SYLLABI

Bachelor of Technology (B.Tech.)

Branch - ECE

Year/Sem: Ist Year/I Sem

Mathematics-I (Credits: 4)

Partial differentiation, Taylor's series, Maxima and Minima, Jacobians, Double integrals Equations to a line, plane, curve and surfaces, Line and surface integrals, Gradient, divergence and curl, Normal and tangent to a surface, Gauss and Stokes theorems, Differential Equations with constants coefficients, Laplace transforms, Algebra of matrices, Determinants, Gauss elimination method, Rank, Eigen values and vectors, Quadratic forms.

Physics-I (Credits: 4)

Frames of reference, Galilean transformation, Michelson Morley Experiment, Postulates of special theory of relativity, time dilation and length contraction, twin paradox, Lorentz transformations, addition of velocities, Relativistic Doppler effect, Mass variation with velocity, Mass-energy relation, electricity and magnetism. Brief discussion on General theory of Relativity. Black holes, bending of light by gravity, gravitational red shift, global positioning system(GPS). Quantization of Radiation: Black body radiation, Wien's law, Rayleigh Jeans law, Planck's law of radiation, photo electric effect Compton scattering. Quantization of Matter: Atomic spectra, Bohr model of hydrogen atom, Frank hertz experiment, Matter waves, de Broglie hypothesis, Davisson Germer experiment, wave packets, phase and group velocity Heisenberg's uncertainty principle, Schrödinger wave equation, potential barrier and Harmonic oscillator. Quantum numbers, Spin and orbital angular momentum, L-S and j-j coupling. Atoms in magnetic field, Zeeman effect. Micro and Macro states, temperature and the partition function, Concept of Entropy, Shannon's information entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications. Basic ideas of bonding in solids, Crystal structure, X-ray diffraction, Band theory of solids. Physical Model for a Sinusoid, Phase and Phase Difference; Average Value, Effective Value, Form Factor And Peak Factor; Concept of Phasors, Non-sinusoidal Waveforms; Power and Power Factor; Behaviour of *R*, *L* and *C* in AC Circuits. AC Circuits: Series *RL* Circuit, Complex Impedance; Series *RC* Circuit, Complex Power; Parallel *RL* Circuit; Parallel *RC* Circuit; Series *RLC* Circuit and its Phasor Diagram; Parallel *RLC* Circuit and its Phasor Diagram, Q factor, Resonance in series parallel RLC circuits.

English (Credits: 3)

Definition of Communication, Process & Stages of Communication, Barriers to Communication, Channels of Communication, The listening process**,** Importance of listening, Purpose and types of listening**,** Hearing and listening, Listening with a purpose, Barriers to listening. Importance of acquiring oral skills, Visual aids, Body Language, Delivery, Pronunciation, Use of connectives Organization of matter: Meta-discourse features, Textual organization, 7 C'S of effective communication, Reading comprehension, Some important synonyms and antonyms, Etiquettes & grooming, Skimming and Scanning, Intensive and extensive reading, SQ3R Technique, Business letters, Memo, Circulars, Notices, Report writing, resume writing, Agenda & Minutes writing, Technology based communication tools, Committee types, Advantages, Conferences, Audio-video conferencing, Barriers and overcoming negative impact, Speech Preparation, Tips for successful job interview, Do's and dont's while appearing for interview, Mock interview, Some interview questions, Telephonic interview tips, Resume writing.

Software Development Fundamentals (Credit: 4)

Introduction to Programs, Processing programs, Types of Programming Languages, Programming Design tools (Pseudo code and Flowcharts), Program Design, Structured Programming, Problem solving and programming, Quality aspects of structured programs, Testing and Debugging Techniques, Self Learning of Pascal. Introduction to Programs, Processing programs, Types of Programming Languages, Programming Design tools (Pseudo code and Flowcharts), Program Design, Structured Programming, Problem solving and programming, Quality aspects of structured programs, Testing and Debugging Techniques, Loop Control and Case Control Structures, Arrays and Strings, Functions and Pointers, Structures and Union, Recursion, Dynamic Memory Allocation, linked-lists, File I/O, C Library.

Physics Lab-I (Credits: 1)

Experiments List-

1. To study the variation of magnetic field along the axis of Helmholtz Galvanometer and to determine its reduction factor. [set-up no.1 & 11]
2. To determine the specific rotation of cane sugar solution using Biquartz polarimeter. [set-up no.2 & 12]
3. To observe Newton's rings and to determine the wavelength of sodium light [Set-up no. 3 & 13]
4. To determine the wavelengths of spectral lines Red, Green and Violet of mercury using plane transmission grating. [set-up no.4 & 14]
5. To study the presence of energy levels in an atom by Franck-Hertz Experiment.[set-up no. 5 & 15]
6. To determine the resistance per unit length of a Carey Foster's bridge and to obtain the specific resistance of a given wire. [set-up no.6 & 16]
7. To determine the Planck's constant using solar cell. [set-up no. 7 & 17]
8. To determine the wavelength of sodium light with the help of Fresnels biprism.[set-up no. 8 & 18]
9. To draw hysteresis loop of a ferromagnetic material & calculate its retentivity and coercivity.[set-up no.9 & 19]
10. To study ultrasonic waves in aluminium and to obtain Young's modulus for it. [set-up no. 10 & 20]

Software Development Lab (Credit: 2)

Initial exercises on MS office, Familiarity with Microsoft word, Familiarity with Microsoft power point, Familiarity with Microsoft excels, Pattern generating problems, Loop Control and Case Control Structures, Arrays and Strings, Functions and Pointers, Structures and Union, Recursion, Dynamic Memory Allocation, linked-lists, File I/O, C Library.

Year/Sem: Ist Year/II Sem

Discrete Mathematics (Credits: 4)

Set theory and Relations, Functions and Algorithms, Logic, Prepositional Functions and Quantifiers, Graphs, Trees and Graph Coloring, Sequential representation, Directed graphs and Binary trees, Groups, Rings and Fields, Ordered sets, Lattices and Boolean algebra, Languages, Finite State Automata Grammars and Finite State Machines.

Physics-II (Credit: 4)

Electromagnetism: Review of vector calculus, Coulomb's law, Gauss law and its applications, boundary value problems, Biot-Savart law, Ampere's law, Faraday's law of induction, boundary conditions, Electrical and magnetic filed in matter, Maxwell's equations in free space and dielectric media. Electromagnetic waves in matter, Reflection, Refraction, Absorption and Total Internal

Reflection. Band theory of solids, carrier scattering, effective mass, Electronic conduction in metals, Intrinsic and extrinsic (n- and p-type) semiconductors and their electrical conductivity, Direct and indirect bandgap semiconductors, optical and thermal properties, Hall Effect in semiconductors, Review of Maxwell-Boltzmann, Fermi Dirac and Bose Einstein distribution functions, Equilibrium carrier concentrations, equilibrium thermal generation, intrinsic carrier concentration, Fermi level, dopants, extrinsic semiconductors, Statistics of donors and acceptors, Drift current, electrical mobility.

Electrical Science (Credit: 4)

Kirchhoff's Circuit Laws; Loop-Current Analysis, Supermesh; Mesh Analysis; Node-Voltage Analysis; Nodal Analysis; Choices of Method of Analysis. Superposition Theorem; Thevenin's Theorem; Norton's Theorem; Maximum Power Transfer Theorem; Millman's Theorem; Reciprocity Theorem. Simple RL Circuit, Time Constant, Decay and Growth of Current; Simple RC Circuit, Discharging of a Capacitor, Charging of a Capacitor. Impedance, Admittance, Hybrid, Equivalent Networks. Half-wave and full-wave (centre tap and bridge) rectifiers, PIV rating of diode, Performance of half-wave and full-wave rectifiers, Shunt capacitor filter. Clippers: Series and Parallel, Limiters, Clampers. Zener diode and its application as a voltage regulator. Basics of Light emitting diode, Varactor diode, Schottky diode and Photodiode. BJT Structure, Working of a transistor, Transistor current equation, Reverse saturation current. The three configurations, CB and CE input and output characteristics, Transistor as an Amplifier DC load line. Junction Field-Effect Transistor (JFET) and Metal Oxide Field-Effect Transistor (MOSFET): Basic construction, Pinch-off voltage, Drain saturation current, Output and transfer characteristics.

Object Oriented Programming (Credit: 4)

Introduction to Java Programming Environment, Data types, variables and array operators, assignment and selection statements, iterative structures, nested loops, string handling in Java, I/O mechanism, command line arguments, class, creating objects, access control in classes; Constructors, methods, parameters, method overloading, recursive methods, returning objects, static members, finalization, final qualifier, nested and inner classes, Objects as references in Java, dynamic memory allocation and garbage collection in Java , Inheritance: Basics, super classes and subclasses, the keyword extends, multilevel hierarchy, method overriding; run time polymorphism, abstract classes, final in inheritance, the object class, Packages and Interfaces, Exception Handling, Applets: Applet fundamentals, native methods, static import, the applet class, applet display method, requesting repainting, a banner applet, passing parameters to applets, uses of applets.

Physics Lab-II (Credit: 1)

List of experiments-

1. To determine the magnetic susceptibility of a paramagnetic, FeCl3 solution by Quinck's tube method.
2. To study the magnetostriction in metallic rod.

a. Using solar cell Trainer
b. Study voltage and current of a solar cell
c. Voltage and current in series and parallel combinations.

3. Draw power curve to find maximum power point (MPP) and to obtain efficiency of a solar cell.
4. To determine the Planck's constant using Wein's distribution law.
5. Using Fiber Optic Kit, to determine

a. Numerical aperture of the fiber.
b. Losses in given fibers.
c. Setting up of optical communication link.

6. To study the Acousto-optic Effect and to determine the velocity of ultrasonic wave in liquid.
7. To determine dispersive power of a prism using spectrometer.
8. To determine the wavelength of sodium light with the help of Fresnel's biprism.

9. To draw hysteresis loop of a ferromagnetic material and to calculate its retentivity and coercivity.
10. To study the dielectric constant and Curie temperature of Ferroelectric ceramics.

Electrical Science Lab (Credit: 1)

List of experiments-

1. Simplify complex network using Thevenin theorem and verify it.
2. State Superposition Theorem and verify.
3. Perform and verify Maximum Power Transfer Theorem.
4. To determine the Z parameters of the given two port network.
5. Calculate the Y parameters for the given two port network.
6. Perform Clipper Circuit.
7. Design Clamper Circuit.
8. Half wave rectifier with and without filter circuit.
9. Full wave rectifier with and without filter circuit.
10. Transistor as an Amplifier.
11. Common Emitter *v-i* characteristic of n-p-n transistor.

Object Oriented Programming Lab (Credit: 1)

Java Programming, Data types, variables and array operators, assignment and selection statements, iterative structures, nested loops, string handling in Java, I/O mechanism, command line arguments, class, creating objects, access control in classes; Constructors, methods, parameters, method overloading, recursive methods, returning objects, static members, finalization, final qualifier, nested and inner classes, Objects as references in Java, dynamic memory allocation and garbage collection in Java, Inheritance and run time polymorphism, abstract classes, final in inheritance, the object class, Packages and Interfaces, Exception Handling, Applets programming, Development of Applets, Applets interfacing, servlet programming and database connectivity.

Year/Sem: II Year/III Sem

Signals and Systems (Credits: 4)

Continuous-time and discrete-time signals, signal energy and power, periodic signals, even-odd signals, exponential and sinusoidal signals, Unit impulse and step functions, continuous and discrete time systems, System classifications. Convolution integral and convolution sum, properties of LTI systems, LTI systems. Fourier Transform representation of continuous-time and discrete time signals, properties, system characterization by linear constant coefficient difference equation. The Laplace Transform, ROC, properties of Laplace-transform, analysis and characterization of LTI systems using Laplace Transform, Stability and Causality using Laplace Transform. The z-transform, Introduction to DSP, Random Variable and Random Processes, probability density function, mean, variance, correlation function, power spectral density.

Analogue Electronics (Credits: 4)

Single stage and Multistage Amplifiers: Biasing for the BJT amplifier design, Biasing for the FET amplifier design, AC analysis of FET Common source amplifier, Common Gate and Common Drain amplifiers. Frequency Response: Small-signal high-frequency hybrid-pi model of a BJT, Amplifier transfer function: low-frequency, mid and high-frequency bands, General expressions for the low frequency and high frequency responses, Miller's theorem, Cascaded Amplifiers, Calculation of

bandwidth of single and multistage Amplifiers, Concept of Gain Bandwidth Product. Differential Amplifiers: BJT Differential pair. Operational Amplifier : General configuration and basic stages of an operational amplifier (Op-amp). Analysis of simple BJT op-amp, Op-amp parameters: ideal and practical. Applications of OP-Amp. Feedback in Analog Circuits. Filters and Signal Generators: Filter types, Filter transfer function, Butterworth and Chebyshev filters, First and second order Active filters. Sinusoidal oscillators: RC and LC oscillators. Precision rectifier circuits and their applications.

Measurement & Instrumentation (Credits: 4)

Measurement Methods, Generalized measurement System, Classification of Instruments, Classification of transducers, Temperature transducer, Pressure transducer, Displacement transducer, Strain gauge, LVDT, RTD, Thermistor, Thermocouple, Piezo-electric transducer. D.C. bridges and their application in measurement of resistance, Kelvin's double bridge, A.C. Bridges- general equation, Potentiometer- DC potentiometer, Multi-range potentiometer, Q-meter and its applications. Amplifiers, Attenuators, Filters, Instrumentation Amplifier, Analog to digital converts. Moving coil, Moving iron, PMMC, Dynamometer and Induction type instruments. Multivibrators: astable, monostable and bistable types. Measurements of phase and frequency (Lissajous Patterns), Types of CRO, Special types of CRO, Types of CRO Probes. Digital Voltmeter

Signals & Systems Lab (Credit: 1)

List of experiments-

1. Signal generation
2. Creating user function for generating delta-function, unit-step function, and periodic signal creating user function for performing signal operation: folding, shifting and signal addition.
3. To verify the linearity and time-invariance of the discrete-time systems.
4. Response of discrete-time LTI systems.
5. MATLAB implementation of discrete time LTI systems.
6. Auto and Cross Correlation.
7. MATLAB Implementation of Fourier series and ramp function.
8. Synthesizing continuous time periodic signals using Fourier series.
9. MATLAB implementation of Discrete Time Fourier Transform (DTFT) of signals.
10. MATLAB implementation of Discrete Time Fourier Transform (DTFT) of LTI systems.

Analogue Electronics Lab (Credit: 1)

List of experiments-

1. Amplifier Circuit
2. Inverting& Non-Inverting amplifier
3. Differentiator (Inverting& Non-Inverting)
4. Integrator
5. Active Low Pass Filter Circuit
6. Active High Pass Filter Circuit
7. Active Band Pass Filter Circuit

8. Different types of oscillators.
9. Triangular Waveform Generator.
10. Square Triangular Waveform Generator.
11. Precision Rectifiers
12. Adder using Op-Amp
13. Subtractor using Op-Amp.

Measurement & Instrumentation Lab (Credit: 1)

List of experiments-

1. Measurement of unknown resistance using Wheat Stone Bridge
2. Measurement of low resistance using Kelvin's Double Bridge.
3. Measurement of unknown inductance using Maxwell Bridge
4. Measurement of unknown capacitance using Shearing Bridge
5. Study of Instrumentation Amplifier.
6. Measurement of strain using Strain Gauge
7. Measurement of displacement using LVDT.
8. Measurement of temperature using Thermocouple.
9. Measurement of time constant of a Thermometer.
10. Signal generation using IC-555 timer.
11. Analog to digital conversion.

Year/Sem: II Year/IV Sem

Digital Circuit Design (Credit: 4)

Conversion of bases, Representation of negative numbers, 9's and 1's complement, 10's and 2's complement, Binary arithmetic, BCD code, Excess-3 code, Gray Code and Alphanumeric code. Logic gates and Boolean algebra, Standard and canonical representation and minimization of Boolean expressions using Karnaugh Map and Quine – McClausky methods. Half & full adder and subtractor, Parallel adder, BCD adders, Look ahead carry generator. Decoders, Encoders, Multiplexers and De-multiplexers, Code convertor, Comparator, Parity generator and Checker. Binary multiplier. Flip Flops: SR, JK, Master slave JK, T and D. Shift Registers and their Applications. Synchronous and Asynchronous counters, Design of counters using flip flops. Moore and Melay machines, State tables, state diagrams and timing diagrams. ROM, PROM, EPROM, EEPROM, PAL, and PLA Characteristics of logic families, RTL, DTL, TTL, ECL and CMOS logic family, Interfacing between TTL and CMOS and vice-versa. Digital to Analog Conversion. Analog to Digital Conversion.

Analog and Digital Communication (Credit: 4)

Introduction: Electronic communication system, Signal properties, Frequency Translation and spectrum. Baseband and carrier Communication. Linear Modulation: Principles of Amplitude Modulation (AM), Double Side Band Modulation with suppressed carrier, Single Side Band,

Quadrature Amplitude Modulation, Vestigial Side Band modulation, Generation and Demodulation, carrier Acquisition, Superhetrodyne AM receiver. Exponential Modulation. Pulse Modulation: Sampling Theorem, Natural and Flat-top sampling, Pulse Code Modulation, Quantization, Companding, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation. Multiplexing and Noise Analysis. Digital communication system, Line coding, Pulse shaping, Digital Modulation schemes. Optimal Reception: Optimal reception of Digital signal, Maximum likelihood detection and Bayes Receiver, Matched Filter, Equalization Techniques.

Digital Signal Processing (Credits: 4)

Review of Discrete time sequences, systems and its properties, review of Z-transforms and its properties, need of DSP system and its application. Discrete Time Fourier Transform, Discrete Fourier Transform. Fast Fourier Transform (FFT) algorithms using Decimation in Time and Decimation in Frequency techniques, Chirp Z-transform, Basic Structures, Review of approximation of filter functions, Design of IIR filters based on Analog filter functions, Invariant & Modified Invariant Impulse Response techniques, Bilinear transformation method, Direct design approach, Linear phase description of FIR filters, Windowing and Frequency sampling techniques of design, Computer aided design techniques, Representation of numbers in digital system, types of arithmetic in digital systems, quantization by truncation and rounding, quantization of input data, quantization of filter coefficients, Realization of filter circuits, Filter design for Sampling Rate Conversation by a Rational Factor I/D.

Control Systems (Credits: 4)

Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram reduction techniques. Signal Flow graph. Standard test signals. Time response of first and second order systems for standard test inputs. Applicatiozzzn of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci. Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Concepts of state variables. State variable representation. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability.

Digital Circuit Design Lab (Credits: 1)

List of experiments-

1. Verification of logic functions of the TTL ICs.

2. Implementation of combinational digital circuits using MSI Logic K-map and Boolean function simplification.

3. Implementation of digital systems Implementation of Binary Adders and Subtractor

4. Implementation of code converters (Gray-to-Binary & Binary-to-Gray)

5. Implementation of magnitude comparators.

6. Implementation of BCD-to-Seven Segment Decoder/Driver

7. Use of Flip-Flop TTL IC in digital system.

8. Implement the 4-Bit binary counter using 7493.

9. Verification of various logic functions of the TTL ICs using 7493 binary counter and measurement of propagation delay.

10. Use of Multiplexer TTL IC for designing digital systems.

11. Use of De-multiplexer TTL ICs for designing digital systems.

12. Implementation of shift register, Implementation of Shift register counters.

13. Implementation of Johnson counters with decoding logic.

Analog and Digital Communication Lab (Credits: 1)

List of experiments-

1. DSB Amplitude Modulation & Demodulation
2. Generate FM modulated signal using VCO IC and measure modulation index
3. Pulse code modulation
4. Delta and sigma delta modulation
5. Pulse width modulation and demodulation
6. Pulse position modulation and demodulation
7. Signal sampling and Reconstruction
8. Amplitude Shift Keying generation and reception
9. Phase Shift Keying modulation and demodulation
10. Frequency Shift Keying modulation and demodulation.
11. Framing & marker in Time Division Multiplexing
12. P N- Sequence generator

Digital Signal Processing Lab (Credit: 1)

List of experiments-

1. Review of MATLAB
2. Generation of various signals using different operations with MATLAB.
3. Implementation of linear convolution with MATLAB
4. Implementation of circular convolution with MATLAB

5. Implementation of linear convolution using overlap add and overlap save methods with MATLAB.
6. Implementation of Z-transform with MATLAB
7. Implementation of DFT and IDFT with MATLAB
8. Implementation of various windows with MATLAB
9. Implementation of various filters (FIR and IIR) with MATLAB.
10. Implementation of decimation and interpolation with MATLAB.

Device and Circuit Simulation Lab (Credit: 1)

List of experiments-

1. PN Junction Diode
2. Zener Diode
3. Bipolar Junction Transistor
4. BJT Biasing
5. Junction Field Effect Transistor
6. BJT Frequency Response
7. FET Frequency Response
8. Multistage Amplifier
9. OP-AMP Basic Circuits.
10. OP-AMP base Filters
11. OP-AMP based Oscillators
12. IC Voltage Regulator

Life Skills (Credits: 2)

Introduction to Organizational Behavior: Ability, Personality, Myers-Briggs Type Indicator (MBTI), Learning, Perception, Values, Terminal Values, Instrumental Values, Importance, Attitude and Job Satisfaction, Assertiveness, Emotional Intelligence. Group: Foundation of group behavior, Models of group development, Group structure, Group Processes, managing change, managing conflict. Teams: Teams vs. Groups, Types of teams, Contemporary issues in managing teams. Motivation: Basic concepts & theories of motivation, Motivating group members, Implications for engineers. Leadership: Basic concepts & theories of leadership, leading a team, Implications for engineers.

Year/Sem: III Year/V Sem

Discipline Elective-1 (Credits: 3)

(i) Electromagnetic Field Theory (ii) Network Synthesis (iii) Digital Hardware Design

(i) Electromagnetic Field Theory:

Propagation in Good Conductors, Skin Effect, Reflection of uniform Plane Waves at normal incidence, Plane Wave reflection, Wave propagation in dispersive media, concept of phase velocity and group velocity. Typical Transmission lines- Co-axial, Two Wire, Micro strip, Coplanar and Slot Lines, Transmission Line Parameters, Transmission Line Equations, Wave propagation in Transmission lines, lossless line, Distortion less line, Input Impedance, Standing Wave Ratio ,Power and lossy lines, Shorted Line, Open-Circuited Line, Matched Line. Wave propagation in waveguides, TEM, TM and TE modes, Rectangular waveguides, circular waveguides, Power transmission and

attenuation, Rectangular cavity resonators, directional couplers, isolator, circulator. Radiation Mechanism, Current Distribution on a Thin Wire Antenna, Radiation Pattern, Radiation Power Density, Radiation Intensity. Beam area, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature and antenna filed zones.

(ii) Network Synthesis:

Poles and zeros, Time-domain response from pole and zero plot. Stability of active networks. Image impedance, iterative impedance, characteristic impedance, propagation coefficient, image transfer coefficient , iterative transfer coefficient, Lattice and Bridged T networks, matching techniques, insertion loss, symmetrical and asymmetrical attenuators and their design.

Low pass, high pass, band pass and band elimination filters, m-derived filters, composite filters, Butterworth approximation, Chebyshev approximation, elliptic function approximation, frequency transformation. LC, RL, RC, and RLC network synthesis, Foster and Cauer network, minimum positive real function, Brune's method, Bott-Duffin method, Synthesis-Coefficient. Lumped parameter equivalent, voltage and current on a transmission line, waveform distortion, attenuation and phase equalizers, distortion-less line, loading, liner reflection on a line, reflection coefficient, input and transfer impedances, reflection factors, reflection loss, insertion loss, T and π equivalents of a line, location of line fault, construction and design of two wire line and coaxial cable.

(iii) Digital Hardware Design:

Digital Design Flow, Simulation and Synthesis process. arithmetic, logic and shifter micro-operations, conditional control, ASM chart, data-path and control logic design. Processor organization, design of ALU, overflow. Introduction to asynchronous sequential machine. Analysis of asynchronous circuits, race condition, primitive flow table, state reduction, state assignment and synthesis of asynchronous circuit. hazards. Ripple carry adder, carry look-ahead adder, carry select adder, carry save adder, parallel multiplier, sign multiplication, Baugh-Wooly multiplication algorithm, radix-4 Booth multiplication algorithm, Package declaration for different data types, use of generate statement, VHDL coding of generic logic components for combinational logic circuits (multiplexer, decoder, parallel adder/ subtractor, ALU and multiplier) and sequential logic circuits (registers and accumulator).

Science Elective (Credits: 3)

(i) Power Science

Power Semiconductor Devices: Diodes- performance parameter, Effects of forward and reverse recovery time, transistors. UJT- operation, characteristics, relaxation oscillators, Power MOSFET-Construction, IGBT, Construction, Working, Diac, Construction, Triac, Construction, Working, Characteristics. Thyristors : V-I characteristics, switching characteristics, Gate characteristics, Two transistor model, turn-on, turn-off, di/dt & dv/dt protection, design of Snubber circuit, firing-resistance and resistance capacitance firing, commutation techniques- class A, B, C&D. Uncontrolled- single phase with (R, RL, and RLE) load. Controlled- single phase with (R, RL, and RLE) load. Choppers : Principle of operation, control strategies, step up and step down chopper, type-A, B, C, & D chopper. Inverters: Single phase inverters, Cyclo converters.

(ii) Science of Semiconductors

Introduction, Synthesis of nano-materials: different approaches of synthesis (Physical Techniques and Chemical Techniques). Characterization techniques of nano-materials: SEM, STM, AFM, Xray diffraction. Properties of nano-materials: Electronic, Magnetic, Optical, Chemical and Mechanical

properties. Applications of Nano-materials: Applications in memory and electronic devices, for magnetic recording, sensors, interfaces.

(iii) Material Science and Applications

Dielectric Materials: Polarization mechanism & Dielectric Constant, Behavior of polarization under impulse and frequency switching, Dielectric loss, Spontaneous polarization, piezoelectric effect; Applications of Dielectric Materials. Magnetic Materials: Concept of magnetism, Classification – dia-, para-, Ferro-, antiferro- and ferri-magnetic materials, Hysteresis; Magnetic Storage and Surfaces. Polymers and Ceramics: Various types of Polymers and their applications; Optical/ Mechanical behavior and Processing of Polymers; Structure, Types, Properties and Applications of Ceramics; Mechanical behavior and Processing of Ceramics. Superconducting Materials: Meissner effect, Critical field, type-I and type-II superconductors; Field penetration and London equation; BCS Theory, High temperature Superconductors and their Applications. Nuclear Materials: Materials for Nuclear power generation, Reactors, Nuclear fuel. Optical Fibers and Laser communication: Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation, Single and Multimode fibers and their propagation characteristics, Low loss fibers, Connectors, Splicing and Splice loss. Couplers; Applications of Laser in various fields including Optical Communication using Optical Cables. Display Devices. Fluorescent Materials.

(iv) Biochemistry

Basic concept in Techniques - Normality –definition, Examples. Molarity- Definition, examples. Purification, Centrifugation, Filtration, Dialysis, Homogenization, Adsorption, absorption, Partition, Centrifuge- types & application ,Density Gradient centrifugation, Sedimentation. pH and buffer : Hydrogen ion concentration, Handerson – Hasselbalch equation, Buffer- definition, Types & its preparation, Buffers of biological importance such as carbonate-bicarbonate, phosphate, acetate, etc., Hemoglobin buffering capacity, Mechanism of action of buffers in biological system, pH meter – instrumentation and application. Use of Different Solvent system- for amino acid, Carbohydrate and Lipid separation. Types of techniques – Analytical Technique. Separation Techniques. Application of Technical Biochemistry in medical field, research field & in Industrial field. Modern trends in microbial production of: Bio-insecticides, Bio fertilizers, Immobilized enzymes, Use of immobilized cell system in production of fine Chemicals, Bio chemistry and semiconductor electronics.

Microprocessor and Interfacing (Credits: 3)

Evolution of microprocessor, single chip microcomputers, embedded microprocessor, semiconductor memory, RAM, ROM, EPROM, cache memory, memory hierarchy. **Intel 8085:** ALU, timing and control unit, registers, data and address bus, pin configuration, Intel 8085 instructions, Instruction cycle, fetch and execute operation, machine cycle and state, instruction and data flow, timing diagram, Interrupts. Machine, assembly and high level language, Instruction and data format, Addressing modes, status flags, Stacks, Subroutines, Assembly language programs. Address space partitioning, memory mapped and I/O mapped I/O schemes, Data transfer schemes, I/O ports, Programmable Peripheral interface (8255), Programmable Counter/Interval Timer (8254), Programmable DMA controller (8257), Programmable Interrupt controller (8259), 8251. Analog to digital converter (ADC-0800, 0808/0809) , Digital to analog converter (DAC-0800), Delay subroutine, 7-segment display, Display of alphanumeric characters, Measurement, Microprocessor based speed control of Stepper motor, Water-level indicator, microprocessor based Traffic light control.

Microprocessor and Interfacing Lab. (Credits: 1)
List of experiments-

1. Study the microprocessor 8085 kit and instruction set.
2. Move and Load based instruction.

3. Addition and subtraction on Binary numbers
4. Arithmetic operation with 16-bit
5. Perform binary addition on F5 H and 8A H at 2601 H and 2602 H. The result should store at 2603 H and 2604 H.
   -Perform decimal addition on 84 H and 75 H at 2701 H and 2702 H. The result stored at 2703 H and 2704 H.
6. Search all the positive numbers from the given array. Search all the even numbers from the given array.
7. Write program for one's complement of 49 H and two's complement of 94 H.
   A number 5B8C store at the location 3201 and 3202 H perform two's complement at 3203 H and 3204 H.
8. Find the larger in between 98 H and 87 H at location 2401 H and 2402 H and store number at 2403 H.
   -Find smaller of BC H and EF H with using same location.
   -Determine the largest number in a data array i.e. 87, 65 and75 through assembly language programming.
   -Arrange 54, EF, 85, 9B and A8 in descending order. These numbers are stored in the memory location 3501 to 3505 H. The count should use memory location 3800 H. Results are to be stored at 3901 to 3901 H.
9. Perform above operation for ascending order.
10. Interfacing of 8255 (Programmable Peripheral Interface) with 8085
    In simple mode0, In strobe mode1 and mode2.
11. Interfacing of 8253 (Programmable Timer/Counter) with 8085
    Generate a mono shot pulse, Generate a square wave

Hardware Lab (Credits: 1)
List of experiments-

1. Regulated power supply ($\pm$ 5V, $\pm$ 12vPower unit).
2. Electricity Detector.
3. Wireless switch.
4. Power saving LED lamp from your scrap box.
5. Friendly mobile charger.
6. Logic gates.
7. Running message display.
8. IR remote control tester.
9. Automatic night lamp.
10. ECM mic Preamplifier.

Year/Sem: III Year/VI Sem

Telecommunication Networks (Credits: 3)
Classification of networks (WAN, MAN, LAN), distributed systems, transmission media, modems, structure of computer network, circuit, packet, message switching, Network topological, Network model, ISO-OSI model, TCP/IP model, primitives and services. Physical Layer Design Issues (Service provided to data link Layer) Introduction Transmission media, RS-232-C and RS-449. Data Link Layer Design Issues (Service Provided to N/w Layer), Framing, error control, flow control, Link Management, Error Detection and Error Correction Coding, Data Link Protocols, local and metropolitan area networks. The Medium Access sub layer, Static and Dynamic Channel Allocation in LANs and MANs, ALOHA Protocols, Different Protocols of LAN, IEEE Standard 802 for LAN

(802.2, 802.4, 802.5). Network Layer Design Issues. Routing, Congestion, Internetworking. Routing Algorithms, formatting, data compression, data security. Transport Layer Design Issue .Connection Management, Buffer Management, Quality of Service. Session Layer Design Issues Synchronization issues. Introduction to Presentation Layer. Encryption and decryption. RSA algorithm.

VLSI Design (Credits: 3)

Introduction to VHDL: Entity Declaration, Architecture Declaration; Dataflow Modeling, Configuration Declaration, Package Declaration, Package Body, data objects and data types, Operators, Generics components, Function Declaration, Hardware simulation & synthesis in VHDL, VLSI Design Flow. Manufacturing process**:** MOS process flow**,** Silicon wafer, photolithography, diffusion and ion implantation, deposition, etching, package materials, interconnect levels, thermal consideration in packaging etc), N-well, p-well and twin tub process, VLSI scaling-constant voltage, constant field scaling, MOS fundamentals, MOS, channel length modulation, body effect, biasing of MOSFETs, capacitances in MOS Design of MOS inverter, static design of NMOS saturated load inverter, NMOS inverter with linear load, depletion mode load, Design of W/L, power dissipation, propagation delay, and noise margin analysis. CMOS inverter, static and dynamic characteristics of CMOS inverter, Combinational and sequential circuits**,** MOS Memory-RAM (static and dynamic), ROM, sense amplifier, address decoder, Reliability, Circuit simulation FPGA basics, Different type of FPGA Architecture, logic design using FPGA, ASIC design, Logic design using ASIC's.

Discipline Elective-2 (Credits: 3)

(i) Embedded System:

Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design. Design Process- Requirements, Specifications, Architecture Design, Designing of Components, System Integration, CISC and RISC instruction set architecture, CISC (Motorola -68HC11 and 8051 processor), CISC (ARM). Memory System Architecture –Caches and Virtual Memory. I/o Sub-system - Busy-wait I/0, DMA and Interrupt driven I/0. Bus Protocols and Bus Organization. Memory Devices and their Characteristics- RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM. I/O Devices- Timers and Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Memory Interfacing. Application Specific Logic Design using Field Programmable Devices and ASICs. Introduction to Hardware Description Languages. Embedded system evolution trends, round-robin, robin with interrupts, function – one scheduling architecture, algorithms, introduction to- assembler - compiler-cross compilers and integrated development environment (IDE). Object oriented interfacing, recursion, debugging strategies, simulators, tasks and data, semaphores and shared Data Operating system services- message questimer function- events - memory management, interrupt routines in an RTOS environment, basic design using RTOS

(ii) Antenna and Wave Propagation:

Basic Antenna parameters, patterns, radiation intensity, beam efficiency, diversity and gain, antenna apertures, effective height, bandwidth, radiation, efficiency, antenna temperature. point sources, power patterns, power theorem, radiation intensity, filed patterns, phase patterns. Array of two isotropic point sources, non-isotropic but similar point sources, principles of pattern multiplication, broad side array, broad side versus end fire array, isotropic point sources of equal amplitude and spacing. Short electric dipole, fields of a short dipole, radiation resistance of short dipole, radiation resistances of $\lambda/2$ Antenna, thin linear antenna, micro strip arrays, low side lobe arrays, long wire antenna, folded dipole antennas. slot antenna , horn antennas, rectangular horn antennas, Helical Antenna, Yagi-Uda array, corner reflectors, parabolic reflectors, log periodic antenna, lens antenna, ultra wide band antennas. Advantages, disadvantages of micro-strip antenna. Various micro-strip antenna configurations and their excitation techniques. Surface wave phenomena. Ground wave propagation, free space propagation, ground reflection, surface wave, diffraction.

Troposcopic scatter, Ionosphere propagation, electrical properties of the ionosphere, effects of earth's magnetic field.

(iii) Electronic Testing

Test process and automatic test equipment, test economics and product quality, fault modelling, logic and fault simulation, testability measures, combinational and sequential circuit test generation. memory test, DSP based analog and mixed signal test, model based analog and mixed signal test, delay test, IIDQ test, built-in self-test, scan chain design, random logic BIST, memory BIST, boundary scan test standard, Analog test bus, functional microprocessor test, fault dictionary, diagnostic tree, testable system design, core based design and test Wrapper design, test design for SOCs , unpowered short circuit tests, unpowered analog tests, powered in-circuit analog, digital and mixed signal tests, optical and X-ray inspection procedures, functional block level design of in-circuit test equipment

Discipline Elective-3 (Credits: 3)

(i) Microwave and Radar System

Microwave Spectrum, Typical applications of Microwaves. Rectangular Waveguide-Design consideration, TE & TM modes, TE_{10} mode analysis, cut-off frequency, propagation constant, phase and group velocity, power transmission, attenuation, waveguide excitation, wall current; Introduction of circular waveguide; resonant frequency, Q-factor. N-port networks-Properties of S matrix, Transmission matrix & their relationships; Microwave passive components and their S matrix representation: Attenuators, Phase shifter, Directional coupler, Bethe-hole coupler, Magic tee, hybrid ring, Circulators, Isolators; Design procedure of filter, low-pass prototype design, implementation. Electron beam & Field interaction for energy exchange in resonant and non-resonant (TWT &BWO) microwave active devices: Basic Radar, The simple form of the Radar equation. Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, pulse Doppler Radar.

(ii) Optical Communication

Propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Optical Fibers and Laser communication: Light propagation in fibers and Graded Index fibers, Numerical Aperture and Attenuation. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation Single and Multimode fibers and their propagation characteristics, Low loss fibers, Connectors, Splicing and Splice loss. Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detect or responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties Couplers; Applications of Laser in various fields including Optical Communication using Optical Cables. Display Devices. Fluorescent Materials. WDM and DWDM systems. Principles of WDM networks.

(iii) DSP Processors

Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FET), Linear time- invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations, Dynamic Range and Precision, Sources of error in DSP implementations, AID Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter. DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing. Commercial Digital signal- processing Devices, Data Addressing modes of

TMS32OC54XX DSPs, Memory space of TMS32OC54XX Processors, Program Control, TMS32OC54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS32OC54XX. ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. The Blackfin Processor, Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals. Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Telecommunication Networks Lab (Credits: 1)

List of experiments-

1. Identification of network hardware.
2. Fabrication of network cables and trouble shooting.
3. To study *stop &wait* and *sliding window* protocol using LAN trainer.
4. To study MAC ALOHA protocol using LAN trainer.
5. To study MAC CSMA and MAC CSMA/CD protocol using LAN trainer.
6. To study TOKEN BUS and TOKEN RING using LAN trainer.
7. To study ETHERNET using OP-NET simulator.
8. To study TOKEN RING using OP-NET simulator.
9. To study SWITCHED LAN using OP-NET simulator.
10. To study Static routing using boson netsim network simulator.
11. To study dynamic routing using boson netsim network simulator.

VLSI Design Lab (Credits: 1)

List of experiments-

1. Simulation of Logic Gates
2. Simulation of Half adder and full adder circuit
3. Simulation of Encoder and
4. Simulation of Decoder circuits
5. Simulation of Multiplexers
6. Simulation of De-multiplexers circuits
7. Simulation of Flip-Flop circuits
8. Simulation of Registers
9. Simulation of Counters
10. Simulation of ALU design

Advanced Communication Lab (Credits: 1)

List of experiments-

1. DPSK generation and Detection.
2. QPSK generation and Detection.
3. PCM generation and Detection using a CODEC Chip.
4. Measurement of losses in a given optical fiber (Propagation loss, bending loss) and numerical aperture.
5. Analog and Digital (with TDM) communication link using optical fiber.
6. Measurements of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.
7. Measurements of directivity and gain of antennas: standard dipole (or printed dipole), micro-strip patch antenna and yagi antenna (printed).
8. Determination of coupling and isolation characteristics of a strip line (or micro-strip) directional coupler.

9. Measurements of resonance characteristics of a micro-strip ring
10. Resonator and determination of dielectric constant of the substrate.
11. Measurement of power division and isolation characteristics of a micro-strip 3 dB power divider

Year/Sem: IV Year/VII Sem

Discipline Elective–4 (Credits: 3)

(i) Internet Based Automation

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes. M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Model and architecture, IoT reference Model, IoT. Reference Architecture- Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, e Health. Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities.

(ii) **Linear VLSI IC Design:**

Energy band diagram of MOSFET, Threshold Voltage, Work function difference, Flat band voltage, Depletion layer thickness, Charge distribution, C-V characteristics. Non-ideal Effects in MOSFET: Short Channel and Narrow Width Effect, Sub-threshold Conduction, VT roll-off, Dain Induced Barrier Lowering, Gate Induced Drain Leakage, Gate Tunnelling, Punch through. MOS amplifiers: Single-Stage Amplifiers, Differential Amplifiers. Active Current Mirrors: Cascode Current mirror, Wilson Current mirror and their applications. Theory and design of MOS Operational Amplifier, Complete CMOS operational amplifier including frequency compensation. Comparators and Voltage Reference Sources. A/D (analogue-to-digital) converters, averaging amplifiers, differentiators, DC (direct-current) amplifiers, integrators, multi-vibrators, Sinusoidal Oscillators, Non-Sinusoidal Oscillators, Active Filters, Switched-Capacitor Filters and Voltage Regulators.

(iii) Multi-rate Signal Processing and Filter Banks

Digital FIR filter design, Filter specifications, ideal filters; Equi-ripple filters; Windowing and the Gibbs phenomenon; The Remez Algorithm, Digital IIR filter design, Bilinear transformation. Down sampling, Up sampling, commutativity of up sampling and down sampling, noble identities, inter-connection of building blocks, poly-phase representation of signals and filters, multi-stage implementation, applications of multi-rate systems. Nyquist Filter and square-root Nyquist filter. Systems using re-sampling filters, Re-sampling filters: Interpolators, Interpolator architecture, band-pass interpolator, rational ratio sampling, arbitrary re-sampling ratio, Farrow filter.

Half-band low pass and high pass filters, window design of half-band filter, Remez Algorithm design of half-band filters, Hilbert transform band-pass filter, Interpolating with low pass half-band filters. Dyadic half-band filters. Recursive poly-phase filters: All pass recursive filters, two-path and M-path recursive all-pass filters. Communication systems applications: timing recovery in a digital demodulator digitally controlled sampled data delay, FM receiver and demodulator.

Discipline Elective–5 (Credits: 3)

(i) Information Theory and Coding

Probability spaces, Random variables, Distributions and densities, Functions of random variables, Statistical Averages, Inequalities of Markov and Chebyshev, Weak law of large numbers. Discrete

entropy, Joint and conditional entropies, Entropy in the continuous case, Maximization of continuous entropy, Entropy of a band limited white Gaussian process.
Kraft- McMillan inequality, Noiseless coding theorem, Construction of optimal codes. Discrete memory less channel, Mutual information and channel capacity, Shannon's fundamental theorem and its weak converse, Capacity of a band limited AWGN channel, Limits to communication – Shannon limit. Coding for reliable digital transmission and storage, Types of codes. Binary field arithmetic, Vector Spaces over GF Generator and parity check matrices, Syndrome and error detection, Hamming codes. Polynomial representation, Systematic encoding, Cyclic encoding, Syndrome decoding. Generator Sequences, Structural properties, Convolutional encoders, Optimal decoding of Convolutional codes- the Viterbi algorithm. Distance properties, Design of the turbo codes, Iterative decoding of turbo codes.

(ii) Advance Control System
Electrical System, Mechanical System, Thermal System, Liquid Level system, Hydraulic System, Pneumatic System, Linearization of nonlinear system, DC Motor speed and position control, Control of Thermal Process, Liquid Level Control Process, Preliminary design consideration, System requirement in time and frequency domain, Lead Compensation, Lag Compensation, Lag-Lead Compensation, Control System design by Root Locus method, Control System design by Frequency Response Techniques. Stability improvement by state feedback, Preconditions for pole placement, State Regulator Design, Design of State Observers, Lyapunov Stability Analysis. Linear Quadratic Optimal Control. Performance Indices. Nonlinear system–Basic concepts and analysis. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems. Digital implementation of controllers.

(iii) Neural Network
Soft computing, history, human brain, biological neuron, artificial neuron, comparison, McCulloch-Pitts Model. Neuron Model, Transfer Function, Network Architectures, Learning Strategy (Supervised, Unsupervised, and Reinforcement), comparison, vector spaces, inner product, norm, orthogonality, reciprocal basis vectors, Eigen value and Eigen vectors. Perceptron Architecture, Pattern classification, single and multiple inputs, learning rule, Unified Learning Rule, Hebb & Pseudo inverse rule, Widrow-hoff, Adaptive Linear Neuron (ADALINE) Network, LMS Algorithm Adaptive Filtering. Taylor Series, Directional Derivatives Minima, Necessary Conditions for Optimality, Eigen system of the Hessian, Steepest Descent, Stable Learning Rates, Minimizing Along a Line, Newton's Method, Conjugate Gradient. Multilayer Perceptrons, Back propagation Algorithm, Chain Rule, Back propagating the Sensitivities, Batch vs. Incremental Training, Drawbacks of Back propagation. Associative Learning, Competitive learning, Self-Organizing Feature Maps, Radial Basis Networks, Adaptive resonance Theory, Hopfield network.

Discipline Elective–6 (Credits: 3)
(i) Mobile Communication
Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.
Large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading. Antennas-Antennas for mobile terminal monopole antennas, PIFA, base station antennas and arrays. Multiple access schemes-FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM. Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme. MIMO and space time signal processing, spatial multiplexing,

diversity/multiplexing trade-off. Performance measures- Outage, average SNR, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

(ii) Stastical Signal Processing

Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, Random Signal Modelling: MA (q), AR(p) and ARMA(p,q) models Estimation of signal in presence of White Gaussian Noise (WGN), Linear Minimum Mean-Square Error (LMMSE) Filtering: Wiener Hoff Equation FIR Wiener filter, Causal IIR Wiener filter, Noncausal IIR Wiener filter Linear Prediction of Signals, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters. Principle and Application, Steepest Descent Algorithm Convergence characteristics; LMS algorithm, convergence, RLS algorithm, derivation, Matrix inversion Lemma, Intialization, tracking of non-stationary. Scalar Kalman filter, Vector Kalman filter Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Non Parametric Spectral estimation Techniques, Parametric Spectral Estimation, AR(p) spectral estimation and detection of Harmonic signals, MUSIC algorithm.

(iii) Image and Video Processing

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization. Image Enhancements and Filtering-Gray level transformations, histogram equalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass. Color transformations. Image Segmentation-Detection of discontinuities. Wavelets and Multi-resolution image processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression, Still image compression standards – JPEG and JPEG-2000. Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video coding standards – MPEG and H.26X. Video Segmentationm, spatial segmentation – motion-based; Video object detection and tracking.

Year/Sem: IV Year/VIII Sem

Discipline Elective–7 (Credits: 3)

(i) Spread Spectrum Communication

Direct sequence spread spectrum methods employing BPSK, QPSK and MSK - Frequency Hop spread spectrum methods - Coherent slow frequency Hop technique - Non coherent slow and fast frequency Hop spread spectrum techniques - Hybrid DS/FH spread spectrum - Complex envelope representation of spread spectrum systems. Frequency Hop Spread Spectrum Systems and examples of Spread Spectrum Systems. Optimal tracking of wideband signals - Early-late tracking loops - Code tracking loops for FHSS-Optimum synchronization techniques - Multiple dwell and sequential detectors - Synchronization using a matched filter. Performance without coding under AWGN and different jamming environments - spread spectrum systems performances with forward error correction - Block coding - Convolution coding and specific error correcting codes - Inter leaving - Random coding bounds. Orthogonal Walsh Codes CDMA Standards, CDMA One (IS-95A, IS-95B), CDMA 2000 (IX, DillV), W-CDMA CDMA for mobile communications – issues, GSM standards, GSM Architecture, Protocols Radio resource management Interfacing between BTS and MSC Restoration technique.

(ii) Speech Signal Processing

Speech production and modelling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid. Requirements of speech codes –quality, coding delays, robustness. All-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation. Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals – prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction. Vector quantization – distortion measures, codebook design, codebook types. Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF. Linear Prediction Coding- LPC model of speech production; Code Excited Linear Prediction-CELP speech production model, Generic CELP encoders and decoders; method; CELP based on adaptive codebook, Adaptive Codebook search; Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards.

(iii) Wireless Sensor Networks

Wireless Network, Classification, Wireless sensor network (WSN), Challenges, Characteristic requirements, Required mechanisms Mobile Ad Hoc Networks (MANETs), field buses, Single-node architecture, Hardware components, communication device, sensors and actuator, Energy consumption, Radio Transceivers, Case study: Tiny Os and nesC, Mica mote, EYES, BT nodes, scatter web. Design principles for WSNs, Adaptive fidelity and accuracy, Physical layer, Frequency allocation, Packet transmission and synchronization, transceiver design, Mediation device, Dynamic modulation scheme. Error control, ARQ & FEC techniques, Hybrid Framing Adaptive schemes, Intermediate checksum schemes, combining packet-size optimization, Link management. Wireless MAC protocols, Address allocation and assignment, Addressing overhead, Gossiping and agent-based unicast forwarding, Energy-efficiency, unicast protocols, multi path uni-cast routing, Source, core & Mesh based tree protocols. Mobile data collectors mobile regions publish/subscribe interaction paradigm, Data-centric routing, Data-centric storage.

Discipline Elective–8 (Credits: 3)

(i) Satellite Communication

Principles and architecture of satellite Communication, Brief history of Satellite systems, applications and frequency bands used for satellite communication. Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day. Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc. Sun Transit Outage phenomena, Doppler frequency shift phenomena and expression for Doppler shift. Satellite link budget Flux density and received signal power equations, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions. Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

(ii) Biomedical Signal Processing

DSP basics, sampling, z-transform, DFT, convolution, correlation, difference equations HR and FIR filters. Biomedical signals and their time and frequency domain characteristics. Random signals-sample space, events probability, random variables, probability distribution. Autocorrelation, covariance, cross-correlation, stationary of random process, wide sense stationary, response of linear system to random signals. Filtering technique for removal of noise, artefacts and interferences. Time

domain and frequency domain filtering. Notch & frequency domain filtering. Notch & Comb filters & their design. Optimal and Adaptive filtering technique. Detection of events in bioelectric signals like ECG, EEG, PCG etc. Detection of waves, correlation & coherence analysis, Wave shaping, envelope extraction and analysis. Processing of events related potentials. DSP techniques for Biomedical Signal. Pattern detection and classification.

(iii) MIMO Systems

Overview of cellular service progression, Gaussian random variable, BER performance of communication systems in an AWGN channel, BER and SER for BPSK, QPSK in AWGN, M-ary PAM, M-QAM, M-ary PSK. MIMO system model, Fundamental properties and models of MIMO systems, Multiple Antennas in wireless systems, Principle of Diversity, Multiplexing Capability, SIMO, MISO, MIMO systems, Electromagnetic Waves propagation through MIMO channels, Orthogonality of signals. MIMO zero forcing receiver, properties of the zero forcing receiver matrix, principle of orthogonality interpretation of ZF receiver, MIMO MMSE receiver, robustness of MMSE to noise amplification, Low and High SNR properties of the MMSE receiver. Singular Value Decomposition (SVD) of the MIMO channel, SVD and MIMO capacity, Alamouti and Spacetime codes, OSTBC, Non linear receiver: VBLAST. Double directional propagation to MIMO channels. Space time Encoder, Design methodology, Spatial Multiplexing/V-BLAST, ML decoding, Sphere decoding, D-BLAST, OSTBC, QOSTBC, Linear dispersion codes. Space time Trellis codes.