Civil Engineering

1. Engineering Mechanics, Strength of Materials and Structural Analysis

Engineering Mechanics: Principle of virtual work, equivalent force system.First and Second Moment of area, Mass moment of Inertia.Static Friction. Kinematics and Kinetics: Kinematics in Cartesian Co-ordinates, motion under uniform and nonuniform acceleration, motion under gravity. Kinetics of particle: Momentum and Energy principles, collision of elastic bodies, rotation of rigid bodies.

Strength of Materials: Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength. Deflection of beams: Macaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method. Torsion of Shafts, Elastic stability of columns, Euler's Rankine's and Secant formulae.

Structural Analysis: Castiglianio's theorems, Slopedeflection, moment distribution, Rolling loads and Influences lines: Influences lines for Shear Force and Bending moment at a section of beam. Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses. Arches: Three hinged, two hinged and fixed arches. Matrix methods of analysis Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, statical method, Mechanism method. Unsymmetrical bending: Moment of inertia, product of inertia, Neutral Axis and Principle axes, bending stresses.

2. Design of Structures: Steel, Concrete

Structural Steel Design: Structural Steel: Riveted, bolted and welded joints and connections. Design of tension and compression member, beams of built up section, riveted and welded plate girders, gantry girders, stancheons with battens and lacings.

Design of Concrete : Concept of mix design. Reinforced Concrete: Working Stress and Limit State method of design-Recommendations of I.S. codes Design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, Cantilever and Counter fort type retaining walls. Prestressed concrete: Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress.

3. Fluid Mechanics, Open Channel Flow, Hydraulic Machines, Hydrology, Water Resources and Engineering:

Fluid Mechanics: Fluid properties and their role in fluid motion, fluid statics, Kinematics and Dynamics of Fluid flow,.Continuity, momentum and energy equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, sluice gates, weirs. Laminar flow between parallel, stationary and moving plates, flow through tube. Laminar and turbulent boundary layer on a flat plate, laminar sub layer, smooth and rough boundaries, drag and lift. Turbulent flow through pipes: Characteris-tics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line. Uniform and non-uniform flows, Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed. **Hydrology:** Hydrological cycle, precipitation, evaporation, transpiration, infiltration, overland flow, hydrograph, flood frequency analysis, flood routing through a reservoir, channel flow routing-Muskingam method.

Water Resources Engineering: Ground and surface water resource, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation.

Irrigation Engineering: (i) Water requirements of crops: consumptive use, duty and delta, irrigation methods and their efficiencies. (ii) Canals: Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load. (iii) Canal structures (iv) Diversion headwork: Principles and design of weirs of permeable and impermeable foundation, Khosla's theory, energy dissipation. (v) Storage works (vi) Spillways (viii) River training:.

4. Geotechnical Engineering: Soil Type and structure - gradation and particle size distribution - consistency limits. Water in soil - capillary and structural - effective stress and pore water pressure - permeability concept - field and laboratory determination of permeability - Seepage pressure - quick sand conditions - Shear strength determination - Mohr Coulomb concept.Compaction of soil - Laboratory and field tests.Compressibility and consolidation concept - consolidation theory - consolidation settlement analysis.Earth pressure theory and analysis for retaining walls, Application for sheet piles and Braced excavation. Bearing capacity of soil - approaches for analysis - settlement analysis - stability of slope of earth walk. Subsurface exploration of soils - methods Foundation - Type and selection criteria for foundation of structures - Design criteria for foundation - Analysis of distribution of stress for footings and pile - pile group action-pile load test. Ground improvement techniques.

5. Transportation Engineering :

Railway Engineering: Permanent way - components, types and their functions - Functions and Design of turn and crossings - Necessity of geometric design of track - Design of station and yards.

Highway Engineering: Principles of Highway alignments - classification and geometrical design elements and standards for Roads. Design principles and methodology of flexible and rigid pavements. Typical construction methods and standards of materials for stabilized soil, WBM, Bituminous works and CC roads. Surface and sub-surface drainage arrangements for roads. Pavement distresses and strengthening by overlays. Traffic surveys and their applications in traffic planning - Typical design features for channelized, intersection, rotary etc - signal designs - standard Traffic signs and markings.

6. Environmental Engineering:

Water Supply: Predicting demand for water, impurities of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water. Water treatment: principles of coagulation, flocculation and sedimentation; slow-; rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

Sewerage systems: Domestic and industrial wastes, storm sewage-separate and combined systems, flow through sewers, design of sewers.BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal watercourse and on land.

Sewage treatment& Solid waste: Working principles, units, chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of wastewater.Collection and disposal in rural and urban contexts, management of long-term ill effects.

MECHANICAL ENGINEERING

Applied Mechanics and Design

Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

Vibrations: Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, shafts, spur gears, rolling and sliding contact bearings, brakes and clutches.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Thermodynamics: Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

Applications: Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. I.C. Engines: air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. Turbomachinery: Pelton-wheel, Francis and Kaplan turbines - impulse and reaction principles, velocity diagrams.

Manufacturing and Industrial Engineering

Engineering Materials: Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Joining: Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

COMPUTER SCIENCE & ENGG. AND INFORMATION TECHNOLOGY

Digital Logic: Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation and computer arithmetic (fixed and floating point).

Computer Organization and Architecture: Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Programming and Data Structures: Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms: Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes – P, NP, NP-hard, NP-complete.

Theory of Computation: Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability.

Compiler Design: Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Operating System: Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases: ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Information Systems and Software Engineering: information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Computer Networks: ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security – basic concepts of public key and private key cryptography, digital signature, firewalls.

Web technologies: HTML, XML, basic concepts of client-server computing.

ELECTRICAL ENGG. & EEE

Networks: Network topology, Node-pair and loop analysis of networks containing independent and dependent sources, Sinusoidal steady state analysis of single-phase and 3-phase circuits, Resonance, Symmetrical components, Magnetically coupled circuits. Fourier series and transform, Laplace transform, Analysis of RLC networks using Laplace transform, Network functions for one-port and two-port networks, Impulse response and superposition integral, Network theorems, State variables, Formulation of state equations of RLC-networks and solutions, Discrete systems.

Signals and Systems: Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and

FFT, z-transform. Sampling theorem, Linear Time-Invariant (LTI) Systems: definitions and

properties; causality, stability impulse response, convolution, poles and zeros, parallel and

cascade structure, frequency response, group delay, phase delay. Signal transmission through

LTI systems.

Electromagnetic Field Theory: Vector fields. Divergence and Stokes theorems. Overview of Electrostatics and Magnetostatics. Poisson's Equation: Derivation, applications, existence and uniqueness. Dielectrics, Displacement vector. Capacitance matrix, Energy in the field.

Ampere's Law: B Field calculations. Vector potential. The magnetic dipole. Magnetization of materials.Faraday's Law: Induced emf in stationary and moving coils. Inductance. Inductance matrix. Energy in the magnetic field. Maxwell's Equation: The wave equation. Poynting theorem. Poynting theorem for phasors.

Electrical Machines: Single phase transformer, three phase transformers, instrument transformers, energy conversion principles, DC machines, induction motors, synchronous

machines, parallel operation of generators, motor starting, characteristics and applications, servo and stepper motors, special machines, electrical drives.

Power Systems and High Voltage: Basic power generation concepts, transmission line models and performance, cable performance, insulation, corona and radio interference, distribution systems, per-unit quantities, bus impedance and admittance matrices, load flow, voltage control, power factor correction, economic operation, symmetrical components, fault analysis, power system protection and switch gear, HVDC transmission and FACTS concepts, power quality, Harmonics in power systems, Renewable energy systems. Power System Stability -Swing equation, single generator infinite bus model, and equal area criterion. Importance of High Voltages and HV tests; general requirements of HV testing ,testing of internal and external insulation systems. Generation of High alternating, direct and impulse voltages; measurements of alternating direct and impulse voltages and dielectric loss. Insulating materials: solids, liquids and gases; their electrical properties and applications; breakdown mechanisms in solid, liquid and gaseous dielectric; measurement of Radio interference Voltage (RIV) and partial discharges; generation and Measurement of impulse currents.

Power Electronics: Semiconductor Devices in switched mode - Diode, SCR, BJT, IGBT, MOSFET - drivers, protection, thermal aspects – ratings Figures of merit - ripple factor, average value, Harmonic factor, Distortion factor, THD, Power factor, Crest factor Power in switching circuits - 2-pulse Midpoint converter - analysis for R load, infinite inductive load, R-L load - implications of commutation overlap - use in DC drives. 3-pulse converter - analysis for R load,

infinite inductive load, R-L load - implications of commutation overlap - use in DC drives. Bridge converters - three phase and single phase - analysis for R load, infinite inductive load, R-L load - implications of commutation overlap - use in DC drives.

Buck, Boost, Buck-Boost and Cuk Converters - circuit steady state analysis - current and voltage ripple estimation - discontinuous and continuous modes of operation. Use of SCR in buck converters - commutation circuit. Inverters - 120 deg. and 180 deg. conduction operation – selective harmonic elimination - McMurray inverter - SPWM, unipolar and bipolar switching Single phase AC Voltage Controller - analysis and operation Snubbers - turn on, turn off, snubbers - RCD snubber Power Electronic Converters, Vector Control/Direct control /Torque Control of Motors, Simulation of PE systems, DSP Applications, Permanent Magnet Machines and Special Machines.

Control Systems & Instrumentation: Representation of continuous and discrete-time signals, shifting and scaling operations, linear, time invariant and causal systems, Fourier series representation of continuous periodic signals, sampling theorem, Principles of feedback, transfer function, block diagrams, steady -state errors, Routh and Niquist techniques, Bode plots, root loci,lag, lead and lead-lag compensation, state space model, state transition matrix, controllability and observability, Bridges and potentiometers, PMMC, moving iron, dynamometer and induction type instruments, measurement of voltage, current, power, energy and power factor, digital voltmeters and multimeters, phase, time and frequency measurement, Q-meters, oscilloscopes, potentiometric recorders, error analysis.

Analog and Digital Electronics: Characteristics of diodes, BJT, FET, amplifiers -biasing,

equivalent circuit and frequency response, oscillators and feedback amplifiers, operational

amplifiers-characteristics and applications, simple active filters, VCOs and timers,combinationaland sequential logic circuits, multiplexer, Schmitt trigger, multi-vibrators, sample and hold circuits,A/D and D/A converters, 8-bitmicroprocessor basics, architecture, programming and interfacing. Semiconductor power diodes, transistors, hyristors, triacs, GTOs, MOSFETs and IGBTs,Converter.

CHEMISTRY

PHYSICAL CHEMISTRY

Structure: Quantum theory: principles and techniques; applications to a particle in a box, harmonic oscillator, rigid rotor and hydrogen atom; valence bond and molecular orbital theories, Hückel approximation; approximate techniques: variation and perturbation; symmetry, point groups; rotational, vibrational, electronic, NMR, and ESR spectroscopy

Equilibrium: Kinetic theory of gases; First law of thermodynamics, heat, energy, and work; second law of thermodynamics and entropy; third law and absolute entropy; free energy; partial molar quantities; ideal and non-ideal solutions; phase transformation: phase rule and phase diagrams – one, two, and three component systems; activity, activity coefficient, fugacity, and fugacity coefficient; chemical equilibrium, response of chemical equilibrium to temperature and pressure; colligative properties;

Kinetics: Rates of chemical reactions, temperature dependence of chemical reactions; elementary, consecutive, and parallel reactions; steady state approximation; theories of reaction

rates – collision and transition state theory, relaxation kinetics, kinetics of photochemical reactions and free radical polymerization, homogeneous catalysis, adsorption isotherms and heterogeneous catalysis.

INORGANIC CHEMISTRY

Main group elements: General characteristics, allotropes, structure and reactions of simple and industrially important compounds: boranes, carboranes, silicones, silicates, boron nitride, borazines and phosphazenes. Hydrides, oxides and oxoacids of pnictogens (N, P), chalcogens (S, Se & Te) and halogens, xenon compounds, pseudo halogens and interhalogen compounds. Shapes of molecules and hard- soft acid base concept.

Transition Elements: General characteristics of d and f block elements; coordination chemistry: structure and isomerism, stability, theories of metal- ligand bonding (CFT and LFT), mechanisms of substitution and electron transfer reactions of coordination complexes. Electronic spectra and magnetic properties of transition metal complexes, lanthanides and actinides.

Instrumental methods of analysis: Atomic absorption and emission spectroscopy including ICP-AES, UV- visible spectrophotometry, NMR, mass, Mossbauer spectroscopy (Fe and Sn), ESR spectroscopy, chromatography including GC and HPLC and electro-analytical methods (Coulometry, cyclic voltammetry, polarography – amperometry, and ion selective electrodes).

ORGANIC CHEMISTRY

Stereochemistry: Chirality of organic molecules with or without chiral centres. Specification of configuration in compounds having one or more stereogeniccentres. Enantiotopic and diastereotopic atoms, groups and faces. Stereoselective and stereospecific synthesis. Conformational analysis of acyclic and cyclic compounds. Geometrical isomerism. Configurational and conformational effects on reactivity and selectivity/specificity.

Reaction mechanism: Methods of determining reaction mechanisms. Nucleophilic and electrophilic substitutions and additions to multiple bonds. Elimination reactions. Reactive intermediates- carbocations, carbanions, carbenes, nitrenes, arynes, free radicals. Molecular rearrangements involving electron deficient atoms.

Organic synthesis: Synthesis, reactions, mechanisms and selectivity involving the followingalkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines. Use of compounds of Mg, Li, Cu, B and Si in organic synthesis. Concepts in multistep synthesis- retrosynthetic analysis, disconnections, synthons, synthetic equivalents, reactivity umpolung, selectivity, protection and deprotection of functional groups.

Pericyclic reactions: Electrocyclic, cycloaddition and sigmatropic reactions. Orbital correlation, FMO and PMO treatments.

Photochemistry: Basic principles. Photochemistry of alkenes, carbonyl compounds, and arenes. Photooxidation and photoreduction. Di-π- methane rearrangement, Barton reaction.

Heterocyclic compounds: Structure, preparation, properties and reactions of furan, pyrrole, thiophene, pyridine, indole and their derivatives.

Biomolecules: Structure, properties and reactions of mono- and di-saccharides, physicochemical properties of amino acids, chemical synthesis of peptides, structural features of proteins, nucleic acids, steroids, terpenoids, carotenoids, and alkaloids.

Spectroscopy: Principles and applications of UV-visible, IR, NMR and Mass spectrometry in the determination of structures of organic molecules.

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Module-1

Linear Wave Shaping Circuits, Hall effects, Rectifiers, Clippers, Clampers, Semiconductor technology, Small Signals Modeling of BJT, MOSFETs, Feedback Amplifiers & Oscillators, OP-Amps, Current Source Circuits, BJT and JFET Frequency Response, Power Amplifiers(A, B, C types), Distortion analysis, Push-pull configuration,

Transients, Resonance, Network theorems, Network Functions: Poles And Zeros, Stability of Networks, Two-Port Parameters, Positive Real Function, Driving-Point Synthesis With LC Elements, Two Terminal-Pair Synthesis By Lader Development

Gate level Minimization, K Map, POS, SOP, Combinational Circuits, Sequential Circuits, Memory & Programmable Logic, Digital Integrated logic Circuits, State machine

Active filter design, Instrumentation Amplifier, Wideband amplifiers, Bistable Multivibrator, Schmitt trigger Circuit, Monostable Multivibrator, Tunnel diode & UJT, VCO, PLL

Spectral Analysis, Power Spectral Density, AM, DSB-SC, SSB-SCand VSB, M, PM, Preemphasis and Deemphasis, Noise in AM & FM

Module-II

Anti-aliasing Filter, PAM, PWM, PPM, PCM, DPCM, DM, ADM, Line Coding**,** ISI, Equalizer, Eye diagram, Timing Jitter, White Noise, BPSK, BFSK, DE-PSK, QPSK, MSK, M-ary PSK, M-ary FSK

Co-ordinate transformation, Electrostatics, Magnetostatics, Steady Electric Currents, Maxwall's Equations, Helmholtz wave equation. Plane wave solution, Polarization of EM wave, Radio Wave Propagation

CMOS p-Well and n-Well Processes, CMOS Inverter, Layout of an Inverter, Combinational & Sequential Logic Circuits in VLSI, Semiconductor Memories, Design Capture Tools, VHDL, Testing and Verification

LTI System, z-transform DFT, IDFT, FFT,DIT & DIF algorithms, Convolution, Correlation, FIR & IIR Filters

Intel 8085 Microprocessor, Memory Interfacing, Stack &Subroutines, Interrupts,8253, 8255, 8257, 8259, Intel 8086, Intel 80386 and 80486

Module-III

DC & AC bridges, True- RMS responding meter, Storage Oscilloscope, Sampling Oscilloscope, Sweep frequency Generator, Spectrum Analyzer, Strain Gages, Displacement Transducers, Instrumentation Amplifier, Isolation Amplifier, IEEE-488 GPIB Bus

High Frequency Transmission line and Wave guides, Smith chart, Field solution for TE and TM modes, Cylindrical waveguides, Microwave Resonator, Power divider and Directional Couplers, Reflex Klystron, Multi-Cavity Magnetron, Microwave Propagation

8051 Microcontroller, Arithmetic Instructions and Programs, Single- Bit Instructions And Programming, Interfacing of 8051

Module-IV

Optical Fiber Modes and Configurations, Attenuation and Distortion in optical Fibers, LED and LASER Diodes, Optical Fiber System Link Budget

Satellite Orbits, Spacing and Frequency Allocation, Satellite Sub-systems, Satellite System Link Models, Direct Broadcast Satellite Services, Application of LEO, MEO and GEO Satellites

Image Digitization, Image Enhancement, Restoration, Compression,Segmentation, Processing of color images

Methods for Speech Processing, Digital Representation of speech Waveform, Linear Predictive Speech Coding

Block codes, Waveform coding, Cyclic Codes, Convolutional Encoding,

Fuzzy Logic , Neural Networks, Evolutionary Computing

Radar Equation, Radar Block Diagram, Radar Frequencies, Applications and Limitations of Radar

TV Transmitters & its Block Diagram, Resolution, Scanning, Resolution, Sync Signal

Cellular Concept & System Design, Mobile Radio Propagation, DS-SS and FH-SS, GSM, CDMA

Antenna Basics & Fundamentals, Horn Antenna, Aperture Antenna, Dipole antenna, Yagi antenna,

Metallurgy & Materials Engineering

Structure: Atomic structure and bonding in materials. Crystal structure of materials, crystal systems, unit cells and space lattices, determination of structures of simple crystals by x-ray diffraction, miller indices of planes and directions, packing geometry in metallic, ionic and covalent solids. Concept of amorphous, single and polycrystalline structures and their effect on properties of materials. Crystal growth techniques. Imperfections in crystalline solids and their role in influencing various properties

Diffusion: Fick’s laws and application of diffusion in sintering, doping of semiconductors and surface hardening of metals.

Metals and Alloys: Solid solutions, solubility limit, phase rule, binary phase diagrams, intermediate phases, intermetallic compounds, iron-iron carbide phase diagram, heat treatment of steels, cold, hot working of metals, recovery, recrystallization and grain growth. Microstructure, properties and applications of ferrous and non-ferrous alloys

Ceramics: Structure, properties, processing and applications of traditional and advanced ceramics.

Polymers: Classification, polymerization, structure and properties, additives for polymer products, processing and applications.

Composites: Properties and applications of various composites.

Advanced Materials and Tools: Smart materials, exhibiting ferroelectric, piezoelectric, optoelectric, semiconducting behavior, lasers and optical fibers, photoconductivity and superconductivity, nanomaterials – synthesis, properties and applications, biomaterials, superalloys, shape memory alloys. Materials characterization techniques such as, scanning electron microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, atomic absorption spectroscopy, differential scanning calorimetry
Mechanical Properties: stress-strain diagrams of metallic, ceramic and polymeric materials, modulus of elasticity, yield strength, tensile strength, toughness, elongation, plastic deformation, viscoelasticity, hardness, impact strength, creep, fatigue, ductile and brittle fracture.

Thermal Properties: Heat capacity, thermal conductivity, thermal expansion of materials.

Electronic Properties: Concept of energy band diagram for materials – conductors, semiconductors and insulators, electrical conductivity – effect of temperature on conductivity, intrinsic and extrinsic semiconductors, dielectric properties.

Optical Properties: Reflection, refraction, absorption and transmission of electromagnetic radiation in solids.

Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, anti ferro magnetism, ferromagnetism, ferrimagnetism, magnetic hysterisis.

Environmental Degradation: Corrosion and oxidation of materials, prevention.

Mathematics

Real Analysis

Axioms of Choice, Countability, Bolzano-Weiestrass theorem, Heine-Borel theorem, Convergence of sequences and series of real numbers, Tests of Convergence, Cauchy Test, Uniform continuity, Sequences and series of functions, Uniform convergence. Power series, Weiestrass approximation theorem, Differentiation, Reimann-Stieltjes Integration, Function of several variables, Differentiability, Inverse function theorem, Implicit function theorem, Constrained maxima and minima.

Complex Analysis

Analytic functions, Power Series, Exponential and trigonometric functions, Conformal mapping, Riemann-Stieltjes integral, Power Series representation of Analytic functions, The index of a closed curve, Cauchy's theorem for rectangle, Cauchy theorem for disc, Cauchy's integral formula, Liouville's theorem, Fundamental theorem of Algebra, Morera's theorem, Open mapping theorem, Zeros, Poles, Classification of Singularities, Laurent Series, Residues, The Maximum Modulus theorem.

Functional Analysis

L^p – spaces, Inequalities in L^p – spaces, Completeness of L^p, Normed linear spaces, inner product spaces examples, properties of Normed linear spaces and inner product spaces, Hilbert spaces, Examples, orthonormal sets, Gram-Schmidt orthonormalizations, Orthonormal polynomials, Orthonormal basis, Fourier Expansion, Hahn Banach Theorem, Baire's category theorem ,Open mapping Theorem ,Closed graph theorem, Uniform boundedness Principle.

Numerical Analysis

Root finding for non-linear equations, Lagrange and Newton interpolations, Interpolating polynomials using finite differences, Hermite interpolation, Piecewise and Spline interpolation, Numerical differentiation, Numerical integration, Numerical Solution of system of linear equations, Numerical solution of ordinary differential equation.

Linear Algebra

Vector spaces over fields, subspaces, bases and dimension, Systems of linear equations, matrices, rank, rank-nullity theorem, duality and transpose, Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonal-lization, rational canonical form, Jordan canonical form.

Modern Algebra

Groups, Subgroups, Normal Subgroups, Quotient groups, Homomorphism, Isomorphism, Cyclic groups, Permutation groups, Symmetric groups, Cayley's Theorem, Sylow theorem, Application of Sylow Theorem, Free Abelian groups, Free Groups, Vector Spaces, Subspaces, Quotient spaces, Linear independence, bases, Dimension, Projection, Algebra of matrices, Rank of a matrix, Characteristic roots and Vectors, Matrix representation of a linear transformation.

Ordinary Differential Equation

System of first order equations, Existence and Uniqueness theorems, Successive approximation Picard's Theorem, Non Uniqueness of solutions, Existence and uniqueness of solution of systems, Strum Liouville's Problem green's functions, Picard's theorem.

Partial Differential Equation

Classification of first order Partial differential equations, Pfaffian differential equations, Lagrange's method, Compatible systems, Charpit's method, Jacobi's method, Integral surfaces passing through a given curve, Monge cone, characteristic strip, Classification of Second order Partial Differential Equations., One dimensional Wave equation, Vibration of an infinite string, origin of the equation, D'Alembert's solution, Vibrations of a semi finite string, Vibrations of a string of finite length, Laplace equation , Boundary value problems, Maximum and minimum principles.

Measure Theory

Sigma Algebra of Sets, Borel sets of **R**, Lebesgue outer measure and its properties, Sigma Algebra of Measurable sets in **R** , Non-measurable sets, Lebesgue measure and its properties,

Cantor set and its properties, Measurable functions, Simple functions, Integration of Nonnegative functions, Riemann and Lebesgue Integration, Monotone convergence theorem, Fatou's Lemma, and Dominated convergence theorem.

Topology

Bases, Subbases, Countability, closed sets, Limit Points, Continuous functions, Subspace topology, Product topology, and Quotient topology, Connectedness, Local connectedness, Path-connectedness, compact Spaces, compactness in metric spaces, locally compacts spaces, Regular and completely regular space, normal spaces.

Discrete Mathematical Structures

Permutation, Combination, Graphs: Basic terminology, Multi graph and Weighted graphs, Paths and circuits, Eulerian Paths and circuits, Hamiltonion Paths and circuits, Trees: Rooted trees, binary search trees, Spanning trees, Cut sets, Recurrence relations and recursive Algorithms, Boolean Algebras.

Linear Programming

Simplex Method, Primal and Dual Problem, Duality & Simplex method, Dual Simplex Method, Transportation Problem, Properties of transportation matrix, N-W corner rule, Vogel's approximation method, and Transportation algorithm, Assignment Problem, Two person zero sum games, Maxmin and Minmax principle.

PHYSICS

Mathematical Physics: Linear vector space; matrices; vector calculus; linear differential equations; elements of complex analysis; Laplace transforms, Fourier analysis, elementary ideas about tensors.

Classical Mechanics: Conservation laws; central forces, Kepler problem and planetary motion; collisions and scattering in laboratory and centre of mass frames; mechanics of system of particles; rigid body dynamics; moment of inertia tensor; noninertial frames and pseudo forces; variational principle; Lagrange's and Hamilton's formalisms; equation of motion, cyclic coordinates, Poisson bracket; periodic motion, small oscillations, normal modes; special theory of relativity – Lorentz transformations, relativistic kinematics, mass-energy equivalence.

Electromagnetic Theory: Solution of electrostatic and magnetostatic problems including boundary value problems; dielectrics and conductors; Biot-Savart's and Ampere's laws; Faraday's law; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; Electromagnetic waves and their reflection, refraction, interference, diffraction and polarization. Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves; radiation from a moving charge.

Quantum Mechanics: Physical basis of quantum mechanics; uncertainty principle; Schrodinger equation; one, two and three dimensional potential problems; particle in a box, harmonic oscillator, hydrogen atom; linear vectors and operators in Hilbert space; angular momentum and spin; addition of angular momenta; time independent perturbation theory; elementary scattering theory.

Thermodynamics and Statistical Physics: Laws of thermodynamics; macrostates and microstates; phase space; probability ensembles; partition function, free energy, calculation of thermodynamic quantities; classical and quantum statistics; degenerate Fermi gas; black body radiation and Planck's distribution law; Bose-Einstein condensation; first and second order phase transitions, critical point.

Atomic and Molecular Physics: Spectra of one- and many-electron atoms; LS and jj coupling; hyperfine structure; Zeeman and Stark effects; electric dipole transitions and selection rules; X-ray spectra; rotational and vibrational spectra of diatomic molecules; electronic transition in diatomic molecules, Franck-Condon principle; Raman effect; NMR and ESR; lasers.

Solid State Physics: Elements of crystallography; diffraction methods for structure determination; bonding in solids; elastic properties of solids; defects in crystals; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids; metals, semiconductors and insulators; transport properties; optical, dielectric and magnetic properties of solids; elements of superconductivity.

Nuclear and Particle Physics: Nuclear radii and charge distributions, nuclear binding energy, Electric and magnetic moments; nuclear models, liquid drop model – semi-empirical mass formula, Fermi gas model of nucleus, nuclear shell model; nuclear force and two nucleon problem; Alpha decay, Beta-decay, electromagnetic transitions in nuclei; Rutherford scattering, nuclear reactions, conservation laws; fission and fusion; particle accelerators and detectors; elementary particles, photons, baryons, mesons and leptons; quark model.

Electronics: Network analysis; semiconductor devices; Bipolar Junction Transistors, Field Effect Transistors, amplifier and oscillator circuits; operational amplifier, negative feedback circuits ,active filters and oscillators; rectifier circuits, regulated power supplies; basic digital logic circuits, sequential circuits.

ENGLISH

Concepts in Literature

Unit-I:	Literature: culture, context, convention, its practice and relevance
Unit- II:	Genres of literature: poetry, fiction, drama
Unit- III:	Genres of literature: short story, essays, biography (with excerpts from sample texts)
Unit -IV:	Literary devices
Unit-V:	Literary forms: Ballad,Comedy,Elegy,Epic,Novel,Ode,Romance,Sonnet,Tragedy,Tragicomey,The Short Story

Classical and neo-classical critical theories

Unit 1. Classical Theory & Criticism
Unit 2. Aristotle's *Poetics*
Unit 3. Longinus' *On the Sublime*
Unit 4. Neoclassical theory and criticism
Unit 5. Samuel Johnson's "Preface" to *Plays of William Shakespeare*

Literature and Social history-I

Unit 1. Medieval Period**:** Feudalism and Role of the Church
Unit 1I. Early Modern**:** Humanism and the English Renaissance and the Print Revolution
Unit III. The Beginnings of Colonialism
Unit.IV – The Enlightenment**:** Ideas of the Enlightenment & The Beginnings of Modern Democracy
Unit.V- Colonialism to Imperialism

Literature and Social history-II

Unit.I- Romanticism:. The French Revolution and After and Romantic Themes
Unit.II- Victorian: Darwinism**,** The Working Classes**.**
Unit. III – Feminist Movements
Unit.IV- Modern: The Modernist Movements in the Arts, The Crisis of Empire and The Rise of 'English'
Unit.V – Post-Modern: The Postcolonial Perspective, Culture Studies and Globalization

The novel in 18th-19th Centuries

Unit. I – Daniel Defoe's *Moll Flanders*
Background, Introducing the Novel and themes and Techniques

Unit. II – Jane Austen's *Persuasion*
Background, Introducing the Novel and Themes and Techniques

Unit. III – Emily Brontë's *Wuthering Heights*
Background, Introducing the Novel and Themes and Techniques

Unit. III – Jonathan Swift's Gullive's Travels
Background, Introducing the Novel and Themes and Techniques

Unit. III – Richardson Pamela
Background, Introducing the Novel and Themes and Techniques

Non Fiction –letter, Essay, biography and Auto-biography.

Unit 1. Non-fictional Prose – General Introduction, Joseph Addison's *The Spectator Papers: The Uses of the Spectator, The Spectator's Account of Himself, Of the Spectator*.

Unit 2. Charles Lamb's "My Relations"

Unit 3. Matthew Arnold's "Preface" to *Poems* (1853).

Unit 4. Rabindranath Tagore's "Nationalism in the West"

Unit 5. Bertrand Russell's *Autobiography*

Theory- Romantic & Victorian theory & Criticism

Unit 1. Romantic Theory & Criticism

Unit 2. Wordsworth's 'Preface' to *Lyrical Ballads* (Second Edition)

Unit 3. Coleridge's *Biographia Literaria* (Chapter XIII)

Unit 4. Victorian Theory & Criticism

Unit 5. Arnold's "The Study of Poetry"

Romantic Poetry

Unit 1. William Blake's "Holy Thursday"(*Songs of Innocence*), "London", "The Tyger" (*Songs of Experience*)

Unit 2. Wordsworth's "Composed Upon Westminster Bridge", "Ode on Intimations of Immortality"

Unit. 3. Lord Byron's *Don Juan* (Canto XI)

Unit. 4. Shelley's "Ode to the West Wind"

Unit. 5. Keats' "Ode to a Nightingale"

Fiction 19th-20th centuries

Unit. I – Thomas Hardy's *The Mayor of Casterbridge*
Background, Introducing the Novel and Themes & Techniques

Unit. II – E.M.Forster's *A Passage to India*
Background , Introducing the Novel and Themes & Techniques

Unit. III – Charles Dickens' *Hard Times*
Background, Introducing the Novel and Themes & Techniques

Unit. IV- W. M Thackray- Vanity Fair
Background, Introducing the Novel and Themes & Techniques

Unit. V- Emily Brante- Wuthering Height.
Background, Introducing the Novel and Themes & Techniques

Renaissance drama- Shakespearian (with alternate play)

Unit 1. General Introduction to English Renaissance Drama
Unit 2. Christopher Marlowe's *The Jew of Malta*
Unit 3. A General Introduction to Shakespeare
Unit 4. *Hamlet*
Unit 5. *The Tempest*

The 20th Century (with alternate play)

Unit I – Joseph Conrad's *Heart of Darkness*
Background**,** Introducing the Novel **&** Themes & Techniques
Unit II – Virginia Woolf's *Mrs Dalloway*

Background**,** Introducing the Novel ***and*** Themes & Techniques

Unit III – D.H.Lawrence's *Sons & Lovers*

Background, Introducing the Novel and Themes & Techniques

Unit. IV- James Joyce's Protrait of an artist as a young man.

Background, Introducing the Novel and Themes & Techniques

Unit. V- William Golding's Lord of the flies

Background, Introducing the Novel and Themes & Techniques

Modern Drama (with alternate play)

Unit 1. Introduction to Modern Drama

Unit 2. George Bernard Shaw's *Pygmalion*

Unit 3. Modern Drama and the Absurd

Unit 4. Samuel Beckett's *Waiting for Godot*

Unit 5. Harold Pinter's *The Birthday Party*

Victorian Poetry (with alternate play)

Unit 1. Poetry in the Victorian world

Unit 2. Tennyson's *In Memoriam* (Sections 7, 35, 50, 96)

Unit 3. Arnold's "Dover Beach", "Yea, in the sea of life enisled"

Unit 4. D.G.Rossetti's "The Blessed Damozel"

Unit 5. Hopkins's "The Windhover", "Pied Beauty", "God's Grandeur"

Modern Poetry (with alternate poetry)

Unit 1. Poetry in the Modern World

Unit 2. Yeats's "Sailing to Byzantium"

Unit 3. Eliot's *The Waste Land*

Unit 4. Auden's "In Memory of W.B.Yeats"

Unit 5. William Carlos Williams' "Spring and All"

Literature of Europe (with alternate play)

Unit. I – Drama in Russian

Russian Drama: Anton Chekhov's *The Seagull*

Unit. II – Drama in Norwegian

The Background of Norwegian Drama: Henrik Ibsen's *The Wild Duck*

Unit. III – Drama in Italian
Italian Dramatic Conventions: Luigi Pirandello's *Six Characters in Search of An Author*
Unit. IV – Drama in German
German Drama: Bertolt Brecht's *Mother Courage & Her Children*

20th Century Criticism

Trends in Formalism

Unit 1. New Criticism
Unit 2. The Heresy of Paraphrase" (Brooks)
Unit 3. The Line of Wit" (Leavis)
Unit 4. Tradition and the Individual Talent" (Eliot)
Unit 5. Russian Formalism

Or

Later Trends

Unit 1. Literary Theory: A Composite View
Unit 2. Structuralism to Post-structuralism
Unit 3. Roland Barthes
Unit 6. Psychoanalysis and Jacques Lacan
Unit 5. Feminism

Commonwealth Literature-I

Unit. 1: **Selected Poems**- Derrick Walcott
Unit. II: **A Dance of the Forests** – Wole Soyinka
Unit. II1: **The Dreams of Tipu Sultan-** Girish Karnad
Unit. IV: **The English Patient** – Michael Ondatjee
Unit. V: **Disgrace**- J.M. Koetzee

Commonwealth Literature-II

Unit. 1: **Selected Poems**- A. K. Ramanujan
Unit. 2: **The Harvest**- Manjula Padmanabhan
Unit. 3: **The Lion and the Jewel**- Wole Soyinka
Unit. 4: **Anthills of Savannah**- Chinua Achebe
Unit. 5: **The Glass Palace**- Amitav Ghosh

Communicative English

Unit1:

Business communication: Basic concepts of Business communication, Barriers and filters. Reading(scanning-skimming)/writing(narrative, descriptive, expository, argumentative)/listening(passive, active) and speaking(focused , situationally appropriate) skills.

Unit2:

Corporate communication: intercultural insensitivity, the multicultural workforce, meetings, communicating through visuals.

Unit3:

Technical writing/ report writing/ business proposals/ principles of note making. How to deal with people/dynamics of non verbal communication/ body language/ telephone etiquettes/ communication challenges in Today's workplace, Network etiquettes

Unit4:

Presentation skills. Basic concepts of Group discussion/ preparation, process and categories of Group discussion, overcoming mistakes in a Group discussion. CV writing, Both Functional and Chronological. Writing a Job application letter. Interview skills and techniques, confidence building.

Unit5:

Business letters, memos, notice, circular, agenda and minutes. Seminars and conferences, correspondence with banks and Media. Drafting of advertisements. Emails/ e-filing, procedures of Filing and file movements. Cross -Cultural communication

Basics of Written Communication

Unit1: NOTE TAKING

Purpose ,Use, Structure. TOPIC SENTENCEA activities/identifying topic sentences/Creating topic sentences for paragraphs, supporting DETAILS/PREPARING SUPPORTING DETAILS/Taking notes- practice with paragraphs

Unit 2: PARAGRAPH WRITING

LINKING DEVICES Repetition of the same word or phrases, Use of pronouns,Elaboration and exemplification, SUPPORTING IDEAS With description, examples and quotation/LOGICAL PROGRESSION, Inside a paragraph and Between a paragraph

Unit 3: REPORTS:

Objectives and readership/tone of the language formal and semiformal/formats of reports:printed form,memo,letter,manuscript types of reports:analytical and informational/oral and written/special and routine

Unit4: BUSINESS CORRESPONCENCE:

cv/resume, coverletters/analysis of samples/chronological cv / resume/functional cv/ job applications/responding to advertisement

Unit 5: WRITTEN COMMUNICATION AT WORKPLACE

MEMOs/Interoffice/Interoffice/Formats of memo/Difference between a business letter and a memo /E-MAILS Net etiquettes/ circulars-formats/notices formats/types of business letters; standard letter parts, formats inquiries, orders & quotationscomplaints and adjustment letters

Contemporary Indian Writing in English-I

Unit 1. Beginnings, Early Twentieth Century and Post-Independence period
Unit.2. Jayanta Mahapatra: "The Abandoned British Cemetery at Balasore"
Unit 3. Keki N. Daruwalla: Wolf , Hawk.

Unit 4. Kamala Das:, A Hot Noon in Malabar, My Grandmothers House.
Unit 5. Vikram Seth: “The Humble Administrator’s Garden”

Contemporary Indian Writing in English-II

Unit 1. *Tughlaq* (Girish Karnad)
Unit 2. *Lights Out* (Manjula Padmanabhan)
Unit 3. Aurobindo Ghosh : “A System of National Education”
Unit 4. *Speeches*
i) The Quit India speeches, August 8, 1942
ii) Speech at the Round Table Conference, Nov.11, 1931
Unit 5. Nehru’s *Autobiography* (Chapters 1, 2, 3, 19, 51, 53)