Gayakwad, PHI

References Books:

1. Operational Amplifiers & Linear Integrated Circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications, Denton J. Daibey, TMH
3. Design with Operational Amplifiers & Analog Integrated Circuits, Sergio Franco, McGraw Hill.
4. Digital Fundamentals - Floyd and Jain, Pearson Education.

Course Outcomes:

- **Classify integrated circuits** based on complexity and describe the characteristics and internal architecture of Op-amps like IC 741.
- **Design and implement analog signal conditioning circuits** using Op-amps for various applications including signal conversion and waveform generation.
- **Develop and simulate active filters and sinusoidal/non-sinusoidal oscillators** suitable for different frequency ranges and waveforms.
- **Analyze the operation of 555 timer and PLL circuits,** and demonstrate their application in timing, control, and frequency synthesis.
- **Differentiate between various DAC and ADC architectures** and interpret their specifications for suitable application in mixed-signal systems.

	L	T	P	C
B. Tech – Open Elective - 2	3	0	0	3

Principles of Signals Processing

Course Objectives:

- ❖ Identify various signals and systems.
- ❖ Understand various transformation techniques and apply them to find spectral domain representation of various signals.
- ❖ Apply convolution and correlation operations between various signals and systems. Develop the digital filter designs.
- ❖ Understand Multirate digital signal processing concepts.

Unit-I

Introduction To Digital Signal Processing: Introduction, A digital Signal – Processing system, the sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation.

Unit-II

Digital Filters: IIR Filters: IIR Analog filter approximations - Butterworth and Chebyshev, Design of IIR Digital filters from analog filters: Impulse invariant techniques, Bilinear transformation method. FIR Filters: Characteristics of FIR Digital Filters, Frequency response, Design of FIR Filters: Fourier Method. Window Techniques, Comparison of IIR & FIR filters.

UNIT III

Multirate Digital Signal Processing: Introduction. Down sampling, Decimation. Up sampling, Interpolation, Sampling Rate Conversion, conversion of band pass signals. Concept of re-sampling. Applications of multi rate signal processing.

UNIT IV

Architecture of ARM Processors: Introduction to the architecture, Programmer's model-operation modes and states, registers, special registers, floating point registers, Behaviour of the application program status register (APSR).

UNIT V

Digital Signal Processors: TMS320C54XX processors, memory space of TMS320C54XX processors, Program control, TMS320C54XX instructions and programming, On-Chip peripherals, Interrupts of TMS320C54XX processors.

Textbooks:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Pearson Prentice Hall, 2007.
2. B.P. Lathi, Signals, Systems & Communications, BS Publications 2013 .

3. Avtar Singh and S. Srinivasan, “Digital Signal Processing”, CENGAGE Learning, 2004

Reference Books:

1. A.V. Oppenheim, Signals and Systems - A.S. Willsky and S.H. Nawab, 2 Ed.,
2. Li Tan, Digital Signal Processing - Fundamentals and Applications - Elsevier. 2008.
3. Robert J. Schilling. Sandra L, Harris, Fundamentals of Digital Signal Processing using Matlab Thomson 2007

Course Outcomes:

- Identify various signals and systems.
- Apply various transformation techniques and apply them to find spectral domain representation of various signals.
- Apply convolution and correlation operations between various signals and systems.
- Develop the digital filter designs.
- Explain the Multirate digital signal processing concepts.

	L	T	P	C
B. Tech – Open Elective - 2	3	0	0	3

Concepts of Microprocessors and Microcontrollers

Course Objectives:

- To understand the organization and architecture of Microprocessor.
- To understand addressing modes to access memory.
- To understand the interfacing of Microprocessor with I/O as well as other devices
- To understand 8051 micro controller architecture
- To understand interfacing of 8051 and their applications

Unit-I:

Introduction to Microprocessor Architecture: Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086– Introduction to 80286 - 80386 - 80486 and Pentium (brief description about architectural advancements only).

Unit -II:

Minimum and Maximum Mode Operations: Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

Unit -III:

Microprocessors I/O Interfacing: 8255 PPI– Architecture of 8255–Modes of operation – Interfacing I/O devices to 8086 using 8255 – Interfacing A to D converters – Interfacing D to A converters – Stepper motor interfacing– Static memory interfacing with 8086.

Unit -IV:

8051 Microcontroller: Overview of 8051 Microcontroller – Architecture – Signal description – Register set – Memory and I/O addressing.

Unit -V:

8051 Interfacing and Applications: Instruction set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals – Applications of microcontrollers.

Textbooks:

1. Microprocessors and Interfacing – Programming and Hardware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition.
2. The 8051 Microcontroller & Embedded Systems Using Assembly and C by Kenneth J. Ayala, Dhananjay V.Gadre, Cengage Learninbg, India Edition.

Reference Books:

1. The Intel Microprocessors-Architecture, Programming, and Interfacing by Barry B. Brey, Pearson, Eighth Edition-2012.
2. Microprocessors and Microcontrollers-Architecture, Programming and System Design by Krishna Kant, PHI Learning Private Limited, Second Edition, 2014.

Course Outcomes:

- Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.
- Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors
- Analyse the Microcontroller and interfacing capability.
- Describe the architecture and interfacing of 8051 controller.
- Know the concepts of PIC micro controller and its programming.

	L	T	P	C
B. Tech – Open Elective - 2	3	0	0	3

Fundamentals of Antennas

Course Objectives:

- Understand the basic principles of radiation and various antenna parameters.
- Analyze and design wire antennas, aperture antennas, and array antennas.
- Understand the concepts of antenna arrays and radiation pattern synthesis.
- Explore broadband and frequency-independent antennas.

UnitI:

Antenna Basics, Introduction to antennas, Radiation mechanism, Basic antenna parameters: Radiation pattern, beam width, gain, directivity, efficiency, input impedance, bandwidth, polarization, Radiation integrals and potential functions

UnitII:

Wire and Loop Antennas, Short dipole and half-wave dipole antennas, Monopole antennas Current distribution and radiation pattern, small and large loop antennas, folded dipole

UnitIII:

Antenna Arrays, Linear arrays: Two-element and N-element array, Broadside and end-fire arrays, Array factors and pattern multiplication, Phased arrays, Binomial and Dolph-Tschebyscheff arrays

UnitIV:

Special Types of Antennas, Yagi-Uda antenna, Helical antennas (axial and normal modes), Microstrip patch antennas, Log-periodic and spiral antennas, Reflector antennas: Parabolic reflector, horn antenna, Antenna miniaturization techniques

Unit-V:

Antenna Measurements and Applications, Antenna measurement range (far-field and near-field techniques), Radiation pattern measurement, Gain, impedance, and polarization measurements, Antennas for mobile communications, radar, and satellite systems

Textbooks

1. C.A. Balanis, Antenna Theory: Analysis and Design, 4th Edition, Wiley, 2016.
2. K.D. Prasad, Antennas and Wave Propagation, Satya Prakashan, 2003.
3. Harish and Sachidananda, Antennas and Wave Propagation, Oxford University Press, 2007.

Reference Books

1. R. S. Elliot, Antenna Theory and Design, Wiley-Interscience.
2. John D. Kraus, Antennas for All Applications, 3rd Edition, McGraw-Hill.
3. Robert E. Collin, Antennas and Radiowave Propagation, McGraw-Hill.

Course Outcomes:

- Explain fundamental antenna parameters and radiation mechanisms.
- Analyze and design various wire and loop antennas.
- Design antenna arrays and interpret their radiation patterns.
- Describe special antennas like microstrip patch, helical, and frequency-independent antennas.
- Understand antenna measurements and apply antenna concepts to practical systems.

B. Tech – Open Elective - 3	L	T	P	C
	3	0	0	3

Fundamentals of VLSI Design

Course Objectives:

- Basic characteristics of MOS transistor and examines various possibilities for configuring inverter circuits and aspects of latch-up are considered.
- Design processes are aided by simple concepts such as stick and symbolic diagrams but the key element is a set of design rules, which are explained clearly.
- Basic circuit concepts are introduced for MOS processes we can set out approximate circuit parameters which greatly ease the design process.
- Understand the concepts of scaling MOS circuits
- Understand FPGA design, synthesis and different case studies

Unit-I

Introduction to MOS Technology: The IC Era, MOS transistor theory, Fabrication processes of nMOS, CMOS and BiCMOS technologies.

Basic Electrical Properties of MOS Circuits: I_{ds} versus V_{ds} relationships, MOStransistor threshold voltage, MOS transistor parameters, the pass transistor, the nMOS inverter, Pull-up to Pull-down ratios for various nMOS inverter configurations, alternative forms of pull-up, the CMOS inverter, the Bi-CMOS inverter, latch-up in CMOS circuits, Comparison between CMOS and BiCMOS technology.

Unit -II

MOS and Bi-CMOS Circuit Design Processes: MOS layers, stick diagrams, design rules and layout, general observations on the design rules, 2µm Double Metal, Double Poly, CMOS/BiCMOS rules, 1.2µm Double Metal, Single Poly CMOS rules, Layout Diagrams of CMOS based inverter, NAND and NOR gates, Symbolic Diagrams-Translation to mask form.

Unit -III

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, limitations of scaling, limits due to sub threshold currents, limits on logic levels and supply voltage due to noise and current density.

Unit -IV

VLSI Design Issues: Advantages and challenges in VLSI Technology, VLSI Design methodologies, VLSI design process, design for testability-DUT, fault model, fault coverage, the single stuck-at fault model, technology options, power calculations, package selection, clock mechanism, introduction to ASIC design flow, mixed signal design and SoC design.

Unit -V

FPGA Design: FPGAs: Elements, types, advantages and limitations, basic FPGA architecture, FPGA design flow, the FPGA design cycle, FPGA routing terminology, basic concepts on verification and testing, simulation, synthesis, programming methods and programming issues of FPGA design.

Textbooks:

1. Essentials of VLSI Circuits and Systems-Kamran Eshraghian, Douglasand A. Pucknell and Sholeh Eshraghian, PHI Learning Private Limited, 2012.
2. VLSI Design–Black Book-Dr. K.V.K.K.Prasad, K. Shyamala, Kogent Learning Solutions Inc.,2012.

Reference Books:

1. CMOSDigitalIntegratedCircuitsAnalysisandDesign-Sung-MoKang,Yusuf Leblebici, Tata McGraw-Hill Education, 2003.
2. VLSI Design–A. Shanthi, A. Kavita, and Newage international Private Limited, 2006.

Course Outcomes:

- ❖ Understand the properties of MOS active devices and simple circuits configured when using them and the reason for such encumbrances as ratio rules by which circuits can be interconnected in silicon.
- ❖ Know three sets of design rules with which nMOS and CMOS designs may be fabricated.
- ❖ Understand the scaling factors determining the characteristics and performance of MOS circuits in silicon technology.
- ❖ Know about scaling of MOS circuits
- ❖ Know about FPGA design, synthesis and different case studies

B. Tech – Open Elective - 3	L	T	P	C
	3	0	0	3

Electronic Measurement & Measuring Instruments

Course Objectives

- ❖ Understand measurement fundamentals and error analysis.
- ❖ Learn the operation of various electrical and electronic measuring instruments.
- ❖ Analyze and interpret oscilloscope readings and waveform behaviors.
- ❖ Gain practical knowledge of signal generators, transducers, and data acquisition systems.
- ❖ Apply digital instrumentation concepts and understand computer-controlled test systems

Unit-I:

Basics of Measurements: Accuracy, Precision, resolution, reliability, repeatability, validity, Errors and their analysis, Standards of measurement. Bridge Measurement: DC bridges- Wheatstone bridge, AC bridges – Kelvin, Hay, Maxwell, Schering and Wien bridges, Wagner ground Connection.

Unit-II:

Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter.

Unit-III:

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Delay lines, Probes and Transducers, Specification of an Oscilloscope. Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope.

Signal Generators: Sine wave generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator. Pulse and square wave generators. Function Generators.

Unit-IV:

Signal Analysis: Wave Analyzer, Spectrum Analyzer.

Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters

Transducers: Types, Strain Gages, Displacement Transducers.

Unit-V:

Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems. IEEE-488 GPIB Bus

Textbooks:

1. Modern Electronics Instrumentation & Measurement Techniques, by Albert D.Helstrick and William D.Cooper, Pearson Education. Selected portion from Ch.1, 5-13.
2. Elements of Electronics Instrumentation and Measurement-3rd Edition by Joshph J.Carr.Pearson Education. Selected portion from Ch.1,2,4,7,8,9,13,14,18,23 and 25.

Reference Books:

1. Electronics Instruments and Instrumentation Technology – Anand, PHI
2. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

Course Outcomes:

- Understand and apply measurement principles including accuracy, precision, and error analysis.
- Use analog and digital instruments to measure basic electrical parameters.
- Operate oscilloscopes and signal generators effectively for waveform analysis.
- Utilize spectrum analyzers, wave analyzers, and frequency counters for signal analysis.
- Interface transducers with electronic systems and perform data acquisition.
- Implement IEEE-488 GPIB bus and basic computer-controlled instrumentation setups.

B. Tech – Open Elective - 3	L	T	P	C
	3	0	0	3

Optical Communications

Course Objectives:

- ❖ To realize the significance of optical fiber communications.
- ❖ To understand the construction and characteristics of optical fiber cable.
- ❖ To develop the knowledge of optical signal sources and power launching.
- ❖ To identify and understand the operation of various optical detectors.
- ❖ To under the design of optical systems and WDM.

UNIT-I

Optical Fiber Communications: Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Ray theory transmission, Modes in planar guide, phase and group velocity, cylindrical Fiber -Modes.Fiber materials, Fiber fabrication techniques, fiber optic cables, Classification of Optical Fibers: Single mode fibers, Graded Index fibers.

UNIT-II

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. Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Optical Fiber Splicing.

UNIT-III

Optical Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED- LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED.LASER diodes- modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effects.

UNITIV

Optical Detectors and Receivers: Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors.Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration.

UNITV

Optical System Design: Considerations, Component choice, Multiplexing, Point-to- point links, System considerations, Link power budget with examples. Rise time budget with examples. WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH.

Textbooks:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition,3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

Reference Books:

1. Optical Fiber Communication and its Applications – S. C. Gupta, PHI, 2005.
2. Fiber Optic Communication Systems – Govind P. Agarwal, John Wiley, 3rd Edition, 2004.

Course Outcomes:

- ❖ Understand and analyze the constructional parameters of optical fibers.
- ❖ be able to design the optical system.
- ❖ Estimate the losses due to attenuation, absorption, scattering and bending.
- ❖ Compare various optical detectors and choose suitable one for different applications.
- ❖ Able to demonstrate the design of WDM

B. Tech – Open Elective - 3	L	T	P	C
	3	0	0	3

Digital Data Communications

Course Objectives:

1. To introduce the fundamental principles of digital modulation schemes and their performance parameters such as bandwidth efficiency, carrier and clock recovery.
2. To familiarize students with data communication concepts, network models, interfaces, and protocols.
3. To impart knowledge on error detection and correction techniques and data link layer protocols.
4. To understand various multiplexing techniques, network topologies, switching methods, and network interfacing devices.
5. To explore multiple access techniques and channel access mechanisms used in modern communication networks.

Unit-I

Digital Modulation Schemes: Digital Data Communications BPSK, QPSK, 8PSK, 16PSK, 8QAM, 16QAM, DPSK – Methods, Band Width Efficiency, Carrier Recovery, Clock Recovery.

Unit-II:

Basic Concepts of Data Communications, Interfaces and Modems: Data Communication Networks, Protocols and Standards, UART, USB, Line Configuration, Topology, Transmission Modes, Digital Data Transmission, DTE-DCE interface, Categories of Networks – TCP/IP Protocol suite and Comparison with OSI model.

Unit-III

Error Correction: Types of Errors, Vertical Redundancy Check (VRC), LRC, CRC, Checksum, Error Correction using Hamming code

Data Link Control: Line Discipline, Flow Control, Error Control

Data Link Protocols: Asynchronous Protocols, Synchronous Protocols, Character Oriented Protocols, Bit-Oriented Protocol, and Link Access Procedures.

Unit-IV

Multiplexing: Frequency Division Multiplexing (FDM), Time Division Multiplexing (TDM), Multiplexing Application, and DSL.

Local Area Networks: Ethernet, Other Ether Networks, Token Bus, Token Ring, FDDI. **Metropolitan Area Networks:** IEEE 802.6, SMDS

Switching: Circuit Switching, Packet Switching, Message Switching.

Networking and Interfacing Devices: Repeaters, Bridges, Routers, Gateway, Other Devices.

Unit-V

Multiple Access Techniques: Frequency- Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA), OFDM and OFDMA. Random Access, Aloha- Carrier Sense Multiple Access (CSMA)- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA), Controlled Access- Reservation- Polling- Token Passing, Channelization.

Textbooks:

1. Data Communications and Networking Behrouz A.Forouzan4th Edition McGraw Hill Education,2017.
2. Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education.

Reference Books:

1. Understanding Communications and Networks, 3rd Edition, W.A.Shay, Cengage Learning, 2003.
2. Data Communications and Networking, Behrouz A Forouzan, Fourth Edition.TMH.
3. Data and Computer communications, 8/e, William Stallings, PHI

Course Outcomes:

- ❖ Understand and analyze digital modulation schemes such as BPSK, QPSK, QAM, and their efficiency in data transmission systems.
- ❖ Explain the basic structure of data communication systems, including protocols, standards, and the OSI and TCP/IP reference models.
- ❖ Identify and apply suitable error detection and correction techniques like VRC, CRC, and Hamming Code for reliable data communication.
- ❖ Differentiate between various data link protocols and flow/error control methods in communication systems.
- ❖ Describe and evaluate multiplexing techniques (FDM, TDM) and switching methods (circuit, packet, message switching) used in data networks.

B. Tech – Open Elective - 4	**L**	**T**	**P**	**C**
	3	0	0	3

Principles of Cellular & Mobile Communications

Course Objectives:

- ❖ Understand the basic cellular concepts like frequency reuse, cell splitting, cell sectoring etc., and various cellular systems.
- ❖ Understand the different types of interferences influencing cellular and mobile communications.
- ❖ Understand the concept of propagation model and the different types antennas used at cell site and mobile.
- ❖ Understand the frequency management, channel assignment, various propagation effects in cellular environment and the concepts of handoff and types of handoffs.
- ❖ Understand the architectures of GSM and 3G cellular systems.

Unit-I

Cellular Mobile Radio Systems: Introduction to Cellular Mobile System, uniqueness of mobile radio environment, operation of cellular systems, consideration of the components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems.

Unit-II

Cellular Concepts: Evolution of Cellular systems, Concept of frequency reuse, frequency reuse ratio, Number of channels in a cellular system, Cellular traffic: trunking and blocking, Grade of Service; Cellular structures: macro, micro, pico and femto cells; Cell splitting, Cell sectoring.

Unit -III

Interference: Types of interferences, Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, design of Antenna system, antenna parameters and their effects, diversity receiver, non- co channel interference-different types.

Unit-IV

Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels, channel assignments to cell sites and mobile units: fixed channel and non-fixed channel assignment.

Handoff Strategies: Concept of Handoff, types of handoff, handoff initiation, delaying handoff, forced handoff, mobile assigned handoff, intersystem handoff.

Unit-V

Digital Cellular Networks: GSM architecture, GSM channels, multiple access schemes; TDMA, CDMA, OFDMA; architecture of 3G cellular systems.

Textbooks:

1. Mobile Cellular Telecommunications – W.C.Y. Lee, Tata McGraw Hill, 2nd Edn. 2006.
2. Principles of Mobile Communications – Gordon L. Stuber, Springer International 2nd Edition, 2007.

Reference Books:

1. Wireless Communications – Theodore. S. Rapport, Pearson education, 2ndEdn., 2002.
2. Mobile Cellular Communication – G Sasibhushana Rao Pearson

Course Outcomes:

- Explain the fundamentals of cellular radio system design and its basic elements.
- Analyse the concepts of different co-channel, non-co-channel interference and cellular coverage on signal & traffic of a designed system.
- Identify the various types of antenna system design suitable for mobile communications.
- Distinguish the number of radio channels, channel assignment and frequency management used in mobile communications and analyse the different hand off & cell splitting techniques and dropped call rate at cell site area.
- Summarize the different types of second-generation system architectures such as GSM, TDMA and CDMA for mobile communication systems.

	L	T	P	C
B. Tech – Open Elective - 4	3	0	0	3

Fundamentals of Satellite Communications

Course Objectives:

- Introduce the fundamentals of satellite communication systems and their applications.
- Explain satellite orbits, launches, and tracking concepts.
- Familiarize students with satellite subsystems and link design.
- Explore modulation, multiple access techniques, and frequency bands used in satellite communication.
- Provide insight into satellite earth stations and various satellite-based applications like GPS, weather monitoring, and broadcasting.

Unit-I:

Introduction to Satellite Communication: History and evolution of satellite communication, Advantages and disadvantages of satellite systems, Applications of satellites in communication, remote sensing, and navigation, Basic concepts of geostationary and non-geostationary orbits, Frequency allocations and spectrum usage for satellite systems.

Unit-II:

Orbital Mechanics and Launching: Orbital elements and mechanics, Kepler's Laws, Types of satellite orbits: GEO, MEO, LEO, and HEO, Satellite launching and launch vehicles, Satellite tracking and control.

Unit-III:

Satellite Subsystems: Communication payload: transponders, antennas, and filters, Power systems: solar panels, batteries, Attitude and orbit control subsystem (AOCS), Telemetry, tracking, and command (TT&C) subsystem, Thermal control subsystem.

Unit-IV:

Satellite Link Design and Performance: Basic link power budget equation, Carrier-to-noise ratio (C/N), G/T, and EIRP, Propagation effects: free-space loss, atmospheric absorption, rain attenuation, Uplink and downlink design, Link margin and system reliability.

Unit-V:

Modulation, Access Techniques, and Applications: Modulation techniques: BPSK, QPSK, QAM, Multiple access schemes: FDMA, TDMA, CDMA, Satellite services: GPS, DTH (Direct to Home), VSAT, MSS (Mobile Satellite Services), Satellite navigation systems: GPS, GLONASS, Galileo, Regulatory bodies: ITU, FCC.

Textbooks:

1. Dennis Roddy, "Satellite Communications", Publisher: 4th edition, McGraw-Hill
2. Timothy Pratt, Charles W. Bostian, and Jeremy Allnutt, "Satellite Communications", Publisher: Wiley, Edition: 2nd Edition.

Reference Books:

1. **M. Richharia and Leslie Davidson,***"Satellite Communications Systems: Design Principles",* Wiley, 4th Edition
2. Tri T. Ha, "Digital Satellite Communications", Publisher: McGraw-Hill
3. **Robert M. Gagliardi,** *"Satellite Communications",* Publisher: Thomson

Course Outcomes (COs):

- ❖ Understand the basic principles and historical development of satellite communication.
- ❖ Analyze satellite orbits, launching methods, and tracking systems.
- ❖ Explain the working of satellite subsystems and their integration.
- ❖ Design satellite links and evaluate performance based on parameters like EIRP, G/T, and noise figure.
- ❖ Understand multiple access techniques (FDMA, TDMA, CDMA) and their application in satellite systems.

	L	T	P	C
B. Tech – Open Elective - 4	3	0	0	3

Fundamentals of Embedded Systems

Course Objectives:

- ❖ To have knowledge about the basic working of a microcontroller system and its programming in assembly language.
- ❖ To provide experience to integrate hardware and software for microcontroller applications systems.

Unit -I:

Introduction to embedded systems: Introduction to embedded systems, Difference between Embedded and General-Purpose Computing. Embedded microcontrollers and their architecture. Embedded system components.

Unit -II:

8051 Microcontroller: 8051 Architecture, Pin configuration, Reset and system clock, timers and interrupts, Special function registers, Program/ data memory, addressing modes. Introduction to 8051 assembly language programming, Arithmetic instructions, Logic and Compare instructions, Branch and conditional instructions, Single bit instruction programming.

8051 Interrupts: Introduction to 8051 interrupts, programming of timer interrupts, programming external hardware interrupts, programming the serial communication interrupts, interrupt priority in the 8051.

Unit -III:

Serial Communication: Basics of serial communication, 8051 connection to RS 232, 8051 serial communications Programming.

Real World Interfacing: Interfacing of A/D and D/A converter, interfacing stepper motor, interfacing of LCD, interfacing of sensors, interfacing keyboard.

Unit -IV:

PIC18F Family: The Architecture of PIC family of devices, PIC18F instructions and assembly language, PIC18F programming model, instruction set, instruction format. Data copy, arithmetic, branch, logical, bit manipulation and multiply divide operations. Stacks, subroutines and macros.

Unit -V:

Interrupts and Timers of PIC: Concepts of Interrupts and Timers. Interrupts and their implementation in PIC18. The PIC18 timers. The CCP. Use of Interrupts in applications.

I/O Port and Interfacing: Concepts of I/O interfacing and PIC18 I/O ports. Interfacing output and input peripherals.

Textbooks:

1. Embedded systems design by Steve Heath, Newnes.
2. The 8051 Microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.
3. PIC microcontroller and embedded systems by Muhammad Ali Mazidi, PHI.

Reference Book:

1. The 8051 microcontrollers by Kenneth J. Ayala, Cengage Learning.

Course Outcomes:

- To acquire knowledge about microcontrollers embedded processors and their applications.
- Foster ability to understand the internal architecture and interfacing of different peripheral devices with Microcontrollers.
- Foster ability to write programs for microcontroller.
- Foster ability to understand the role of embedded systems in industry.
- Foster ability to understand the design concept of embedded systems.

	L	T	P	C
B. Tech – Open Elective - 4	3	0	0	3

Transducers and Signal Conditioning

Course Objectives:

- To understand the classification, necessity, and functioning of various sensing elements and transducers used in industrial instrumentation.
- To explore the working principles and applications of passive transducers including resistive, capacitive, and inductive types.
- To learn the operation and applications of active transducers like thermocouples, piezoelectric sensors, and Hall-effect devices.
- To introduce the architecture and operational characteristics of Op-Amps, including various signal processing configurations.
- To analyze the role of signal conditioning circuits using operational amplifiers in measurement systems and industrial applications.

Unit-I

Classification and Sensing Element: General - Definition - Necessity - Types - classification based on the principle of Active and passive - Primary and Secondary - Examples in each Advantages Primary sensing elements - Bourdon tubes. Bellows - Load cells - Thermistors-Types - construction and operation of Metal Resistance thermometer - Digital encoding transducer.

Unit-II

Passive Transducers: Resistive Transducer - Strain Gauge - construction and working of Strain gauge Strain gauge in measurement of displacement - Capacitive transducer and its applications - Liquid level measurement using capacitive transducers Inductive transducer Basic structure -proximity sensor - Measurement of pressure using inductive transducer - Construction and operation of LVDT, RVDT.

UNIT-III

Active Transducers: Thermocouple - construction and principle Tacho generator Measurement of angular velocity using Piezoelectric transducers principal measurement of pressure and vibrations - Hall effect Transducer - photo voltaic transducers (solar cell) - photo conductive transducer Measurement of radiation using Geiger Muller tube.

UNIT-IV

Operational Amplifiers: Block diagram - DC, AC signal conditioning operational amplifiers IC 741 - Pin details Important terms - characteristics of Ideal op amp - inverting and Non-inverting mode-Gain Applications of op. amps Adders, Subtractor, Scale charger, integrator, Differentiator, Voltage to current converter - current to voltage converters Differential amplifiers Comparators (inverting and non-inverting).

UNIT-V

Signal Conditioners in Industrial Instrumentation: Operational amplifier with capacitive transducer Operational amplifier as Instrumentation amplifiers - Bridge amplifier - active filters using op.amp - LPF, HPF-LPF as integrator- HPF as differentiator Clipper, Clamper using op.amp. Successive approximation ADC - R - 2R ladder network DAC - wein bridge oscillator using op.amp - op. amp as Zero crossing Detector.

Textbooks:

1. Transducers And Instrumentation – D.V.S. Murty – PHI Learning Pvt. Ltd.
2. Electronic Instrumentation – H.S. Kalsi – Mcgraw Hill Education (India) Pvt. Ltd.
3. Measurement Systems: Application And Design – Ernest O. Doebelin and Dhanesh N. Manik – Mcgraw Hill Education (India) Pvt. Ltd.

Reference Books:

1. Instrumentation, Measurement and Analysis – B.C. Nakra and K.K. Chaudhry – Tata McGraw Hill Education Pvt. Ltd.
2. Sensors and Transducers – Ian R. Sinclair – Elsevier (Newnes)
3. Industrial Instrumentation – S.K. Singh – Tata McGraw Hill Education Pvt. Ltd.
4. Integrated Electronics: Analog and Digital Circuits and Systems – Jacob Millman and Christos C. Halkias – McGraw Hill Education Pvt. Ltd.

Course Outcomes:

- Understand and classify different types of sensors and transducers, along with their working principles and relevant examples.
- Understand the construction and applications of passive transducers used for measuring displacement, pressure, and liquid levels.
- Understand the operation of active transducers and how they are used to measure temperature, angular velocity, vibrations, and radiation.
- Understand the functioning of operational amplifiers and their use in analog signal processing tasks such as amplification, filtering, and signal conversion.
- Understand the design and working of signal conditioning circuits using operational amplifiers for applications like ADC, DAC, waveform shaping, and filt

	L	T	P	C
B. Tech: Honors	3	0	0	3

Digital System Design

Course Objectives:

- ❖ To provide extended knowledge of digital logic circuits in the form of state model approach.
- ❖ To provide an overview of system design approach using programmable logic devices.
- ❖ To provide and understand of fault models and test methods.
- ❖ To get exposed to the various architectural features of CPLDS.
- ❖ To learn the methods and techniques of CPLD design with EDA tools

UNIT-I:

Minimization Procedures and CAMP Algorithm: Review on minimization of switching functions using tabular methods, k-map, QM algorithm, CAMP-I algorithm, Phase-I: Determination of Adjacencies, DA, CSC, SSMs and EPCs,, CAMP-I algorithm, Phase-II: Passport checking, Determination of SPC, CAMP-II algorithm: Determination of solution cube, Cube based operations, determination of selected cubes are wholly within the given switching function or not, Introduction to cube based algorithms.

UNIT-II:

PLA Design, Minimization and Folding Algorithms: Introduction to PLDs, basic configurations and advantages of PLDs, PLA-Introduction, Block diagram of PLA, size of PLA, PLA design aspects, PLA minimization algorithm (IISc algorithm), PLA folding algorithm (COMPACT algorithm)-Illustration of algorithms with suitable examples.

UNIT -III:

Design of Large-Scale Digital Systems: Algorithmic state machine charts-Introduction, Derivation of SM Charts, Realization of SM Chart, control implementation, control unit design, data processor design, ROM design, PAL design aspects, digital system design approaches using CPLDs, FPGAs and ASICs.

UNIT-IV:

Fault Diagnosis in Combinational Circuits: Faults classes and models, fault diagnosis and testing, fault detection test, test generation, testing process, obtaining a minimal complete test set, circuit under test methods- Path sensitization method, Boolean difference method, properties of Boolean differences, Kohavi algorithm, faults in PLAs, DFT schemes, built in self-test.

UNIT-V:

Fault Diagnosis in Sequential Circuits: Fault detection and location in sequential circuits, circuit test approach, initial state identification, Haming experiments, synchronizing experiments, machine identification, distinguishing experiment, adaptive distinguishing experiments.

Textbooks:

1. Logic Design Theory-N. N. Biswas, PHI
2. Switching and Finite Automata Theory-Z. Kohavi, 2nd Edition, 2001, TMH
3. Digital system Design using PLDd-Lala

Reference Books:

1. Fundamentals of Logic Design – Charles H. Roth, 5th Ed., Cengage Learning.
2. Digital Systems Testing and Testable Design – Monobaraminic, Melvin A. Breuer and Arthur D. Friedman- John Wiley & Sons Inc.

Course Outcomes:

- To provide in depth understanding of Fault models.
- To understands test pattern generation techniques for fault detection.
- To design fault diagnosis in sequential circuits.
- To provide understanding in the design of flow using case studies.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Analog And Digital CMOS VLSI Design

Course Objectives:

- ❖ To teach fundamentals of CMOS Digital integrated circuit design such as importance of Combinational MOS logic circuits, and Sequential MOS logic circuits.
- ❖ To teach the fundamentals of Dynamic logic circuits and basic semiconductor memories which are the basics for the design of high performance digital integrated circuits.
- ❖ Basic design concepts, issues and tradeoffs involved in analog IC design are explored.
- ❖ To learn about Design of CMOS Op Amps, Compensation of Op Amps,
- ❖ Design of Two-Stage Op Amps, Power Supply Rejection Ratio of Two-Stage Op Amps, Cascade Op Amps, Measurement Techniques of OP Amp.

Digital CMOS Design

Unit I: Review: Basic MOS structure and its static behaviour, Quality metrics of a digital design: Cost, Functionality, Robustness, Power, and Delay, Stick diagram and Layout, Wire delay models. Inverter: Static CMOS inverter, Switching threshold and noise margin concepts and their Evaluation, Dynamic behaviour, Power consumption.

Unit II: Physical design flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model. Combinational logic: Static CMOS design, Logic effort, Rationed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Unit III: Sequential logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, Non-bistable sequential circuit. Advanced technologies: Giga-scale dilemma, short channel effects, High–k, Metal Gate Technology, FinFET, TFET etc.

ANALOG CMOS DESIGN

Unit IV: Single Stage Amplifier: CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common gate stage, Cascade stage, Choice of device models. Differential Amplifiers: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

Unit V: Passive and active current mirrors: Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage and difference pair, Noise. Operational amplifiers: One stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP.

Textbooks:

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.
3. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", TMH, 2007.

Reference Books:

1. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition.
2. R J Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
3. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design",TMH, 3rd Edition.
4. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition.

Course Outcomes:

- Appreciate the trade-offs involved in analog integrated circuit design.
- Understand and appreciate the importance of noise and distortion in analog circuits.
- Analyze complex engineering problems critically in the domain of analog IC design for conducting research.
- Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS, Alternative CMOS Logics, Estimation of Delay and Power, Adders Design.
- Solve engineering problems for feasible and optimal solutions in the core area of digital IC's

	L	T	P	C
B. Tech: Honors	3	0	0	3

VLSI Signal Processing

Course Objectives

- To understand the structure and advantages of DSP algorithms, and gain knowledge of pipelining, parallel processing, and retiming techniques for efficient implementation.
- To obtain knowledge of folding and unfolding transformations and their application in optimizing DSP architectures for reduced hardware complexity.
- To understand the principles of systolic architecture design and how they are applied in FIR filtering and matrix operations.
- To obtain knowledge of fast convolution algorithms such as Cook-Toom and Winograd for reducing computational load in DSP systems.
- To understand the design strategies for low-power DSP systems using numerical optimization, bit-level arithmetic, and pipelining techniques.

Unit -I

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms Pipelining and Parallel Processing Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power Retiming Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques.

Unit –II

Folding and Unfolding: Folding- Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multirate systems Unfolding- Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding.

Unit -III

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

Unit -IV

Fast Convolution: Introduction – Cook-Toom Algorithm – Winogard algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection.

Unit -V

Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic. Numerical strength reduction, synchronous, wave and asynchronous pipelines, low power design. Low Power Design: Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches.

Textbooks:

1. Keshab K. Parthi, VLSI Digital signal processing systems, design and implementation, Wiley, Inter Science, 1999.
2. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994
3. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.

Reference Books:

1. John G. Proakis, Dimitris G. Manolakis "Digital Signal Processing: Principles, Algorithms, and Applications" Pearson Education, 2007 (4th Edition).
2. Jan M. Rabaey, Massoud Pedram "Low Power Design Methodologies", Springer, 1996.

Course Outcomes:

- To understand the use of pipelining, parallelism, and retiming to enhance performance and minimize power in digital signal processing systems.
- To obtain knowledge of how folding and unfolding techniques contribute to efficient hardware design and reduced register usage in DSP implementations.
- To understand the methodology of systolic array design for high-speed computation in FIR filters and two-dimensional systems.
- To obtain knowledge of applying fast convolution algorithms to achieve computational efficiency in real-time signal processing applications.
- To understand the techniques used in developing low-power DSP architectures through bit-level operations, pipelining models, and power analysis

B. Tech: Honors	L	T	P	C
	3	0	0	3

CAD for VLSI

- **Course Objectives**
  - Introduce the principles and methodologies of computer-aided design (CAD) tools used in VLSI.
  - Provide understanding of the various stages in VLSI design automation.
  - Familiarize students with hardware description languages and synthesis tools.
  - Explain algorithms for layout, verification, and optimization of VLSI circuits.
  - Develop skills to use CAD tools for design, simulation, and testing of integrated circuits.

Unit I:

Overview of VLSI CAD Tools and Design Flow: Introduction to VLSI design automation, Design flow: Specification to fabrication, Types of CAD tools: front-end and back-end, Design representation: netlists, layouts, and formats, Design challenges and automation benefits

Unit II:

Hardware Description Languages (HDL): Introduction to Verilog and VHDL, Design units and simulation models, Behavioral, dataflow, and structural modeling, Testbench creation and simulation, Case study: Simple digital design using HDL

Unit III:

Logic Synthesis and Optimization: RTL to gate-level synthesis, Technology libraries and mapping, Logic optimization techniques, Boolean algebra and DAG representation, Power, area, and timing trade-offs

Unit IV:

Physical Design Automation: Floor planning and partitioning, Placement algorithms: combinatorial and analytical, Routing algorithms: maze routing, channel routing, Clock tree synthesis and timing closure, Design rule checking (DRC) and layout versus schematic (LVS)

Unit V:

Verification and Testing in CAD: Simulation vs formal verification, Static timing analysis (STA), Design for Testability, (DFT) concepts, Built-in self-test (BIST), CAD tools for verification and test automation

Textbooks:

1. Sabih H. Gerez, Algorithms for VLSI Design Automation, 3rd Edition, Wiley, 2009.
2. Neil Weste, Kamran Eshraghian, Principles of CMOS VLSI 0Design, 4^{th} Edition, Pearson, 2015.

Reference Books

1. Sanjay Churiwala, VLSI Design and EDA Tools, Wiley, 2020.
2. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, 3^{rd} Edition, McGraw-Hill, 2008.
3. Wayne Wolf, Modern VLSI Design: IP-Based Design, 4th Edition, Pearson, 2008.
4. Rajesh K. Gupta, VLSI CAD: Algorithms and Tools, 1st Edition, Springer, 2012.

Course Outcomes:

- ❖ Describe the role and flow of CAD tools in VLSI design automation.
- ❖ Apply HDL coding and simulation for digital circuit design.
- ❖ Use synthesis tools to convert RTL to gate-level netlists.
- ❖ Understand and apply algorithms for placement, routing, and floor planning.
- ❖ Perform verification and testing using CAD methodologies.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Embedded System Design

Course Objectives:

- ❖ To provide an overview of Design Principles of Embedded System.
- ❖ To provide clear understanding about the role of firmware.
- ❖ To understand the necessity of operating systems in correlation with hardware systems.
- ❖ To learn the methods of interfacing and synchronization for tasking.

Unit -I:

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

Unit -II:

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

Unit -III:

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Unit -IV:

RTOS Based Embedded System Design: Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization, Device Drivers.

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

Unit -V:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose RTOS.

Textbooks:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

Reference Books:

1. Embedded Systems - Raj Kamal, TMH. systems.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013.
4. An Embedded Software Primer - David E. Simon, Pearson Education.

Course Outcomes:

- ❖ Understand basic concepts of embedded systems
- ❖ Analyze the applications in various processors and domains of embedded system.
- ❖ Develop embedded hardware and software development cycles and tools.
- ❖ Understand what a microcomputer is, core of the embedded system.
- ❖ Remember the definitions of ASICs, PLDs, memory, memory interface, Knowledge
- ❖ Understand different concepts of RTOS, sensors, memory interface.

B. Tech: Honors	L	T	P	C
	3	0	0	3

Embedded Real Time Operating Systems

Course Objectives:

- To enable the learner to understand the fundamentals of UNIX/Linux systems, file operations, and process control techniques essential for embedded development.
- To enable the learner to gain knowledge of Real-Time Operating Systems (RTOS), task management, synchronization mechanisms, and communication services.
- To enable the learner to explore system-level programming concepts including pipes, signals, event registers, and the I/O subsystem.
- To enable the learner to understand how real-time systems handle exceptions, interrupts, and timer-based operations for precise task scheduling.
- To enable the learner to study and compare real-time operating systems through case studies like RTLinux, VxWorks, Tiny OS, and Android OS.

Unit – I: Introduction

Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

Unit - II: Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

Unit - III: Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/ O Subsystem

Unit - IV: Exceptions, Interrupts and Timers

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

Unit - V: Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, Tiny OS, and Basic Concepts of Android OS.

Textbook:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011.

Reference Books:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, 2007, TMH.
2. Advanced UNIX Programming, Richard Stevens.
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh.

Course Outcomes:

- Able to perform basic file I/O operations and implement process control functions using UNIX/Linux system calls.
- Able to explain the architecture and key features of RTOS, including task creation, scheduling, inter-task communication, and semaphore usage.
- Able to implement basic building blocks like pipes, signals, and event-driven I/O mechanisms in real-time applications.
- Able to design and manage real-time interrupt handling using hardware/software timers and exception control routines.
- Able to analyze, compare, and apply features of different RTOS like RTLinux, MicroC/OS-II, VxWorks, and Android OS for embedded systems.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Embedded Networking

Course Objectives:

- Understand the Embedded Communication Protocols
- Develop a network based on Embedded systems
- Know about interfaces and buses

Unit-I: Embedded Communication Protocols

Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming - ISA/PCI Bus protocols –Firewire.

Unit-II: USB and CAN Bus

USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types –Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs –CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN.

Unit-III: Ethernet Basics

Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers –Using the internet in local and internet communications – Inside the Internet protocol.

Unit-IV: Embedded Ethernet

Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure.

Unit V: Wireless Embedded Networking

Wireless sensor networks – Introduction – Applications – Network Topology – Localization – Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing Data Centric routing.

Textbooks:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002
2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port -Jan Axelson, Penram Publications, 1996.

Reference Books:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series -Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.
3. Networking Wireless Sensors - Bhaskar Krishnamachari, Cambridge press 2005.

Course Outcomes:

- ❖ Understand the Embedded Communication Protocols
- ❖ Develop a network based on Embedded systems
- ❖ Interfaces the hardware and know to uses the buses

	L	T	P	C
B. Tech: Honors	3	0	0	3

IoT based Embedded System Design

Course Objectives:

- Understand the overview of Internet of Things, building blocks of IoT and the real-world applications.
- Analyze the IoT Physical Devices and End Points and Case studies illustrating IoT design.
- Know the importance of hard/soft Real-Time Systems and to familiarize the cases for tasks, semaphores, queues, pipes, and event flags.

Unit – I

Introduction to Internet of Things: Definitions & Characteristics of IoT, Physical and Logical Design of IoT, IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Levels & Deployment Templates. Tools for IoT: Chef, Chef case studies, Puppet, Puppet case study, NETCONF-YANG case studies.

Unit – II:

IoT Physical Devices and End Points: Basic Building Blocks of an IoT Device, Raspberry Pi- about the Raspberry Pi Board, Raspberry Pi Interfaces-Serial, SPI and I2C. Introduction to Beagle Bone Black Board and its Internals. Data Analytics For IoT: Apache Hadoop, Using Hadoop Map Reduce for Batch Data Analysis, Apache Oozie, Apache Spark, Apache Storm, using Apache Storm Real Time Data Analysis.

Unit – III:

IoT Platforms Design Methodology: IoT Design Methodology, Case Study on IoT System for Weather Monitoring. Case Studies illustrating IoT Design: Home Automation, Smart Parking, Weather Monitoring System, Weather Reporting Bot, Air Pollution Monitoring, Forest Fire Detection, Smart Irrigation, IoT Printer.

Unit – IV:

RTOS Concepts: Differences between Traditional OS and RTOS, Real Time System Concepts, Hard Versus Soft Real- Time Systems: Examples, Jobs & Processors, Hard and Soft Timing Constraints, Hard Real –Time Systems, Soft Real Time Systems. Classical Uniprocessor Scheduling Algorithms –RMS, Preemptive EDF, Allowing for Preemptive and Exclusion Condition.

Unit – V:

Introduction to Vx-Works: RTOS Kernel & Issues in Multitasking Task Assignment, Task Switching, Foreground ISRs And Background Tasks, Critical Section, Vxworks – POSIX Real Time Extensions, Timeout Features, Task Creation, Semaphores (Binary, Counting), Mutex, Mailbox, Message Queues. Case Study: Automatic Vending Machine for ESD.

Textbooks:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach, Universities Press", 2015.
2. Jane W. S. Liu, "Real Time Systems", Pearson Education, Asia, 2018. Wind River Systems Inc., "VxWorks Programmers Guide", 2019.

Reference Books:

1. C.M. Krishna and G. Shin, "Real Time Systems", McGraw-Hill Companies Inc., 2015.

Course Outcomes:

- Understand the terminology, enabling technologies and tools of IoT.
- Develop the building blocks of IoT physical devices and end points using Raspberry Pi and data analytics.
- Design methodology and case study illustration of different application domains.
- Analyze various scheduling algorithms and application to real time systems.
- Illustrate the concepts of real time operating system and VxWorks.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Network Security and Cryptography

Course Objectives:

- The main objectives of this course are to explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests public key algorithms, design issues and working principles of various authentication protocols and various secure communication standards including Kerberos, IPSEC, and SSL/TLS.

Unit I:

Basic Principles: Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography.

Unit II:

Symmetric Encryption: Mathematics of Symmetric Key Cryptography, Introduction to Modern Symmetric Key Ciphers, Data Encryption Standard, Advanced Encryption Standard.

Unit III:

Asymmetric Encryption: Mathematics of Asymmetric Key Cryptography, Asymmetric Key Cryptography

Unit IV:

Data Integrity, Digital Signature Schemes & Key Management: Message Integrity and Message Authentication, Cryptographic Hash Functions, Digital Signature, Key Management.

Unit V:

Network Security-I: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, Network Security-II : Security at the Network Layer: IPSec, System Security

Textbooks:

1. Cryptography and Network Security, 3rd Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill,2015
2. Cryptography and Network Security,4th Edition, William Stallings, (6e) Pearson,2006
3. Everyday Cryptography, 1st Edition, Keith M.Martin, Oxford,2016.

Reference Books:

1 Network Security and Cryptography, 1st Edition, Bernard Meneges, Cengage Learning,2018.

Course Outcomes:

- Explain different security threats and countermeasures and foundation courses of cryptography mathematics.
- Classify the basic principles of symmetric key algorithms and operations of some symmetric key algorithms and asymmetric key cryptography
- Revise the basic principles of Publickey algorithms and Working operations of some Asymmetric key algorithms such as RSA, ECC and some more
- Design applications of hash algorithms, digital signatures and key management techniques
- Determine the knowledge of Application layer, Transport layer and Network layer security Protocols such as PGP, S/MIME, SSL, TSL, and IPsec.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Advanced Communication Networks

Course Objectives:

- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Provide the student with knowledge of advanced networking concepts and techniques.
- Provide the student with knowledge of Real Time Communications over Internet and Packet Scheduling.

Unit-I

Overview of Internet Concepts, Challenges and History: Overview Of -ATM. TCO/IP congestion And Flow Control in Internet; Throughput Analysis of TCP Congestion Control, TCP For High Bandwidth Delay Networks and Fairness Issues In TCP.

Unit-II

Issues Of Real Time Communications Over Internet: Adaptive Applications, Latency and Throughput, Integrated Services Model (Intserv), Resource Reservation Protocol. Characterization of Traffic by linearly bounded Arrival Processes (LBAP), Leaky Bucket Algorithm and Its Properties.

Unit-III

Packet Scheduling Algorithms-Requirements and Choices: Scheduling Guaranteed Service Connections, GPS, WFQ And Rate Proportional Algorithms, High Speed Scheduler Design; Theory of Latency Rate Servers and Delay Bounds in Packet Switched Networks For LBAP Traffic; Active Queue Management - RED, WRED And Virtual Clock, Control Theoretic Analysis of Active Queue Management.

Unit-IV

IP Address Lookup-Challenges: Packet Classification Algorithms and Flow Identification, Grid of Tries, Cross Production and Controlled Prefix Expansion Algorithm. Admission Control in Internet: Concept of Effective Bandwidth, Measurement Based Admission Control; Differentiated Services in Internet (Diffserv), Diffserv Architecture and Framework.

Unit-V

IPV4, IPV6, IP Tunneling, IP Switching And MBPLS, Overview of IP Over ATM And Its Evolution to IP Switching; MPLS Architecture and Framework, MPLS Protocols, Traffic Engineering Issues In MPLS.

Textbooks:

1. J.F. Kurose & K.W. Ross, “Computer Networking- A top-down approach featuring the internet”, Pearson, sixth edition, 2013.
2. Nader F. Mir, “Computer and Communication Networks”, second edition, 2015.

Reference books:

1. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach”, Morgan Kaufman Publishers, 2004.
2. Jean Wairand and PravinVaraiya, “High Performance Communications Networks”, 2nd edition, 2000.

Course Outcomes:

- Recall the concepts and issues of real time communications over the internet.
- Classify protocols and algorithms for communication networks.
- Identify the mechanisms for quality of service in networking.
- Analyze IP addressing challenges and services on the internet
- Explain the different versions of IP protocols, IP switching and MPLS protocols.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Wireless and Mobile Communications

Course Objectives:

- ❖ Facilitate the understanding of the basics of Cellular System design Fundamentals and Large-scale propagation models
- ❖ Provide the concepts of small-scale fading and Equalization.
- ❖ Build knowledge on multiple access techniques, GSM and Cellular Standards.

Unit-I

The Cellular Concept System Design Fundamentals: Frequency reuse, Frequency management, Channel Assignment Strategies, Handoff Strategies, Co-channel Interference, Adjacent channel interference, Power control for Reducing Interference, Cell Splitting and Sectoring.

Unit-II

Mobile Radio Propagation Large Scale Path Loss: Free space propagation model, Reflection, Ground Reflection (Two-Ray) model, Diffraction: Knife – edge Diffraction Model, Scattering, Practical link budget design using path loss models: Log Normal Shadowing, Determination of percentage of coverage area, Outdoor propagation models: Okumura and Hata models, Indoor propagation models: Partition losses (same floor), Partition losses between floors, Signal penetration into buildings.

Unit-III

Mobile Radio Propagation Small Scale Fading and Multipath: Impulse response model, Spread Spectrum Sliding Correlator Channel Sounding, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading: Flat Fading, Frequency selective Fading, Fast Fading and Slow Fading.

Unit-IV

Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in Communication Receiver, Linear Equalizers, Non-Linear Equalizers: Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for Adaptive Equalization: Zero Forcing Algorithm and Least Mean Square Algorithm.

Unit-V

Multiple Access Techniques: FDMA, TDMA and CDMA. Comparison of these technologies based on their signal separation, Advantages and Disadvantages. GSM System: Architecture and Interfaces, Subsystems, Logical channels, HSCSD, GPRS and EDGE. IS-95 System: Architecture, Air interface, Physical and Logical channels, Evolution of CDMA One to CDMA 2000. Higher Generation Cellular Standards: 3G, 4G, VoLTE, UMTS, Introduction to 5G.

Textbooks:

1. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3. V.K.Garg and J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.

Reference Books:

1. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
2. AshaMehrotra, "A GSM system Engineering" Artech House Publishers Boston, London,1997.

Course Outcomes:

- ❖ Understand and apply frequency-reuse concept in mobile communications, and analyze its effects on interference, system capacity, and handoff techniques.
- ❖ Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
- ❖ Distinguish various multiple-access techniques for mobile communications and their advantages and disadvantages.
- ❖ Evaluate GSM and CDMA systems by functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using these technologies.
- ❖ Devising the higher generation Cellular standards 3G, 4G & 5G.

B. Tech: Honors	L	T	P	C
	3	0	0	3

Machine Learning for Next Generation Communications

Course Objectives:

- Develop and apply machine learning algorithms to enhance the performance of wireless communication and networks.
- Use deep learning techniques to improve wireless communication network's coverage and channel capacity.
- Evaluate the performance of machine learning algorithms and deep learning techniques in wireless communication networks.

Unit - I

Machine Learning for Spectrum Access and Sharing: Online Learning Algorithms for Opportunistic Spectrum Access, Performance Measures of the Online Learning Algorithms, Random and Deterministic Approaches, The Adaptive Sequencing Rules Approach, Structure of Transmission Epochs, Learning Algorithms for Channel Allocation, Distributed Learning.

Unit – II

Machine and Reinforcement Learning for Resource Allocation in Communication Networks: Use of QLearning for Cross-layer Resource Allocation, Deep Q-Learning and Resource Allocation, Cooperative Learning and Resource Allocation, Decentralized Resource Minimization, Resource Minimization Approaches, Optimized Allocation.

Unit - III

Deep Learning–Based Coverage and Capacity Optimization: Related Machine Learning Techniques for Autonomous Network Management, Data-Driven Base-Station Sleeping Operations by Deep Reinforcement Learning, Deep Q-Learning Preliminary and its Applications to BS Sleeping Control, Dynamic Frequency Reuse through a Multi-Agent Neural Network Approach.

Unit - IV

Machine Learning in Energy Efficiency Optimization: Self-Organizing Wireless Networks, Traffic Prediction and Machine Learning, Cognitive Radio and Machine Learning, Deep Learning, Positioning of Unmanned Aerial Vehicles, Traffic Prediction, Mobility Prediction

Unit - V

Machine Learning–Based Adaptive Modulation and Coding (AMC) Design: Overview of ML-Assisted AMC, k-NN-Assisted AMC, Algorithm for k-NN-Assisted AMC, Performance Analysis of k-NN-Assisted AMC System, RL-Assisted AMC, Machine Learning for Joint Channel Equalization and Signal Detection.

Textbooks:

1. Fa-Long Luo," Machine Learning for Future Wireless Communications", John Wiley and Sons, 2020
2. Ruisi He, Z Ding, "Applications of Machine Learning in Wireless Communications", IET Telecommunication series 81.
3. K. K. Singh, A. Singh, K. Cengiz, Dac-Nhuong Le, "Machine Learning and Cognitive Computing for Mobile Communications and Wireless Networks", Wiley 2020.

Reference Books:

1. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms, "Cambridge University Press",2014.
2. Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis Takis Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", CRC Press, 2017.

Course Outcomes:

- Develop a comprehensive understanding of machine learning and deep learning techniques for wireless communication networks.
- Design machine learning algorithms for spectrum access and sharing and reinforcement learning algorithms for resource allocation.
- Design deep learning algorithms for optimizing coverage and channel capacity.
- Apply machine learning algorithms for optimizing energy efficiency, modulation, coding, channel equalization, and signal detection.
- Analyze and evaluate the performance of machine learning and deep learning algorithms in wireless communication networks.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Transform Techniques

Course Objectives:

- To provide a strong foundation in Fourier analysis.
- To introduce two-dimensional transform techniques.
- To provide knowledge of time-frequency analysis using wavelets
- To impart knowledge of discrete wavelet transform and multiresolution analysis
- To expose students to real-world applications of transform techniques

Unit -I:

Fourier analysis: Fourier series, Examples, Fourier Transform, Properties of Fourier Transform, Discrete Time Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform.

Unit -II:

2-D Transforms: Two-dimensional orthogonal and Unitary transforms, DFT, DCT, DST, Walsh, Hadamard, Haar and Slant Transforms, KLT, Singular value Decomposition – definition, properties.

Unit -III:

Continuous Wavelet Transform (CWT): Time – Frequency Analysis: Window function, Short Time Fourier Transform, Need for wavelets, Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation, Series Expansion using Wavelets, Tiling of time scale plane for CWT. Important Wavelets: Haar, Daubechies.

Unit -IV:

Discrete Wavelet Transform: Limitations of CWT, Concept of scaling and shifting, Discrete-time wavelets, Wavelet basis and orthonormal wavelets, Comparison of DWT with CWT, Multi Resolution Analysis- Concept of signal approximation at various scales, Construction of nested subspaces, Role of scaling function (ϕ) and wavelet function (ψ),Two-scale relation, **Filter Bank Interpretation of DWT-** Decomposition into approximation and detail coefficients, Low-pass and high-pass filters, Down sampling (decimation by 2), Signal reconstruction using synthesis filters

Unit -V:

Application of Transforms: Dual Tone Multi frequency Signal Detection, JPEG, JPEG-2000, Spectral analysis of sinusoidal signals, non-stationary signals, OFDM, Denoising and feature extraction using DWT.

Textbooks:

1. J. G. Proakis and D. G. Manolakis, "Digital signal processing: Principles, Algorithm And Applications", 4th Edition, Prentice Hall, 2007.
2. A.K. Jain, "Fundamentals of Digital Image Processing", PHI, 2015.
3. A Wavelet Tour of Signal Processing theory and applications –Raghuveer M. Rao and Ajit S. Bopardikar, Pearson Edu, Asia, New Delhi, 2003.

Reference Books:

1. Sanjit. K. Mitra, "Digital signal processing", 3rd Edition, McGraw Hill, 2006.
2. Jaideva C. Goswami and Andrew K. Chan, "Fundamentals of Wavelets" Wiley publishers, 2006.
3. A Wavelet Tour of Signal Processing-Stephen G. Mallat, Academic Press, 2 Ed
4. Digital Image Processing – S. Jayaraman, S. Esakkirajan, T. Veera Kumar TMH,2009.

Course Outcomes:

- Analyze signals using Fourier transforms and FFT
- Apply 2D transforms and SVD for signal/image processing
- Use CWT for time-frequency signal analysis
- Implement DWT for signal compression and reconstruction
- Solving real-world problems using transformation techniques

B. Tech: Honors	L	T	P	C
	3	0	0	3

Statistical Signal Processing

Course Objectives:

- To understand the qualitative problems of Signal Detection and Estimation in the framework of statistical inference.
- To write down hypothesis tests and estimation schemes for typical problems of interests
- To gain an understanding of Signal Detection and Estimation of signals in white and non-white Gaussian noise

Unit-I

Signal models and characterization: Types and properties of statistical models for signals and how they relate to signal processing, Common second-order methods of characterizing signals including autocorrelation, partial correlation, cross-correlation, power spectral density and cross-power spectral density.

Unit-II

Spectral estimation: Nonparametric methods for estimation of power spectral density, autocorrelation, cross-correlation, transfer functions, and coherence form finite signal samples.

Unit-III

Review of signal processing: A review on random processes, A review on filtering random processes, Examples. Statistical parameter estimation: Maximum-like-hood estimation, maximum posterior estimation, Cramer-Rao bound.

Unit-IV

Eigen structure-based frequency estimation: Pisarenko, MUSIC, ESPRIT their application sensor array direction finding. Spectrum estimation: Moving average (MA), Auto Regressive (AR), Auto Regressive Moving Average (ARMA), Various non-parametric approaches.

Unit-V

Wiener filtering: The finite impulse case, causal and non-causal infinite impulse responses cases, Least mean squares adaptation, recursive least squares adaptation, Kalman filtering.

Textbooks:

1. Steven M.Kay, fundamentals of statistical signal processing: estimation Theory,PreticeHall,1993.
2. Monsoon H. Hayes, Stastical digital signal processing and modeling, USA, Wiley,1996.

Reference Books:

1. Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, Statistical and adaptive signal processing, Artech House, Inc,2005, ISBN 1580536107

Course Outcomes:

- ❖ Analyse signals and develop their statistical models for efficient processing
- ❖ Formulate filtering problems from real life applications and design filtering solutions to estimate a desired signal from a given mixture by minimizing a cost function
- ❖ Design and analyse efficient algorithms for estimation of various parameters of signals with different constraints
- ❖ Develop efficient methods for spectrum and frequency estimation suiting the requirements derived from practical problems.

B. Tech: Honors	L	T	P	C
	3	0	0	3

Advanced Digital Signal Processing

Course Objectives:

- To Know the analysis of discrete time signals.
- To study modern digital signal processing algorithms and applications.
- To Have an in-depth knowledge of use of digital systems in real time applications
- To Apply the algorithms for wide area of recent applications.

Unit –I:

Review of DFT, FFT, IIR Filters and FIR Filters: Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion.

Unit –II:

Applications of Multi Rate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Sub-band Coding of Speech Signals, Quadrature Mirror Filters, Trans-multiplexers, Over Sampling A/D and D/A Conversion.

Unit -III:

Non-Parametric Methods of Power Spectral Estimation: Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

Unit –IV:

Implementation of Digital Filters: Introduction to filter structures (IIR & FIR), Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

Unit –V:

Parametric Methods of Power Spectrum Estimation: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

Textbooks:

1. Digital Signal Processing: Principles, Algorithms & Applications - J.G.Proakis& D. G. Manolakis, 4 th Ed., PHI.
2. Discrete Time Signal Processing - Alan V Oppenheim & R. W Schaffer, PHI.
3. DSP – A Practical Approach – Emmanuel C. Ifeacher, Barrie. W. Jervis, 2 Ed., Pearson Education.

Reference Books:

1. Modern Spectral Estimation: Theory & Application – S. M .Kay, 1988, PHI.
2. Multi Rate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education.
3. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C.Gnanapriya, 2000,TMH .
4. Digital Spectral Analysis – Jr. Marple

Course Outcomes:

- To understand theory of different filters and algorithms
- To understand theory of multirate DSP, solve numerical problems and write algorithms
- To understand theory of prediction and solution of normal equations
- To know applications of DSP at block level.

	L	T	P	C
B. Tech: Honors	3	0	0	3

Deep Learning Techniques for Signal Processing

Course Objectives:

- ❖ Understand the foundational principles and concepts of Machine Learning and Deep Learning.
- ❖ Apply deep learning methods for evaluating and implementing speech processing.
- ❖ Analyze and apply deep learning methods to image processing tasks, biomedical signal processing and their applications.

UNIT - I

Fundamentals of ML & DL: Basics of Machine Learning (ML), Supervised Learning, Unsupervised Learning, Reinforcement Learning, Introduction to Deep Learning, Perceptron Algorithm, Multilayer Perceptron (Neural Networks), ML vs Deep Neural Networks.

UNIT - II

Deep Learning Algorithms: Basic Building Blocks of CNN, Forward and Back propagation in CNN, Classic CNN Architectures, Modern CNN Architectures, Basic Building Blocks of RNNs, RNNs and Properties, Deep RNN Architectures.

UNIT - III

DL in Speech Processing Applications: A case study approach on Real time Analysis of Speech Processing: Preprocessing, Feature extraction and Implementation of Classification based on Deep learning methods.

UNIT - IV

DL in Image Processing Applications: A case study approach on Real time Analysis of Image Processing: Preprocessing, Feature extraction and Implementation of Classification based on Deep Learning Methods.

UNIT - V

DL in Bio-medical Signal Analysis: A case study approach on Real time Analysis of any Biomedical signals: Preprocessing, feature extraction and Implementation of Classification based on Deep learning methods.

Textbooks:

1. Uday Kamath John Liu, James Whitaker, “Deep Learning for NLP and Speech Recognition”, Springer nature, 2019.
2. Deep Learning: Methods and Applications”, Li Deng, Microsoft Technical Report.
3. “Automatic Speech Recognition - Deep learning approach” - D. Yu, L. Deng, Springer, 2014.
4. “Machine Learning for Audio, Image and Video Analysis”, F. Camastra, Vinciarelli, Springer, 2007.

Reference Books:

1. Ian J. Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. B. Yagnarayana, “Artificial Neural Networks”, Prentice Hall, New Delhi, 2007.

Course Outcomes:

- ❖ Understand fundamentals of Machine Learning and Deep Learning.
- ❖ Analyze Various Deep Learning Architectures.
- ❖ Analyze the deep learning methods for speech processing.
- ❖ Analyze the deep learning methods for Image processing.
- ❖ Analyze the deep learning methods for biomedical signal processing.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Electronic Devices and Linear ICs

Course Objectives

- Introduce the fundamental principles and characteristics of semiconductor devices.
- Provide an understanding of the construction, operation, and applications of electronic devices.
- Explain the design and analysis of amplifier circuits using transistors.
- Familiarize students with the operational amplifier (Op-Amp) and its linear and nonlinear applications.
- Introduce commonly used linear ICs and their applications in analog electronic systems.

Unit I: Semiconductor Devices

Introduction to semiconductors: intrinsic and extrinsic, PN junction diode: characteristics, applications (rectifiers, clippers, clampers, Zener diodes), Bipolar Junction Transistor (BJT): operation, configurations (CE, CB, CC), characteristics, Field Effect Transistors (FETs): JFET and MOSFET characteristics and applications.

Unit II: Transistor Amplifiers and Feedback

BJT biasing methods and stability, Small-signal equivalent circuits of BJT and FET, Frequency response of single-stage amplifiers, Concept of feedback: positive and negative, Types of negative feedback amplifiers and their characteristics.

Unit III: Operational Amplifiers (Op-Amps)

Introduction to Op-Amps: internal structure and characteristics, Op-Amp parameters: input offset voltage, bias current, slew rate, CMRR, PSRR. Op-Amp configurations: inverting, non-inverting, voltage follower, Practical limitations of Op-Amps.

Unit IV: Applications of Op-Amps

Mathematical operations: adder, subtractor, integrator, differentiator, Instrumentation amplifier, comparator, Schmitt trigger, Precision rectifiers, log and antilog amplifiers, Signal conditioning circuits.

Unit V: Specialized Linear ICs and Applications

555 Timer: block diagram, modes (astable, monostable), applications, 566 VCO and 565 PLL: working and applications, Voltage regulators: IC 78xx, 79xx, LM317, Active filters: low-pass, high-pass, band-pass, band-stop (1st and 2nd order).

Text Books

1. David A. Bell, Electronic Devices and Circuits, Oxford University Press, 5th Edition, 2008.
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, Pearson Education, 4th Edition, 2020.

Reference Books

1. Robert L. Boylestad & Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, 11th Edition, 2013.
2. Adel S. Sedra & Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, 8th Edition, 2019.
3. D. Roy Choudhury & Shail B. Jain, Linear Integrated Circuits, New Age International Publishers, 5th Edition, 2018.
4. Jacob Millman & Christos C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems, McGraw Hill Education, 2nd Edition, 2015.

Course Outcomes:

- ❖ Understand the characteristics and applications of semiconductor diodes and transistors.
- ❖ Analyze and design transistor-based amplifier circuits.
- ❖ Explain the internal structure, characteristics, and parameters of operational amplifiers.
- ❖ Design and implement linear and nonlinear applications using Op-Amps.
- ❖ Understand and apply commonly used linear ICs in analog systems like oscillators, voltage regulators, and filters.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Fundamentals of Lab VIEW

Course Objectives

- Introduce the graphical programming environment of LabVIEW and its applications in engineering.
- Demonstrate the fundamentals of data acquisition, signal processing, and instrumentation using LabVIEW.
- Develop skills to design and implement virtual instruments (VIs) for automation and control.
- Familiarize students with LabVIEW programming structures such as loops, case structures, and arrays.
- Enable students to build real-time data monitoring and control systems using LabVIEW.

Unit I:

Introduction to LabVIEW Environment: Overview of LabVIEW and graphical programming, LabVIEW environment and components: Front Panel, Block Diagram, Controls and Indicators, Data types and variables in LabVIEW, Creating, saving, and running a simple VI, Understanding controls, indicators, and connectors.

Unit II:

Programming Structures and Dataflow: Dataflow programming model in LabVIEW, Sequence structures: while loops, for loops, and case structures, Shift registers and feedback nodes, Arrays and clusters: creation, manipulation, and applications, Error handling and debugging tools.

Unit III:

Data Acquisition and Signal Processing: Interfacing LabVIEW with DAQ hardware, Analog and digital input/output operations, Signal generation and analysis: waveform generation, filtering, and FFT, Timing and synchronization techniques, Basic signal processing applications.

Unit IV:

File I/O and Communication: File input/output operations: reading from and writing to files, Data logging and data management, Introduction to VI server and subVIs, Communication protocols: Serial communication (RS232), TCP/IP basics in LabVIEW, Remote monitoring using LabVIEW Web Services.

Unit V:

Applications and Project Development: Design of automated test and measurement systems, Real-time data acquisition and control, Case studies: Temperature monitoring, motor control, sensor interfacing, User interface design and optimization, Overview of LabVIEW advanced toolkits (brief introduction).

Textbooks:

1. Lisa K. Wells and Jeffrey Travis, LabVIEW for Everyone: Graphical Programming Made Easy and Fun, Prentice Hall, 3rd Edition, 2011.
2. J. Patrick Levesque, LabVIEW: A Developer's Guide to Real World Integration, Prentice Hall, 1st Edition, 2001.

Reference Books:

1. Gary W. Johnson, LabVIEW Graphical Programming: Practical Applications in Instrumentation and Control, McGraw Hill, 2nd Edition, 1997.
2. Jonathan W. Valvano, Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment, CreateSpace, 2nd Edition, 2011. (For interfacing concepts)
3. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, LabVIEW: Advanced Programming Techniques, CRC Press, 1st Edition, 2007.

Course Outcomes (COs)

- ❖ Understand LabVIEW environment, tools, and programming basics.
- ❖ Develop virtual instruments (VIs) using graphical programming.
- ❖ Apply data acquisition and signal processing techniques in LabVIEW.
- ❖ Implement control structures, arrays, and file handling in LabVIEW programs.
- ❖ Design real-time monitoring and automated testing systems using LabVIEW.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Geographic Information Systems (GIS)

Course Objectives

- ❖ Introduce the fundamental concepts, components, and applications of Geographic Information Systems.
- ❖ Demonstrate spatial data models, data structures, and spatial database management.
- ❖ Explore spatial analysis techniques and GIS modeling.
- ❖ Understand GIS software, tools, and data visualization methods.
- ❖ Enable students to apply GIS technology in real-world problems like urban planning, environmental management, and resource mapping.

Unit I: Introduction to Geographic Information Systems

Definition, history, and evolution of GIS, Components and architecture of GIS, Geographic data types: spatial and non-spatial data, GIS applications in environment, urban planning, agriculture, disaster management, Overview of GIS software platforms.

Unit II: Spatial Data Models and Data Structures

Raster and vector data models: concepts and differences, Topology and network models, Data formats and standards (e.g., Shapefile, GeoJSON), Spatial data acquisition: GPS, remote sensing, digitization, Coordinate systems, projections, and georeferencing.

Unit III: Spatial Database Management and Data Input

Spatial database concepts and management systems (Spatial DBMS), Data quality and error handling, Data input and editing techniques, Metadata and data standards, Integration of GIS with other information systems.

Unit IV: Spatial Analysis and Modeling

Basic spatial analysis operations: buffering, overlay, and spatial queries, Network analysis and terrain analysis, Spatial interpolation and geostatistics, GIS modeling and decision support systems, Map algebra and suitability analysis.

Unit V: Visualization, GIS Software and Applications

Cartography and map design principles, Visualization tools and techniques in GIS, Web GIS and cloud GIS services, Case studies: Urban planning, natural resource management, disaster response, Future trends: Mobile GIS, real-time GIS, 3D GIS.

Textbooks

1. Ian Heywood, Sarah Cornelius, and Steve Carver, An Introduction to Geographical Information Systems, Pearson Education, 4th Edition, 2011.
2. Kang-tsung Chang, Introduction to Geographic Information Systems, McGraw Hill, 9th Edition, 2019.
3. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, Principles of Geographical Information Systems, Oxford University Press, 3rd Edition, 2015.

Reference Books

1. Chor Pang Lo and Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice Hall, 2nd Edition, 2007.
2. Michael N. DeMers, GIS Modeling in Raster, Wiley, 1st Edition, 2002.
3. Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind, Geographic Information Science and Systems, Wiley, 4th Edition, 2015.
4. Chunrong Jia, GIS Fundamentals: A First Text on Geographic Information Systems, XanEdu Publishing, 5th Edition, 2016.

Course Outcomes:

- Explain the basic concepts, components, and architecture of GIS.
- Understand spatial data types, data models, and data acquisition methods.
- Perform spatial analysis and queries using GIS tools.
- Manage and manipulate spatial databases effectively.
- Apply GIS for solving practical problems in various domains.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Principles of Communication Systems

Course Objectives:

- ❖ To understand the basic algorithms of communication
- ❖ To improve the Mathematical analytical skills
- ❖ To understand the Role of Noise in Communication
- ❖ To understand the principles of Analog & Digital Modulation Techniques

Unit I:

Amplitude Modulation: Frequency Translation, Frequency- Division Multiplexing, Time & Frequency – Domain description, switching modulator, Envelop detector. DSB-SC, SSB-SC, VSB-SC modulation and demodulation. **(Qualitative Treatment).**

Unit II:

Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals. **(Qualitative Treatment).**

Unit III:

Noise: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth, Noise Figure. Introduction, Pre-emphasis and De-emphasis in FM, Noise analysis of AM and FM system. **(Qualitative Treatment).**

Unit IV:

Pulse Analog Modulation: Time Division Multiplexing, Types of Pulse modulation, PAM PWM, PPM Generation and demodulation. **(Qualitative Treatment).**

Unit V:

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, adaptive delta modulation. **(Qualitative Treatment).**

Textbooks:

1. H Taub & D. Schilling, Gautam Sahe, (2007). Principles of Communication Systems. TMH.
2. B. P. Lathi, Communication Systems. B S Publication
3. Simon Haykin, “Communication Systems” -, John Wiley, 2nd Ed.

Reference Book:

1. Simon Haykin, MichaelMoher (2007). Introduction to Analog and Digital Communications, John Wiley
2. R.P. Singh,S P Sapre, (2017). Communication Systems: Analog and Digital,TMH.
3. George Kennedy and Bernard Davis. (2004). Electronics & Communication System. TMH
4. Kwang-Cheng Chen,. (2023). Principles of Communication: A First Course in Communication. River Publishers.
5. Rodger E. Ziemer, William H. Tranter (2015). PRINCIPLES OF. COMMUNICATIONS. Systems, Modulation, and Noise, Wiley.

Course Outcomes:

- Analyze the performance of analog modulation schemes in time and frequency domains.
- Analyze the performance of angle modulated signals
- 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.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Coding Theory and Practice

Course Objectives:

- Introduce fundamental concepts of coding theory and error control coding.
- Provide knowledge of various types of error-detecting and error-correcting codes.
- Explore encoding and decoding algorithms for linear block codes, cyclic codes, and convolutional codes.
- Understand the practical applications of coding techniques in digital communication systems.
- Develop skills to design and analyze codes for reliable data transmission and storage.

Unit I:

Introduction to Coding Theory: Importance of coding in communication and data storage, Types of errors and error models, Basics of coding theory: code words, code rate, minimum distance, Hamming distance and weight, Types of codes: block codes and convolutional codes.

Unit II:

Linear Block Codes: Definition and properties of linear block codes, Generator and parity-check matrices, Encoding methods, Syndrome decoding and error detection, Hamming codes and their properties.

Unit III:

Cyclic Codes: Definition and properties of cyclic codes, Polynomial representation of codewords, Generator polynomial and parity-check polynomial, Encoding using shift registers, BCH and Reed-Solomon codes: basics and applications.

Unit IV:

Convolutional Codes: Structure of convolutional codes, Encoder representation: shift registers and trellis diagrams, Parameters: constraint length, code rate, Viterbi decoding algorithm and its implementation, Applications of convolutional codes.

Unit V:

Advanced Topics and Applications: Concatenated codes and turbo codes, Low-density parity-check (LDPC) codes, Performance evaluation: bit error rate (BER) and coding gain, Coding standards in digital communication (e.g., GSM, LTE), Practical coding applications in wireless and storage systems.

Textbooks

1. S. Lin and D. J. Costello Jr., Error Control Coding: Fundamentals and Applications, Pearson Education, 2nd Edition, 2004.
2. Ranjan Bose, Information Theory, Coding and Cryptography, Tata McGraw Hill, 2nd Edition, 2008.
3. F. J. MacWilliams and N. J. A. Sloane, The Theory of Error-Correcting Codes, North-Holland (Elsevier), 1st Edition, 1977.

Reference Books

1. R. E. Blahut, Theory and Practice of Error Control Codes, Addison-Wesley, 1st Edition, 1983.
2. W. Cary Huffman and Vera Pless, Fundamentals of Error-Correcting Codes, Cambridge University Press, 1st Edition, 2003.
3. T. K. Moon, Error Correction Coding: Mathematical Methods and Algorithms, Wiley-IEEE Press, 1st Edition, 2005.
4. John G. Proakis and Masoud Salehi, Digital Communications, McGraw Hill, 5th Edition, 2008.

Course Outcomes

- Understand basic principles and terminology of coding theory.
- Construct and analyze linear block codes and cyclic codes.
- Implement encoding and decoding algorithms for error control codes.
- Apply convolutional coding and Viterbi decoding in communication systems.
- Evaluate the performance of coding schemes and understand practical coding standards.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Fundamentals of Digital Signal Processing

Course Objectives

- Introduce the fundamental concepts and mathematical tools of Digital Signal Processing (DSP).
- Analyzing the characterization of discrete-time signals and systems.
- Explore the design and implementation of digital filters.
- Explain the application of the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT).
- Introduce DSP implementation aspects and real-time application domains.

Unit I:

Discrete-Time Signals and Systems: Classification and properties of signals, Classification of systems: linearity, time-invariance, causality, stability, Discrete-time system modeling: difference equations, Linear convolution and circular convolution.

Unit II:

Z-Transform and Its Applications: Definition and properties of Z-transform, Region of convergence (ROC) and its significance, Inverse Z-transform: long division, partial fractions, and residue method, System analysis using Z-transform: stability and causality.

Unit III:

Discrete Fourier Transform (DFT) and FFT: DFT and its properties, Linear and circular convolution using DFT, FFT algorithms: Radix-2 DIT and DIF, Efficient computation and applications of FFT.

Unit IV:

Digital Filter Design: Introduction to digital filters: FIR and IIR, Design of IIR filters using impulse invariance and bilinear transformation, Design of FIR filters using windowing techniques, Frequency response and stability of filters.

Unit V:

DSP Applications and Implementation: Overview of DSP applications: audio, speech, biomedical, image, and communication, Real-time DSP systems and processors (e.g., DSP chips like TMS320), Finite word length effects in digital filters, Introduction to MATLAB/Python for DSP simulations.

Textbooks

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson Education, 5th Edition, 2021.
2. A.V. Oppenheim and R.W. Schafer, Discrete-Time Signal Processing, Pearson Education, 3rd Edition, 2021.

Reference Books

1. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing, McGraw Hill Education, 4th Edition, 2019.
2. Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw Hill, 4th Edition, 2010.
3. P. Ramesh Babu, Digital Signal Processing, Scitech Publications, 6th Edition, 2011.
4. Monson H. Hayes, Schaum's Outline of Digital Signal Processing, McGraw Hill, 1st Edition, 1999.

Course Outcomes:

- Understand and analyze discrete-time signals and systems using time-domain and frequency-domain tools.
- Apply convolution, Z-transform, and DFT techniques to solve DSP problems.
- Design and analyze digital filters (FIR and IIR).
- Implement efficient computation of the DFT using FFT algorithms.
- Explore real-world DSP applications and implementation issues.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Microcontrollers and Interfacing

Course Objectives:

- ❖ Introduce the architecture, programming, and applications of microcontrollers.
- ❖ Provide a strong foundation in assembly and embedded C programming for microcontrollers.
- ❖ Demonstrate the interfacing techniques for connecting microcontrollers with external peripherals and devices.
- ❖ Develop skills for designing microcontroller-based systems.
- ❖ Expose students to real-time applications and embedded systems development.

Unit I:

Introduction to Microcontrollers: Evolution and classification of microcontrollers, Overview of 8051 and ARM Cortex-M microcontrollers, Architecture of 8051: CPU, registers, memory, I/O ports, Harvard vs Von Neumann architecture, Comparison of microprocessors and microcontrollers.

Unit II:

8051 Programming and Instruction Set: Addressing modes and instruction formats, Data transfer, arithmetic, logical, and control instructions, Assembly language programming for 8051, Embedded C programming: data types, control structures, I/O operations, Program examples using KEIL IDE.

Unit III:

Timers, Counters, and Interrupts: 8051 timer/counter architecture and modes, Timer programming for delay generation and event counting, Interrupt structure of 8051: vector addresses and priorities, Interrupt programming examples, Real-time application examples using timers and interrupts.

Unit IV:

Interfacing I/O Devices and Communication: Interfacing LEDs, switches, 7-segment displays, Interfacing LCDs, keypads, stepper motors, and DC motors, ADC and DAC interfacing techniques, Serial communication: UART, RS232 protocols, Basics of SPI and I2C protocols.

Unit V:

Introduction to Advanced Microcontrollers (ARM Cortex-M): ARM Cortex-M architecture basics, Cortex-M features and programming model, GPIO programming and peripheral interfacing, Overview of real-time embedded system design, Case studies: temperature monitoring, motor control, sensor data acquisition.

Textbooks:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Pearson Education, 2nd Edition, 2006.
2. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design, Pearson Education, 2nd Edition, 2011.

Reference Books:

1. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, 3rd Edition, 2010.
2. John B. Peatman, Design with Microcontrollers, McGraw Hill Education, 1st Edition, 1997.
3. Jonathan W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, CreateSpace Independent Publishing Platform, 3rd Edition, 2016.
4. Steven F. Barrett and Daniel J. Pack, Microcontrollers: Fundamentals and Applications with PIC, Prentice Hall, 1st Edition, 2006.

Course Outcomes:

- Describe the architecture and functional components of microcontrollers.
- Develop assembly and embedded C programs for microcontroller applications.
- Interface microcontrollers with input/output devices, sensors, and actuators.
- Design real-time embedded applications using timers, interrupts, and serial communication.
- Integrate hardware and software components for microcontroller-based systems.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Digital Design with Verilog HDL

Course Objectives:

- ❖ Introduce the principles of digital system design using Verilog Hardware Description Language (HDL).
- ❖ Familiarize students with modeling techniques in Verilog for combinational and sequential logic.
- ❖ Provide hands-on experience in simulation and synthesis of digital circuits.
- ❖ Enable students to understand FSM design and module-based design practices.
- ❖ Bridge the gap between digital logic design and implementation using programmable devices like FPGAs.

Unit I:

Introduction to Digital Design and Verilog HDL: Basics of digital systems: logic gates, Boolean algebra, combinational & sequential logic, Introduction to Verilog: design flow, modules, ports, identifiers, operators, Verilog modeling styles: behavioral, dataflow, and structural, Simulation vs. synthesis concepts.

Unit II:

Combinational Logic Design using Verilog: Verilog constructs for modeling combinational circuits, Design examples: adders, multiplexers, encoders, decoders, comparators, conditional statements (if, case), continuous assignments, modeling combinational logic using assign and always blocks.

Unit III:

Sequential Logic Design and Test Benches: Flip-flops, registers, counters, shift registers in Verilog, Synchronous and asynchronous designs, Writing and using test benches: stimulus generation, monitoring outputs, Timing and clocking in digital circuits.

Unit IV:

Finite State Machines and RTL Design: FSM types: Mealy and Moore models, FSM coding techniques in Verilog, FSM design examples: vending machine, traffic light controller, serial detector, RTL design principles and best practices.

Unit V:

FPGA Implementation and Design Flow: FPGA architecture basics: CLBs, IOBs, LUTs, routing, Design flow: HDL coding → simulation → synthesis → implementation → programming, Using EDA tools (e.g., Xilinx Vivado, Intel Quartus): simulation, synthesis, and timing analysis, Design examples on FPGA boards.

Textbooks

1. Morris Mano and Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, Pearson Education, 6th Edition, 2017.
2. Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2nd Edition, 2003.

Reference Books

1. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with Verilog Design, McGraw Hill Education, 3rd Edition, 2013.
2. Zainalabedin Navabi, Verilog Digital System Design, McGraw Hill Education, 2nd Edition, 2005.
3. Douglas L. Perry, VHDL: Programming by Example, McGraw Hill Education, 4th Edition, 2002.
4. Richard S. Sandige & Michael L. Sandige, Fundamentals of Digital and Computer Design with VHDL, McGraw Hill Education, 1st Edition, 2012.

Course Outcomes:

- ❖ Understand the syntax and semantics of Verilog HDL for modeling digital systems.
- ❖ Model combinational and sequential circuits in different levels of abstraction.
- ❖ Simulate, debug, and verify Verilog designs using test benches.
- ❖ Design and implement Finite State Machines (FSMs) using Verilog.
- ❖ Integrate Verilog-based designs into FPGA design flow using simulation and synthesis tools.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Fundamentals of VLSI

Course Objectives:

- ❖ Introduce the fundamental principles and methodologies of VLSI design.
- ❖ Familiarize students with CMOS technology and its design rules.
- ❖ Develop skills in digital circuit design and layout using CMOS logic.
- ❖ Understand the design and implementation of combinational and sequential subsystems.
- ❖ Provide exposure to VLSI design flow and CAD tools used in the industry.

Unit I:

Introduction to VLSI and CMOS Technology: Overview of VLSI design process, MOS transistors: structure and operation, CMOS technology: nMOS, pMOS, CMOS inverter, CMOS fabrication process: n-well, p-well, twin-tub, SOI.

Unit II:

CMOS Design Rules and Layout: Stick diagrams and layout design, Lambda-based design rules, Design rules for wires, transistors, contacts, and wells, Design examples: CMOS inverter, NAND, NOR gates layout.

Unit III:

Combinational and Sequential Logic Design: Static CMOS logic gates: NAND, NOR, XOR, Transmission gates and pass transistor logic, Sequential logic: latches, flip-flops, registers, Timing issues: setup time, hold time, clock skew.

Unit IV:

Subsystem Design and Integration: Design of adders: ripple-carry, carry-lookahead, Multiplexers, decoders, encoders, Memory elements: SRAM, DRAM basics, Interconnects and scaling issues in VLSI.

Unit V:

VLSI Design Methodologies and Tools: VLSI design flow: RTL to GDSII, Introduction to HDL (Verilog/VHDL) for digital design, Schematic and layout design using EDA tools, Introduction to FPGA and ASIC design concepts.

Textbooks

1. Neil H.E. Weste, David Harris, and Ayan Banerjee, CMOS VLSI Design: A Circuits and Systems Perspective, Pearson Education, 5th Edition, 2023.
2. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design, PHI Learning, 3rd Edition, 2003.

Reference Books

1. S.M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, McGraw Hill, 3rd Edition, 2002.
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 1st Edition, 2002.
3. Wayne Wolf, Modern VLSI Design: IP-Based Design, Pearson Education, 4th Edition, 2008.
4. Michele Morganti, Digital VLSI Design and Simulation with Verilog, Springer, 1st Edition, 2003.

Course Outcomes:

- ❖ Understand CMOS fabrication technology and the principles of VLSI design.
- ❖ Apply CMOS design rules to develop stick diagrams and layouts.
- ❖ Design and analyze basic combinational and sequential logic using CMOS circuits.
- ❖ Understand subsystem design and system-level integration.
- ❖ Describe the steps in the VLSI design flow and use basic EDA tools.

B. Tech – Minors	L	T	P	C
	3	0	0	3

VLSI Design Flow: RTL to GDS

Course Objectives:

- Introduce the complete VLSI design flow from Register Transfer Level (RTL) to GDSII layout.
- Familiarize students with industry-standard tools and methodologies used in ASIC and SoC design.
- Enable understanding of synthesis, floorplanning, placement, clock tree synthesis, routing, and physical verification.
- Explore key issues in timing, power, and area optimization.
- Provide practical exposure to digital implementation using EDA tools.

Unit I: Overview of VLSI Design Flow

Introduction to ASIC and SoC design, VLSI design hierarchy: RTL, gate-level, and layout, Design abstraction levels and VLSI design styles, EDA tools used in front-end and back-end design, Overview of standard cell-based design.

Unit II: RTL Design and Functional Verification

RTL coding guidelines using Verilog/VHDL, Finite State Machines, datapath/control logic design, Functional simulation and test benches, Introduction to formal verification and linting, Code coverage metrics.

Unit III: Logic Synthesis and Static Timing Analysis

Logic synthesis flow and constraints (SDF, SDC), Gate-level netlist generation and analysis, Technology mapping and optimization, Static Timing Analysis (STA): setup and hold checks, Timing paths, slack, and timing reports.

Unit IV: Physical Design – Floor planning to Routing

Floor planning and partitioning, Placement of standard cells and macros, Clock Tree Synthesis (CTS) and buffering, Routing: global and detailed routing strategies, Congestion analysis and ECO (Engineering Change Order).

Unit V: Physical Verification and Signoff

Design Rule Checking (DRC) and Layout vs Schematic (LVS), Parasitic extraction (RC extraction), Signal integrity and IR drop analysis, Power and area optimization techniques, Tape-out and GDSII generation.

Textbooks

1. S. K. Lim, Practical Problems in VLSI Physical Design Automation, Springer, 1st Edition, 2013.
2. Wayne Wolf, Modern VLSI Design: IP-Based Design, Pearson Education, 4th Edition, 2008.
3. Douglas L. Perry, VHDL and Verilog HDL, Tata McGraw Hill, 1st Edition, 2002.

Reference Books

1. Michael John Sebastian Smith, Application-Specific Integrated Circuits, Addison-Wesley, 1st Edition, 1997.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Pearson, 2nd Edition, 2003.
3. Khosrow Golshan, EDA for IC Implementation, Circuit Design, and Process Technology, Wiley-IEEE Press, 1st Edition, 2010.
4. Hubert Kaeslin, Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication, Cambridge University Press, 1st Edition, 2017.

Course Outcomes:

- ❖ Understand the complete VLSI design flow from RTL to GDSII layout.
- ❖ Perform RTL design, functional verification, and logic synthesis.
- ❖ Apply floorplanning, placement, clock tree synthesis, and routing techniques.
- ❖ Analyze and optimize timing, power, and area in digital designs.
- ❖ Use physical verification and signoff techniques to finalize the chip layout.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Fundamentals of Quantum Communications

Course Objectives

- ❖ Introduce the fundamental principles of quantum mechanics relevant to communication.
- ❖ Explore the concepts of quantum bits (qubits), entanglement, and quantum states.
- ❖ Study architecture and working of quantum communication systems.
- ❖ Understand protocols for quantum key distribution and quantum cryptography.
- ❖ Discuss real-world applications, challenges, and the future of quantum communication networks.

Unit I:

Fundamentals of Quantum Mechanics for Communication: Postulates of quantum mechanics, Qubits vs classical bits, Superposition and measurement, Quantum gates and unitary operations, Quantum entanglement and its significance.

Unit II:

Quantum Information and Qubit Systems: Quantum states and density matrices, Bloch sphere representation, Quantum no-cloning theorem, Quantum teleportation, Bell's inequalities and quantum nonlocality

Unit III:

Quantum Communication Protocols: Quantum communication architecture, Quantum teleportation protocol, Super dense coding, Quantum repeaters and long-distance communication.

Unit IV:

Quantum Cryptography and QKD: Introduction to quantum cryptography, Quantum Key Distribution (QKD): BB84, E91 protocols, Security proofs and eavesdropping, Comparison with classical cryptographic techniques, Practical implementations and QKD networks.

Unit V:

Quantum Communication Technologies and Applications: Physical realization of qubits: photons, ions, quantum dots, Quantum channels: fiber optics, free space optics, satellite links, Recent advances: quantum internet, quantum memory, quantum network protocols, Challenges and future trends in quantum communication.

Textbooks

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, 10th Anniversary Edition, 2011.
2. Mark M. Wilde, Quantum Information Theory, Cambridge University Press, 2nd Edition, 2017.

Reference Books

1. Giuliano Benenti, Giulio Casati, Davide Rossini, and Giuliano Strini, Principles of Quantum Computation and Information: A Comprehensive Textbook, World Scientific Publishing, 2nd Edition, 2019.
2. Alexander Sergienko (Ed.), Quantum Communication and Quantum Networking: First International Conference, QuantumComm 2009, Naples, Italy, October 26–30, 2009, Revised Selected Papers, Springer, 1st Edition, 2010.
3. Rodney Loudon, The Quantum Theory of Light, Oxford University Press, 3rd Edition, 2000.

Course Outcomes (COs)

- ❖ Understand the foundational principles of quantum mechanics used in communication.
- ❖ Analyze the behavior of quantum bits and their role in information theory.
- ❖ Apply concepts like entanglement and superposition in quantum communication protocols.
- ❖ Explain and evaluate quantum key distribution (QKD) and its applications in secure communication.
- ❖ Explore real-world quantum communication systems and emerging research trends.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Fundamentals of Multimedia Networking

Course Objectives:

- Introduce multimedia networking concepts and protocols for efficient transmission of multimedia data.
- Explore multimedia compression techniques and their impact on network performance.
- Understand Quality of Service (QoS) requirements and mechanisms for multimedia communication.
- Study transport, session, and application layer protocols supporting multimedia applications.
- Analyze emerging trends and challenges in multimedia networking, including streaming and real-time communication.

Unit I:

Introduction to Multimedia Networking: Overview of multimedia data types: audio, video, images, text, Characteristics and challenges of multimedia networking, Multimedia communication system architecture, Network requirements for multimedia applications, Multimedia networking models and standards.

Unit II:

Multimedia Compression and Coding: Principles of data compression: lossless and lossy, Audio compression standards: PCM, ADPCM, MP3, Image compression: JPEG, JPEG2000, Video compression techniques: MPEG-1, MPEG-2, MPEG-4, H.264, Impact of compression on bandwidth and quality.

Unit III:

Network Protocols for Multimedia: Transport protocols: UDP, RTP (Real-time Transport Protocol), Session protocols: RTSP (Real Time Streaming Protocol), Signaling protocols: SIP (Session Initiation Protocol), Multicast communication for multimedia, Error control and concealment techniques.

Unit IV:

Quality of Service (QoS) in Multimedia Networking: QoS parameters: delay, jitter, bandwidth, packet loss, QoS provisioning and guarantees, Integrated Services (IntServ) and Differentiated Services (DiffServ), Traffic shaping and admission control, Resource reservation protocols (RSVP).

Unit V:

Multimedia Networking Applications and Trends: Streaming media and Video on Demand (VoD), Voice over IP (VoIP) and video conferencing, Multimedia over wireless and mobile networks, Cloud multimedia services and content delivery networks (CDNs), Emerging trends: 5G multimedia networking, augmented and virtual reality.

Textbooks

1. Fred Halsall, Multimedia Communications: Applications, Networks, Protocols and Standards, Pearson Education, 1st Edition, 2001.
2. K. R. Rao, Zoran S. Bojkovic, and Dragorad A. Milovanovic, Multimedia Communication Systems: Techniques, Standards, and Networks, Pearson Education, 1st Edition, 2002.
3. Stefan Winkler, Multimedia Networking: Technologies, Management and Applications, Wiley, 1st Edition, 2008.

Reference Books

1. Timothy S. Rappaport, Wireless Communications: Principles and Practice, Pearson Education, 2nd Edition, 2002.
2. Mark S. Drew and Zixiang Xiong, Multimedia Security: Steganography and Digital Watermarking Techniques for Protection of Intellectual Property, Wiley, 1st Edition, 2007.

Course Outcomes:

- Describe the components and architecture of multimedia networking systems.
- Explain multimedia data formats and compression techniques.
- Analyze network protocols for multimedia transport and control.
- Understand QoS requirements and mechanisms for multimedia applications.
- Design basic multimedia communication systems and evaluate their performance.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Ad-hoc and Wireless Sensor Networks

Course Objectives:

- Introduce the fundamental concepts of wireless ad-hoc and sensor networks.
- Explore network architectures, protocols, and algorithms specific to wireless sensor networks (WSNs) and Mobile Ad-hoc Networks (MANETs).
- Understand key challenges such as energy efficiency, routing, and security in wireless sensor and ad-hoc networks.
- Provide knowledge about medium access control and transport layer protocols tailored for WSNs and MANETs.
- Enable students to analyze and design wireless sensor network applications and protocols.

Unit I:

Introduction to Wireless Sensor Networks (WSNs) and Ad-hoc Networks: Overview and characteristics of WSNs and MANETs, Applications: environmental monitoring, military, healthcare, Sensor node architecture and deployment strategies, Challenges: resource constraints, dynamic topology, scalability, Comparison of WSNs and traditional wireless networks.

Unit II:

Network Architectures and Protocols: WSN architecture: flat, hierarchical, location-based, MANET architecture and protocol stack overview, Routing challenges in ad-hoc and sensor networks, Classification of routing protocols: proactive, reactive, hybrid, Examples of routing protocols: AODV, DSR, LEACH, PEGASIS.

Unit III:

Medium Access Control (MAC) Protocols and Energy Management: MAC protocols for WSNs and MANETs: contention-based and schedule-based, Energy-efficient MAC protocols: S-MAC, T-MAC, B-MAC, Sleep/wake-up mechanisms and duty cycling, Energy conservation techniques and power-aware routing, QoS considerations in MAC protocols.

Unit IV:

Transport Layer and Security in Wireless Networks: Transport layer protocols and challenges in WSNs, Congestion control and reliable data delivery, Security issues: attacks on

WSNs and MANETs (e.g., wormhole, Sybil), Security mechanisms: cryptography, key management, secure routing, Trust management and intrusion detection.

Unit V:

Applications, Tools, and Case Studies: Case studies: Smart agriculture, healthcare monitoring, disaster management, Sensor network platforms and simulation tools: TinyOS, NS-2/NS-3, OMNeT++, Integration with IoT and cloud computing, Recent trends: mobile sensor networks, cognitive radio sensor networks, Future directions and research challenges.

Textbooks

1. C. Siva Ram Murthy and B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Pearson Education, 1st Edition, 2004.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, Wiley, 1st Edition, 2007.
3. Samarjit Chakraborty, Wireless Sensor Networks, Oxford University Press, 1st Edition, 2014.

Reference Books

1. John A. Stankovic, Wireless Sensor Networks, Springer, 1st Edition, 2021.
2. Erik D. Veenstra and Mark van Eeten, Wireless Sensor Networks and Applications, CRC Press, 1st Edition, 2018.
3. Debashis Saha, Ad Hoc and Sensor Networks: Theory and Applications, Cambridge University Press, 1st Edition, 2020.
4. K. Akkaya and M. Younis, Wireless Sensor Networks: Principles and Practice, Wiley, 1st Edition, 2020.

Course Outcomes:

- Explain the architecture and characteristics of ad-hoc and wireless sensor networks.
- Analyze various routing and MAC protocols designed for WSNs and MANETs.
- Identify and address challenges related to energy management and scalability in wireless networks.
- Evaluate security threats and implement basic security mechanisms in wireless sensor networks.
- Design simple applications and protocols for wireless sensor networks.

	L	T	P	C
B. Tech – Minors	3	0	0	3

Digital Image Processing

Course Objectives:

- Introduce the fundamental concepts and techniques of digital image processing.
- Demonstrate image representation, enhancement, and restoration methods.
- Explore image segmentation and feature extraction techniques.
- Provide knowledge of image compression standards and methods.
- Enable practical understanding through implementation of image processing algorithms.

Unit I:

Introduction and Digital Image Fundamentals: Digital image processing overview and applications, Image acquisition, sampling, and quantization, Image representation: pixels, resolution, color models (RGB, HSV, CMYK), Basic operations on images: pixel arithmetic, geometric transformations, Image file formats and storage.

Unit II:

Image Enhancement Techniques: Spatial domain methods: point processing (contrast stretching, thresholding), histogram processing, Spatial filtering: smoothing filters, sharpening filters, edge enhancement, Frequency domain methods: Fourier transform, filtering in frequency domain, Noise models and noise reduction techniques, Color image enhancement basics.

Unit III:

Image Restoration and Segmentation: Image degradation models, Inverse filtering and Wiener filtering, Morphological image processing: dilation, erosion, opening, closing, Image segmentation techniques: thresholding, region growing, edge-based segmentation, watershed, Feature extraction: edges, corners, texture analysis.

Unit IV:

Image Compression: Need for image compression, Lossless compression techniques: Run-Length Encoding, Huffman coding, Arithmetic coding, Lossy compression techniques: Transform coding, JPEG standard, JPEG2000, Performance measures: compression ratio, PSNR, Introduction to video compression basics.

Unit V:

Advanced Topics and Applications: Color image processing techniques, Object recognition basics, Introduction to pattern recognition, Applications: medical imaging, remote sensing, biometrics, Tools and software: MATLAB Image Processing Toolbox, OpenCV.

Textbooks

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Pearson Education, 4th Edition, 2022.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1st Edition, 1989.
3. S. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, McGraw Hill, 2nd Edition, 2019.

Reference Books

1. William K. Pratt, Digital Image Processing: PIKS Scientific Inside, Wiley-Interscience, 4th Edition, 2007.
2. Scott E. Umbaugh, Digital Image Processing and Analysis: Computer Vision and Image Analysis, CRC Press, 4th Edition, 2022.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Digital Image Processing Using MATLAB, Gatesmark Publishing, 3rd Edition, 2020.
4. K. R. Castleman, Digital Image Processing, Prentice Hall, 2nd Edition, 1996.

Course Outcomes:

- Understand digital image fundamentals and image acquisition techniques.
- Apply various image enhancement and restoration techniques.
- Perform image segmentation and extract meaningful features.
- Analyze and implement image compression algorithms.
- Use digital image processing tools and libraries for practical applications

	L	T	P	C
B. Tech – Minors	3	0	0	3

Sensors and Data Acquisition System

Course Objectives:

- ❖ Provide an understanding of different types of sensors, their characteristics, and applications.
- ❖ Introduce transduction mechanisms used in converting physical parameters into electrical signals.
- ❖ Explain the architecture and design of data acquisition (DAQ) systems.
- ❖ Teach interfacing of sensors with DAQ systems using signal conditioning techniques.
- ❖ Develop the ability to design and analyze complete measurement and instrumentation systems.

Unit I:

Introduction to Sensors and Transducers: Classification of sensors: active, passive, analog, digital, Static and dynamic characteristics of sensors: accuracy, sensitivity, resolution, repeatability, generalized measurement system, Types of transducers: resistive, capacitive, inductive, piezoelectric, optical, Selection criteria for sensors.

Unit II:

Measurement of Physical Parameters: Temperature sensors: RTD, thermistors, thermocouples, Pressure and force sensors: strain gauges, piezoelectric sensors, Displacement sensors: LVDT, capacitive sensors, Flow sensors: electromagnetic, turbine, ultrasonic flow meters, Humidity, light, and level sensors.

Unit III:

Signal Conditioning Circuits: Need for signal conditioning, Amplification: instrumentation amplifiers, Filtering: analog filters (low-pass, high-pass, band-pass), Linearization, isolation, and protection, A/D and D/A conversion: resolution, sampling rate, quantization error.

Unit IV:

Data Acquisition Systems: Architecture of data acquisition systems, DAQ hardware components: multiplexers, sample-and-hold circuits, ADCs, microcontrollers, DAQ software and data logging, Interface standards: USB, RS232, SPI, I2C, Case study: LabVIEW-based DAQ system.

Unit V:

Sensor Interfacing and Applications: Interfacing sensors with microcontrollers (Arduino, PIC, ARM), Wireless sensor networks (WSNs) and IoT-based data acquisition, Remote data monitoring and control, Case studies: biomedical monitoring, industrial automation, smart agriculture, Calibration techniques and error analysis.

Textbooks

1. R. S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill, 3rd Edition, 2013.
2. John G. Webster (Editor), Measurement, Instrumentation, and Sensors Handbook, CRC Press, 2nd Edition, 2014.
3. Ernest O. Doebelin and Dhanesh N. Manik, Measurement Systems: Application and Design, McGraw Hill, 5th Edition, 2007.

Reference Books

1. D. Patranabis, Sensors and Transducers, PHI Learning, 2nd Edition, 2013.
2. Rangan, Mani, and Sharma, Instrumentation Devices and Systems, Tata McGraw Hill, 2nd Edition, 2010.
3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer, 4th Edition, 2016.
4. Paul Horowitz and Winfield Hill, The Art of Electronics, Cambridge University Press, 3rd Edition, 2015.

Course Outcomes:

- Explain the working principles and classifications of various sensors.
- Select appropriate sensors for specific physical measurements.
- Analyze the design and components of data acquisition systems.
- Apply signal conditioning techniques for accurate data acquisition.
- Design and implement basic sensor-DAQ interfacing systems using microcontrollers/ DAQ hardware.

B. Tech – Minors	L	T	P	C
	3	0	0	3

Medical Robotics

Course Objectives:

- Introduce the fundamental concepts of robotics applied in the medical field.
- Explore various types of medical robots and their applications in surgery, rehabilitation, and diagnostics.
- Demonstrate kinematics, dynamics, and control techniques specific to medical robots.
- Discuss human-robot interaction, safety, and ethical considerations in medical robotics.
- Provide knowledge about the design, development, and integration of medical robotic systems.

Unit I:

Introduction to Medical Robotics: Overview of robotics and medical robotics, History and evolution of medical robots, Classification of medical robots: surgical, rehabilitation, diagnostic, assistive robots, Components of medical robotic systems: sensors, actuators, controllers, Advantages and challenges of medical robotics.

Unit II:

Kinematics and Dynamics of Medical Robots: Review of robotic manipulator kinematics, Forward and inverse kinematics of medical robot arms, Workspace analysis for medical robots, Dynamics and force control strategies, End-effector design considerations for medical applications.

Unit III:

Control Systems in Medical Robotics: Control architecture: position, force, impedance control, Teleoperation and master-slave robotic systems, Haptic feedback and tactile sensing, Safety and reliability in control systems, Real-time control challenges.

Unit IV:

Human-Robot Interaction and Safety: Human factors in medical robotics, Ergonomics and user interface design, Safety standards and regulatory aspects (FDA, ISO), Risk analysis and fault tolerance, Ethical considerations and patient safety.

Unit V:

Applications and Case Studies: Surgical robots: Da Vinci system, orthopedic robots, Rehabilitation robots: exoskeletons, prosthetics, Diagnostic and imaging robots, Robot-assisted therapy and telemedicine, Future trends: AI integration, autonomous medical robots.

Textbooks

1. Paolo Dario, Vijay Kumar (Eds.), Medical Robotics: Minimally Invasive Surgery, Wiley-IEEE Press, 1st Edition, 2011.
2. Robin R. Murphy, Introduction to AI Robotics, MIT Press, 1st Edition, 2000. (For robotics fundamentals)
3. J. P. Desai, P. Kazanzides, R. H. Taylor, Medical Robotics, CRC Press, 1st Edition, 2011.

Reference Books

1. Sherif M. El-Hefnawy, Medical Robotics: Minimally Invasive Surgery, CRC Press, 1st Edition, 2017.
2. Jacques Marescaux, Michel Gagner, Robotic Surgery: Current Applications and New Trends, Springer, 1st Edition, 2018.
3. Timothy A. P. Spicer, Robot-Assisted Surgery: An Introduction, Wiley, 1st Edition, 2015.
4. J. J. Craig, Introduction to Robotics: Mechanics and Control, Pearson, 4th Edition, 2014.

Course Outcomes:

- Understand the basics of robotics with a focus on medical applications.
- Analyze the kinematics and control of medical robotic manipulators.
- Describe different types of medical robots and their roles in healthcare.
- Evaluate human-robot interaction and safety standards in medical robotics.
- Design basic medical robotic systems for surgical and rehabilitation applications.