CIVIL ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector Identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy's Integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson's rule, single and multi-step methods for differential equations.

Unit 2: Mechanics

Bending moment and shear force in statically determinate beams. Simple stress and strain relationship; Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

Unit 3: Structural Analysis

Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

Unit 4: Concrete Structures

Concrete Technology- properties of concrete, basics of mix design. Concrete design-basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of prestressed concrete, analysis of beam sections at transfer and service loads.

Unit 5: Steel Structures

Analysis and design of tension and compression members, beams and beam-columns, column bases. Connections-simple and eccentric, beam-column connections, plate girders and trusses. Plastic analysis of beams and frames.

Unit 6: Soil Mechanics

Origin of soils, soil classification, three-phase system, fundamental definitions, relationship and interrelationships, permeability and seepage, effective stress principle, consolidation, compaction, shear strength.

Unit 7: Foundation Engineering

Sub-surface investigations- scope, drilling bore holes, sampling, penetration tests, plate load test. Earth pressure theories, effect of water table, layered soils. Stability of slopes-infinite slopes, finite slopes. Foundation types-foundation design requirements. Shallow foundations-bearing capacity, effect of shape, water table and other factors, stress distribution, settlement analysis in sands and clays. Deep foundations-pile types, dynamic and static formulae, load capacity of piles in sands and clays, negative skin friction.

Unit 8: Fluid Mechanics and Hydraulics:

Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

Hydrology: Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics.

Irrigation: Duty, delta, estimation of evapo-transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Types of irrigation system, irrigation methods. Water logging and drainage, sodic soils.

Unit 9: Water requirements

Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/recycle, energy recovery, treatment and disposal).

Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

Unit 10: Highway Planning

Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

Importance of surveying, principles and classifications, mapping concepts, coordinate system, map projections, measurements of distance and directions, leveling, theodolite traversing, plane table surveying, errors and adjustments, curves.

MECHANICAL ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy's integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by trapezoidal and Simpson's rule, single and multi-step methods for differential equations.

Unit 2: 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.

Unit 3: Theory of Machines and Vibrations

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.

Unit 4: Fluid Mechanics

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.

Unit 5: 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.

Unit 6: Thermodynamics and Applications

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.

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 ï impulse and reaction principles, velocity diagrams.

Unit 7: Manufacturing 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.

Unit 8: 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.

Unit 9: Production Planning and Control

Forecasting models, aggregate production planning, scheduling, materials requirement planning.

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

Unit 10: Operations Research:

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

ELECTRICAL AND ELECTRONICS ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of Linear equations, Eigen Values and eigen vectors.

Calculus: Mean Value Theorems, Theorems of integral Calculus Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series. Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equation (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Euler's equations, initial and boundary value problems, Partial Differential Equations and variable separable method.

Complex variables: Analytic functions, Cauchy's integral theorem and integral formula, Taylor's and Laurent's series, Residue theorem, solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.

Numerical Methods: Solutions of non-linear algebraic equations, single and multi-step methods for differential equations.

Transform Theory: Fourier transform, Laplace transform, Z-transform.

Unit 2: Electric Circuits and Fields

Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits.

Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

Unit 3: Signals and Systems

Representation of continuous and discrete-time signals; shifting and scaling operations; linear, time-invariant and casual systems; Fourier series representation of continuous periodic signals; sampling theorem; Fourier, Laplace and Z transforms.

Unit 4: Electrical Machines

Single Phase transformer – equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers – connections, parallel operation; auto-transformer; energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors – principles, types, performance characteristics, starting and speed control; Single phase induction motors; synchronous machines – performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Unit 5: Power Systems

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.

Unit 6: Protection and switchgear

Principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Unit 7: Control Systems

Principles of feedback; transfer function; block diagrams; steady ï state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-leg compensation; state space model; state transition matrix, controllability and observability.

Unit 8: Electrical and Electronic Measurements

Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; Oscilloscopes; potentiometric recorders; error analysis.

Unit 9: Analog and Digital Electronics

Characteristics of diodes, BJT, FET; amplifiers ï biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers ï characteristics and applications; simple active filters; VCOsô and timers; combinational and sequential logic circuits; multiplexer; Schmitt trigger; multi-vibrators; sample and hold circuits; A/D and D/A convertors; 8-bit microprocessor basics, architecture, programming and interfacing.

Unit 10: Power Electronics and Drives

Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs ï static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters ï fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

ELECTRONICS AND COMMUNICATION ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrix Algebra, Systems of linear equations, Eigen values and eigen vectors.

Calculus: Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series. Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green’s theorems.

Differential equations: First order equation (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy’s and Euler’s equations, Initial and boundary value problems, Partial Differential Equations and variable separable method.

Complex variables: Analytic functions, Cauchy’s integral theorem and integral formula, Taylor’s and Laurent’s series, Residue theorem, solution integrals.

Probability and Statistics: Sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Discrete and continuous distributions, Poisson, Normal and Binomial distribution, Correlation and regression analysis.

Numerical Methods: Solutions of non-linear algebraic equations, single and muti-step methods for differential equations.

Transform Theory: Fourier transform, Laplace transform, Z-transform.

Unit 2: Networks

Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits. 2-port network parameters: driving point and transfer functions. State equations for networks.

Unit 3: Electronic Devices

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility and resistivity. Generation and recombination of carriers. p-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERs. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Unit 4: Analog Circuits

Small Signal Equivalent circuits of diodes, BJTs MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single-and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations. Function generators and wave- shaping circuits, 555 Timers. Power supplies.

Unit 5: Digital Circuits

Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs.

Semiconductor memories. Microprocessor (8085): architecture, programming, memory and I/O interfacing.

Unit 6: 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.

Unit 7: Control Systems

Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback)systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis; root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Unit 8: Analog Communication Systems

Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem.

Unit 9: Digital Communication Systems

pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Unit 10: Electromagnetics

Elements of vector calculus: divergence and curl; Gaussô and Stokesô theorems, Maxwellôs equations; differential and integral forms. Wave equation, Poynting vector.

Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines; characteristics impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation. Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers. Basics of Antennas: Dipole antennas; radiation pattern; antenna gain.

ELECTRONICS AND INSTRUMENTATION

Unit 1: Engineering Mathematics

Linear algebra-Matrix algebra-eigen values and eigen vectors; Calculus-evaluation of definite integrals, partial derivatives, maxima and minima, multiple integrals; Differential equations- first order (linear and non-linear), higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, initial and boundary value problems; partial differential equations-variable separable method; Complex variables-analytic functions, Cauchy’s integral theorem and integral formula, Taylor’s series, residue theorem; Numerical methods-solutions of non-linear algebraic equations and differential equations.

Unit 2: Electric Circuits

Ohm’s law, KCL, KVL, node and mesh analysis, ideal current and voltage sources, Network theorems: superposition, Thevenin’s, Norton’s, maximum power transfer; sinusoidal steady-state analysis; resonance; transient analysis of dc and ac networks; two-port networks; three-phase circuits.

Unit 3: Analog and Digital Circuits

Characteristics of diodes, BJTs, JFETs and MOSFETs; Amplifiers-single and multistage; Frequency response; Operational amplifiers - design, characteristics, linear and non-linear applications; instrumentation amplifiers; precision rectifiers; **I**-to-**V** and **V**-to **I** converters; active filters; comparators; signal generators and wave shaping circuits.

Combinational logic circuits-minimization of Boolean functions; IC families (TTL, MOS, CMOS); arithmetic circuits, multiplexer and decoders. Sequential circuits-flip-flops, counters, shift registers, schmitt trigger, timers, multivibrators and S/H circuits. Analog-to-digital and digital-to-analog converters. 8-bit and 16-bit microprocessors (architecture, memory and I/O interfacing) and 8-bit microcontroller.

Unit 4: Signals and Systems

Linear Time-Invariant (LTI) Systems-definitions and properties; causality, stability; Laplace transform and transfer function; Fourier series-Fourier transforms; Impulse and frequency responses of first and second order systems; Discrete time systems, difference equations, impulse and frequency responses; Z-transforms and transfer functions; convolution and correlation; IIR and FIR filters.

Unit 5: Electrical and Electronic Measurements

Measurement of R, L and C; bridges and potentiometers; measurement of voltage, current, power, power factor and energy; instrument transformers; Q-meter; waveform analyzers. Digital volt-meters and multi-meters. Time, phase and frequency measurements; Oscilloscope; Noise and interference in instrumentation. Introduction to virtual instrumentation.

Unit 6: Transducers and Smart Instruments

Static and dynamic characteristics of transducers; units and standards; calibration techniques; classification of errors-error analysis; variable resistance, variable inductance and variable capacitance transducers; piezo-electric transducers; fibre-optic transducers; ultrasonic transducers; smart transducers; introduction to micro electro mechanical systems (MEMS).

Unit 7: Industrial and Analytical instrumentation

Pressure, flow, temperature and level measurements- principle of operation, installation and maintenance, calibration; measurement of force, torque, velocity, vibration, humidity, viscosity, and density.

Spectrophotometers (UV and IR); pH meters; conductivity meters; analyzers (O_2, NO_2, H_2S), chromatography (gas and liquid); NMR spectroscopy, X-ray spectroscopy and mass spectrometer.

Unit 8: Control Systems

Principles of feedback; transfer function, signal flow graphs; time response analysis; Bode plots, root-loci, Routh and Nyquist criteria; compensation techniques; State space analysis.

Unit 9: Process control

Batch and continuous process; modeling-level, flow and thermal processes; servo and regulator operations; interacting and non-interacting systems; control actions (on-off, P,I, D, PI and PID) and controller tuning; complex control techniques(feed-forward, cascade, ratio and split-range); dynamic matrix control; distillation column control; control of heat exchanger; valve-types, characteristics, sizing, positioners, cavitation and flashing.

Unit 10: Logic and Distributed control system

PLC-sequential and programmable controllers, programming logic-ladder logic and function block programming; data acquisition system (DAS); direct digital control (DDC); supervisory control and data acquisition system (SCADA); distributed control system (DCS); HART and Field bus, OLE for process control (OPC)

COMPUTER SCIENCE AND ENGINEERING / INFORMATION TECHNOLOGY

Unit 1: Engineering Mathematics

Mathematical Logic: Propositional Logic; First Order Logic.

Probability: Conditional Probability; Mean, Median, Mode and Standard Deviation; Random variables; Distributions; uniform, normal, exponential, Poisson, Binomial.

Set Theory and Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra.

Combinatorics: Permutations; Combinations; Counting; Summation; generating functions; recurrence relations; asymptotics.

Graph Theory: Connectivity; spanning trees; cut vertices & edges; covering; matching; independent sets; Colouring; Planarity; Isomorphism.

Linear Algebra: Algebra of matrices, determinants, systems of linear equations, Eigen values and Eigen Vectors.

Numerical Methods: LU decomposition for systems of linear equations; numerical solutions of non-linear algebraic equations by Secant, Bisection and Newton-Raphson Methods; Numerical integration by trapezoidal and Simpson's rules.

Calculus: Limit, Continuity & differentiability, Mean Value Theorems, Theorems of integral calculus, evaluation of definite& improper integrals, Partial derivatives, Total derivatives, maxima & minima.

Unit 2: Theory of Computation

Regular languages and finite automata, Context free languages and Push-down automata, Recursively enumerable sets and Turing machines, Undecidability; NP-completeness.

Unit 3: Digital Logic

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

Unit 4: 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.

Unit 5: 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.

Unit 6: 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.

Unit 7: Compiler Design

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

Unit 8: 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.

Unit 9: 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.

Unit 10: 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.

PRODUCTION ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus: Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and Minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems.

Differential equations: First order equations (linear and non-linear), Higher order linear differential equations with constant coefficients, Cauchy's and Euler's equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

Complex variables: Analytic functions, Cauchy's integral theorem, Taylor and Laurent series.

Probability and Statistics: Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations Integration by rapezoidal and Simpson's rule, single and multi-step methods for differential equations.

Unit 2: Engineering Materials and Applied Mechanics

Engineering Materials: Structure and properties of engineering materials and their applications: effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

Applied Mechanics: Engineering Mechanics – equivalent force systems, free body concepts, equations of equilibrium; strength of materials – stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

Unit 3: Theory of Machines and Design

Analysis of planar mechanisms, cams and followers; governers and fly wheels; design of elements – failure theories; design of bolted, riveted and welded joints; design of shafts, keys, spur gears, belt drives, brakes and clutches.

Unit 4: Thermal Engineering

Fluid Mechanics – fluid statics, Bernoulli's equation, flow through pipes, equations of continuity and momentum; thermodynamics – zeroth, first and second law of thermodynamics, thermodynamic system and processes, calculation of work and heat for systems and control volumes; air standard cycles; basics of internal combustion engines and steam turbines; heat transfer – fundamentals of conduction, convection and radiation, heat exchangers.

Unit 5: Metal Casting and Forming

Casting Processes ï types and applications; patterns ï types and materials; allowances; moulds and cores ï materials, making, and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering; casting inspection, defects and remedies.

Metal Forming ï Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working ï forging, rolling, extrusion, wire and tube drawing; sheet metal working processes such as blanking, piercing, blending, deep drawing, coining and embossing; analysis of rolling, forging, extrusion and wire/rod drawing; metal working defects.

Unit 6: Metal Joining Processes

Welding Processes ï manual metal arc, MIG, TIG, plasma arc, submerged arc, electroslag, thermit, resistance, forge, friction, and explosive Welding; other joining processes ï soldering, brazing, braze welding; inspection of welded joints, defects and remedies; introduction to advanced welding processes ï ultrasonic, electron beam, laser beam; thermal cutting.

Unit 7: Machining and Machine Tool Operations

Basic Machine tools; machining processes-turning, drilling, boring, milling, shaping, planning, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining ï geometry of cutting tools, chip formation, cutting forces and power requirements, Merchantõs analysis; selection of machining parameters; tool materials, tool wear and tool life, economics of machining, thermal aspects of machining, cutting fluids, machinability; principles and applications of nontraditional machining processes ï USM, AJM, WJM, EDM and Wire cut EDM, LBM, EBM, PAM, CHM, ECM.

Tool Engineering: Jigs and fixtures ï principles, applications, and design; press tools ï configuration, design of die and punch; principles of forging die design.

Unit 8: Metrology and Inspection

Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.

Unit 9: Powder Metallurgy

Production of metal powders, compaction and sintering.

Polymers and composites: Introduction to polymers and composites; plastic processing ï injection, compression and blow molding, extrusion, calendaring and thermoforming; molding of composites.

Unit 10: Manufacturing Analysis

Sources of errors in manufacturing; process capability; tolerance analysis in manufacturing and assembly; process planning; parameter selection and comparison of production alternatives; time and cost analysis; manufacturing technologies ï strategies and selection.

Computer Integrated Manufacturing: Basic concepts of CAD, CAM, CAPP, cellular manufacturing, NC, CNC, DNC, Robo tics, FMS and CIM.

METALLURGICAL ENGINEERING

Unit 1: Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of linear equations, Eigen values and eigen vectors.

Calculus: Limit, continuity and differentiability; Partial Derivatives; Maxima and Minima; Sequences and series; Test for convergence; Fourier series.

Vector Calculus: Gradient; Divergence and Curl; Line; Surface and Volume integrals; Strokes, Gauss and Green's theorems.

Differential Equations: Linear and non-linear first order ODEs; Higher order linear ODEs with constant coefficients; Cauchy's and Euler's equations; Laplace transforms; PDEs – Laplace; heat and wave equations.

Probability and Statistics: Mean, median, mode and standard deviation; Random variables; Poisson, normal and binomial distributions; Correlation and regression analysis.

Numerical methods: Solutions of linear and non-linear algebraic equations; integration of trapezoidal and Simpson's rule; single and multi-step methods for differential equations.

Unit 2: Thermodynamics and Rate Processes

Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps.

Unit 3: Electro Chemistry and Mass Transfer

Principles of electro chemistry – single electrode potential, electro-chemical cells and polarizations, aqueous corrosion and protection of metals, oxidation and high temperature corrosion – characterization and control; heat transfer – conduction, convection and heat transfer coefficient relations, radiation, mass transfer – diffusion and Fick's laws, mass transfer coefficients; momentum transfer – concepts of viscosity, shell balances, Bernoulli's equation, friction factors.

Unit 4: Extractive Metallurgy

Minerals of economic importance, comminution techniques, size classification, Flotation, gravity and other methods of mineral processing; agglomeration, pyro- hydro- and electro-metallurgical processes; material and energy balances; principles and processes for the extraction of non-ferrous metals – aluminium, copper, zinc, lead, magnesium, nickel, titanium and other rare metals.

Unit 5: Iron and Steel making

Principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization, sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steel making, furnaces and refractories.

Unit 6: Physical Metallurgy

Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment of steels, cast iron and aluminium alloys; surface treatments; recovery, recrystallization and grain growth; industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of scanning and transmission electron microscopy; industrial ceramics, polymers and composites; electronic basis of thermal, optical, electrical and magnetic properties of materials; electronic and opto-electronic materials.

Unit 7: Mechanical Metallurgy

Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory - types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; super-plasticity; fracture ï Griffith theory, basic concepts of linear elastic and elasto-plastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing ï tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

Unit 8: Metal casting and Forming

Metal casting ï Patterns and moulds including mould design involving feeding, gating and risering, melting, casting practices in sand casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; hot, warm and cold working of metals, Metal forming ï fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming;

Unit 9: Metal joining

Soldering, brazing and welding, common welding processes of shielded metal arc welding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; welding metallurgy, problems associated with welding of steels and aluminium alloys, defects in welded joints;

Unit 10: Powder Metallurgy

NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.

INDUSTRIAL BIO-TECHNOLOGY

Unit 1: Engineering Mathematics

Differential equation - First order equations (linear and non-linear) ï Higher order linear differential equation with constant co-efficients ï Method of variation of parameters ï Initial and boundary value problems ï Partial differential equations and variable separation methods.

Probability and statistics ï Sampling theorem ï Mean, Mode, Median and standard deviation ï Random variables ï Poisson, normal and binomial distributions ï Correlation and regression analysis ï Tests of significance (x^2 and t)

Numerical methods ï Numerical solutions of linear and non-linear equations ï Integration by trapezoidal and Simpsonâs rule ï Single and multi-step methods for differential equations

Unit 2: Microbiology and Cell Biology

Types of Microbes – Bacteria, fungi, algae and viruses ï Staining of bacteria ï Applications of microscopes

Growth Kinetics ï Role of substrate ï Growth phases ï Monod Kinetics ï Sterilization methods

Impact of microbes ï Human diseases and welfare ï Applications in agriculture ï Bio and geo cycles

Cell and tissue structures ï Cellular components and functions ï Cell division / mitosis and meiosis ï Cellular locomotion ï Cytoskeletons

Membranes and transport ï Cellular membrane structure ï Transport of Na, K, Ca ions ï Proton pump ï Facilitated transports

Signals and Communications ï Nervous Systems (signal transmission) ï Endocrine systems (ligands, receptors and hormones) ï Secondary signaling molecules (G proteins, etc.)

Unit 3: Biochemistry and Instrumental Methods

Biomolecules ï Carbohydrates ï Proteins ï Lipids ï Coenzymes and Cofactors

Biopolymer synthesis ï DNA, RNA synthesis ï Proteins synthesis ï Lipid synthesis

Metabolic Pathways ï Oxidative phosphorylation ï Calvin cycle ï Nucleic acid metabolism

Spectroscopic Methods ï UV-Vis spectroscopy ï IR, GC, HPLC ï Mass Spec, XRD ï Atomic Absorption, Fluorescence

Immunochemical methods ï ELISA, RIA ï Electrophoresis ï Western Blot ï Histochemical techniques

Chromatographic techniques ï TLC, ion-exchange ï Gel permeation ï Immuno chromatography

Unit 4: Molecular Biology and Genetic Engineering

DNA and its modifications – DNA extraction, modifying enzymes ï DNA protein interaction ï Polymerase Chain Reaction

Molecular biological techniques – In vitro transcription ï In vitro translation ï Immuno precipitation

Recombinant DNA Technology ï Expression systems ï Organismic modifications ï **Fundamentals of Genetics** ï Inheritance, selection ï Mendelism ï Genotype ï phenotype correlation ï One gene one enzyme hypothesis ï Epistasis

Gene mapping ï Gene cloning ï Sequencing ï Complex diseases

Applications of genetics – Pharmacogenetics ï Prenatal diagnosis ï Hybrid vigour ï Gene Therapy

Unit 5: Enzyme and Immuno Technology

Sources and applications of free enzymes – Microbial, plant and animal enzymes ï Tanning, food and detergent industries ï Diagnostic applications

Enzyme Immobilization – Immobilization methods and supports ï Properties of free and immobilized enzymes ï Applications of immobilized enzymes

Purification and characterization ï Extraction methods ï Purification techniques ï Enzyme characterization ï Development of enzyme assays

Principles of immunology ï Antigen-antibody interaction ï Cell mediated immunoresponse ï Mechanism of antibody response

Immunodiagnostic techniques ï In vitro methods ï In vivo methods

Vaccines ï Immunological preparations ï Types of vaccines

Unit 6: Bioinformatics and Computational Biology

Introduction – Biological database: Genbank, Swissprot ï Human genome project ï DNA, RNA, protein sequences

Pattern matching and Machine learning ï Pairwise alignment ï Multiple sequence alignment ï BLAST, FASTA ï Hidden Markov Models

Phylogeny ï Irrelevant mutations and controls ï Mutations as measure of time and distance, Time intervals and distances between species

Protein architecture ï Primary structure ï automated Edman method ï Super secondary structure ï Tertiary structure

Protein folding ï Scaffold design ï Backbone loop and turn design ï Search algorithms for domain analysis

Drug design ï Computer aided drug design ï Combinatorial chemistry ï Protein, RNA structure prediction

Unit 7: Mass & Heat Transfer

Mass transfer fundamentals – Laws of diffusion ï Vapour liquid equilibria ï Liquid liquid equilibria ï Adsorption equilibria

Distillation – Simple, steam, flash distillation ï McCabe-Thiele Method ï HETP, HTU, NTU concepts

Separation equipment – Rotary vacuum drier ï Absorption tower ï Staged and continuous extractor ï Membrane separator

Heat transfer theory ï Steady state conduction ï Forced and natural convection ï Combined conduction and convection ï Extended surfaces

Design of heat transfer equipment ï Double pipe heat exchanger ï Shell and tube heat exchanger ï Multiple effect evaporators

Operations ï Cooling towers ï Flash evaporation ï Settling and sedimentation ï Continuous filtration

Unit 8: Unit Operations & Biochemical Engineering

Stoichiometry and energetics of microbial metabolism ï Mass and energy balance ï Heats of reaction and vaporization ï Energetics ï ATP as energy currency ï **Enzyme catalysis** ï Enzyme catalyzed reactions ï Inhibition, denaturation and deactivation ï Enzyme kinetics ï Mechalis ï Menton

Upstream processing ï Substrate preparation ï Innoculum preparation ï Sterilization techniques

Bioprocess parameters ï Oxygen transfer in bioreactors ï Bioprocess monitoring and control ï Facultative and anaerobic fermentations

Downstream processing ï Precipitation, centrifugation, ultra filtration ï Crystallization and electrophoresis ï Solvent mediated separations

Product recovery ï Nutsche and rotary vacuum filters ï Magma crystallizer ï Supercritical extractor

Unit 9: Reaction Engineering & Thermodynamics

Chemical Kinetics – Rate equations for homogeneous reactions ï Concentration and temperature dependence ï Rate equations for heterogeneous catalytic reactions

Ideal reactors and non-ideal flow – Isothermal, batch reactors and flow reactors ï Performance equations for single reactors RTD in non-ideal flow Reactor performance with non-ideal flow

Industrial reactors – Trickle bed reactors ï Slurry reactors ï Fluidized bed reactors

Solution thermodynamics – Concepts of chemical potential and fugacity ï Ideal and non-ideal solutions ï Activity coefficients ï Gibbs-Duhem equation

Phase equilibrium ï Criteria for phase equilibrium ï Vapour-liquid equilibrium calculations for binary systems

Chemical reaction equilibria ï Evaluation of equilibrium constant ï Effect of T & P on equilibrium constant ï Equilibrium conversion for single reactions

Unit 10: Applications of Biotechnology

Food Biotechnology – Food processing using bacteria, yeast, fungi ï Single cell protein
Food preservation, cheese manufacture

Plant Biotechnology – Plant tissue culture ï Vectors for plant modification ï Genetically modified crops

Animal Biotechnology – Animal tissue culture ï Products from animal cell culture ï Transgenic animals

Chemical feedstock and acids – Ethanol, butanol, acetone, glycerol ï Citric, lactic, acetic acids ï Glutamic, aspartic acids and phenylalanine

Environmental Biotechnology – Aerobic and anaerobic treatment of waste water - Solid waste treatment ï Air pollution and control

Antibiotics and Enzymes – Penicillin, streptomycin, erythromycin ï Proteases, amylases, lipases ï Biopesticides, biofertilizers

ENGLISH

Unit 1: Chaucer to Shakespeare

Geoffrey Chaucer	:	The Prologue to the Canterbury Tales
Edmund Spenser	:	Prothalamion
Shakespeare	:	Sonnets

		(12,18,29,30,33,53,54,60,65,73,90,94,107,116,144)
John Donne	:	A Valediction : Forbidding Mourning
Andrew Marvell	:	To His Coy Mistress
Francis Bacon	:	Of Truth
		Of Death
		Of Revenge
		Of Marriage and Single Life
		Of Ambition
		Of Nobility
Christopher Marlowe	:	Dr.Faustus
Thomas Middleton	:	The Changeling
John Webster	:	The Duchess of Malfi
William Shakespeare	:	Twelfth Night
		Henry IV Part I
		Macbeth
		The Tempest
		Antony and Cleopatra

Unit 2 : Jacobean to Augustan Age

John Milton	:	Paradise Lost ï Book IX
John Dryden	:	Mac Flecnoe
Alexander Pope	:	An Epistle to Dr.Arbuthnot
Thomas Gray	:	Elegy Written in a Country Churchyard
Thompson	:	Spring
		Autumn
		Winter
William Collins	:	Ode to Evening
William Blake	:	A Poison Tree
		The Tiger
		The Lamb
John Dryden	:	Preface to the Fables
Jonathan Swift	:	The Battle of the Books
Daniel Defoe	:	Robinson Crusoe
Addison and Steele	:	The Spectator and the Coverly Papers (Essays 1-10 Macmillan Edn.)
Samuel Johnson	:	Preface to Shakespeare
William Congreve	:	The Way of the World
R.B.Sheridan	:	The Rivals
Goldsmith	:	She Stoops to Conquer
Henry Fielding	:	Tom Jones

Unit 3 : Romantic Period

Wordsworth	:	Intimation Ode
		Tintern Abbey
Coleridge	:	Kubla Khan
		The Rime of the Ancient Mariner

P.B.Shelley	:	To a Skylark
John Keats	:	Ode to a Nightingale Ode on a Grecian Urn
Byron	:	Vision of Judgement
Charles Lamb	:	Essays of Elia 1. The South-Sea House 2. Dream Children : A Reverie 3. Christ Hospital Five and Thirty Years Ago 4. Oxford in the Vacation 5. All FoolsôDay
Wordsworth	:	Preface to the Lyrical Ballads
Walter Scott	:	The Heart of Midlothian
Jane Austen	:	Pride and Prejudice
Emily Bronte	:	Wuthering Heights

Unit 4 : Romantic Period

Tennyson	:	Ulysses The Lotus Eaters
Robert Browning	:	My Last Duchess Andrea Del Sarto
Matthew Arnold	:	The Scholar Gipsy Dover Beach
D.G.Rossetti	:	The Blessed Damozel
G.M.Hopkins	:	The Wreck of the Deutschland
Matthew Arnold	:	The Study of Poetry
Oscar Wilde	:	The Importance of Being Earnest
Charles Dickens	:	Great Expectations
Thomas Hardy	:	The Woodlanders

Unit 5 : Modern and Contemporary Periods

W.B.Yeats	:	Sailing to Byzantium
T.S.Eliot	:	The Waste Land
W.H.Auden	:	The Unknown Citizen
Philip Larkin	:	Church Going

C.B.Lewis	:	Fern Hill
T.S.Eliot	:	Tradition and the Individual Talent
E.M.Forster	:	(Selections from E.M.Forster. Edited by R.Krishnamoorthy & Published by Macmillan). 1. Notes on the English Character 2. My Wood 3. Hymn Before Action 4. Tolerance 5. What I Believe
G.B.Shaw	:	Arms and the Man
John Osborn	:	Look Back in Anger
T.S.Eliot	:	Murder in the Cathedral
D.H.Lawrence	:	The Rainbow
William Golding	:	Lord of the Flies
Joseph Conrad	:	Lord Jim

Unit 6 : American Literature

Emerson	:	Brahma
Poe	:	The Raven
Whitman	:	When Lilacs Last in the Dooryard Bloomôd
Emily Dickinson	:	Success is Counted Sweetest I Tasted a Liquor Never Brewed Because I Could not Stop for Death A Narrow Fellow in the Grass
Robert Frost	:	Mending Wall Stopping By Woods on a Snowy Evening
Wallace Stevens	:	The Emperor of Ice-cream
Emerson	:	The American Scholar
Henry James	:	The Art of Fiction
OôNeill	:	The Hairy Ape
Edward Albe	:	Whoôs Afraid of Viginia Woolfe
Hawthorne	:	The Scarlet Letter
Mark Twain	:	Huckleberry Finn
Ernest Hemingway	:	The Old Man and the Sea
Faulkner	:	The Sound and the Fury
Alice Walker	:	Color Purple

Unit 7 : Indian and English Literature

Toru Dutt	:	The Lotus Our Casuarina Tree
R.Parthasarathy	:	Under Another Sky A River Once
Sarojini Naidu	:	Indian Weavers

Kamala Dass	:	Introduction My Grandmotherȏs House
Nissim Ezekiel	:	Enterprise Night of the Scorpion
A.K.Ramanujan	:	Small Scale Reflections on a Great House Obituary
Sri Aurobindho	:	The Renaissance in India
Tagore	:	Post Office
Girish Kamard	:	Tughlaq
R.K.Narayan	:	The Guide
Chaman Nahal	:	Azadi
Deshpande	:	The Dark Holds No Terror
Arundathi Roy	:	God of Small Things

Unit 8 : Language and Linguistics

Family of Indo-European Languages
Foreign Influences
Word Making
Change of Meaning
Spelling Reforms
Standard English
Morphology
Basic Sentence Patterns
IC Analysis
Structural Linguistics
T.G. Grammar
English Language Teaching
Translation
Semantics, Pragmatics and Discourse
Descriptions and classification of Consonants and Vowels
Accent
Intonation
Phonetic Transcription
Writing a research paper: Bibliography, abstract, documentation, etc.,
Mechanics of thesis writing

Unit 9 : Criticism and Literary Theories

Aristotle	:	Poetics
Dr.Johnson	:	Life of Milton
T.S.Eliot	:	The Function of Criticism
I.A.Richards	:	Four Types of Meaning
Northrop Frye	:	The Archetypes of Literature
Lionel Trillin	:	The Meaning of a Literary Idea
Rolland Barthes	:	The Death of the Author

Wayne Booth	:	Telling and Showing
Edward Wilson	:	A Historical Interpretation of Literature
Derrida	:	Structure, Sign ad Play in the Discourse of Human Sciences
Terry Eagleton	:	Capitalism, Modernism and Post Modernism
Elaine Showalter	:	Towards a Feminist Poetics
Gayatri Spivak	:	Imperialism and Sexual Difference

Unit 10 : Post Colonial Literature and European Literature in Translation

A.G.Smith	:	Ode on the Death of William Butler Yeats Like an Old Proud King in a Parable.
Margeret at Wood	:	Journey to the Interior
P.K.Page	:	Adolescence
Wilfered Campbell	:	The Winter Lakes
George Ryga	:	The Ecstasy of Rita Joe
Margaret Lawrance	:	The Stone Angel
Ondaatje	:	Running in the Family
Sir Thomas More	:	Utopia
Moliere	:	The Misanthropist
Ibsen	:	A Dollṡ House
Wole Soyinka	:	The Lion and the Jewel
Chinua Achebe	:	Things Fall Apart

MATHEMATICS

Unit 1: Real Analysis

Finite-countable and uncountable sets,-Bounded and unbounded sets-Archimedean Property-Ordered field-Completeness of **R-**Extended real number system-Sequences and series-limsup and liminf of a sequence-convergence of sequences and series-uniform convergence-continuity of a function-types of discontinuities-uniform continuity-differentiability-Rolle's theorem-mean value theorem – monotone functions, functions of bounded variations,-Riemann Integral and its properties-Improper integrals and their convergence and uniform convergence- sequence of functions and series of functions-point wise convergence and uniform convergence-Bolzano-Weierstrass Theorem-Compact subsets of $\mathbf{R}^n$**-**Heine-Borel Theorem-Riemann-Stieltjes integral and its properties- partial, directional and total derivatives in $\mathbf{R}^n$**.**

Unit 2: Complex Analysis

Algebra of complex numbers, Riemann Sphere, Stereographic projection, lines, circles, cross ratio, Mobious transformation, Analytic functions, Cauchy-Riemann equations, line integrals, Cauchy's theorem for convex regions, Morera's theorem, Liouville's theorem, Fundamental Theorem of Algebra, Cauchy's Integral formula, power series representation, classification of singularities, Riemann theorem for removable singularities, Taylor's and Laurent's series expansions, maximum modulus principle. Schwarz lemma, Open mapping theorem, Contour integration, Conformal mapping, Entire functions, Harmonic functions, Elliptic functions, Analytic continuation.

3. Algebra

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, symmetric groups, alternating groups, simple groups, Sylow's theorem, Finite abelian groups, Rings, ideals, integral domains, polynomial rings, Euclidean ring, Principal ideal domains, Unique factorisation domains, Finite fields, Extension fields, Splitting fields, Galois Theorem.

Vector spaces, linear independence, bases, dimension, subspaces, quotient spaces, algebra of linear transformations, kernel, range, isomorphism, matrix representation of a linear transformation, change of bases, Dual bases, dual space, projection, transpose, trace, determinant, Hermitian, Unitary and normal transformations, eigen values and eigen vectors, Cayley-Hamilton theorem, Invariant subspaces, canonical forms: triangular form, Jordan form, rational canonical form.

4. Topology

Topological spaces-Basis for a topology-The product topology ï The subspace topology-Closed sets and limit points, Continuous functions-the product topology-The metric topology. Connected spaces-connected subspaces of the Real line ï Components and local connectedness, Compact spaces-compact subspaces of the Real lineï Limit Point Compactness ï Local Compactness. The Countability Axioms ï The separation Axioms ï Normal spaces ï The Urysohn Lemma ï The Tietze extension theorem.

5. Measure Theory and Functional Analysis

Measure Theory: Lebesgue Outer Measure-Measurable sets-Regularity ï Measurable Functions-Borel and Lebesgue Measurablility- Integration of Non-negative functions ï The General Integral ï Riemann and Lebesgue Integrals, Field of sets, sigma-field of sets, finitely additive set function and countably additive set function, measure, Measurable and measure spaces, Extension of measures, signed measures, Jordan, Hahn decomposition theorem, Monotone convergence Theorem, Fatouôs lemma, Dominated convergence theorem, absolute continuity, $\mathbf{L^p}$ spaces-Convex functions, Jensenôs inequality, Holderôs and Minkowskiôs inequalities, Radon-Nikodym derivative, Fubiniôs Theorem.

Functional Analysis: Normed Linear space-Continuous Linear Transformations ï Banach spaces-The Hahn-Banach Theorem ï The natural embedding of N in N** - Open mapping theorem ï Closed graph Theorem ï Uniform boundedness theorem ï conjugate of an operator ï Inner product space ï Orthogonalisation process ï Hilbert Space ï Orthonormal sets-Orthogonal complements ï conjugate space H* - Adjoint of an operator ï Self-adjoint ï Normal and Unitary Operators ï Projections.

6. Differential Equations

Ordinary Differential Equations : Second order homogeneous equations-Initial value problems-Linear dependence and independence-Wronskian and a formula for Wronskian-Non-homogeneous equation of order two. Homogeneous and non-homogeneous equation of order n ï Initial value problems- Annihilator method to solve non-homogeneous equation- Algebra of constant coefficient operators. Initial value problems ï Existence and uniqueness theorems- Solutions to solve a non-homogeneous equation ï Wronskian and linear dependence ï reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients ï The Legendre equation. Euler equation ï Second order equations with regular singular points ï Exceptional cases ï Bessel Function. Equation with variable separated ï Exact equation- method of successive approximations ï the Lipschitz condition-convergence of the successive approximations and the existence theorem.

Partial Differential Equations: Linear and non-linear first order partial differential equations – Second order equations in two independent variables – canonical forms – equations with constant coefficients - general solution. The Cauchy problem – Homogeneous wave equation – Initial Boundary value problem -Non- homogeneous boundary conditions – Non- homogeneous wave equation – Riemann method – Goursat problem – spherical wave equation – cylindrical wave equation. Separation of variable – Vibrating string problem – Existence and uniqueness of solution of vibrating string problem. – Heat conduction problem – Existence and uniqueness of solution of heat conduction problem – Laplace and beam equations. Boundary value problems – Maximum and minimum principles – Uniqueness and continuity theorem – Dirichlet Problem for a circle, a circular annulus, a rectangle – Dirichelt problem involving Poisson equation – Neumann problem for a circle and a rectangle. The Delta function – Green's function – Method of Green's function – Dirichlet Problem for the Laplace and Helmholtz operators.

7. Mechanics and Numerical Methods

Mechanics : Generalised coordinates - Constraints – Virtual work- Energy and Momentum, Derivation of Lagrange's equations-Examples – Integrals of motion. Hamilton's Principle – Hamilton's Equation – Other variational principle. Hamilton Principle function – Hamilton-Jacobi Equation- Separability, Differential forms and generating functions – Special Transformations-Lagrange and Poisson brackets.

Numerical Methods: Representation of numbers (binary, octal, decimal, hexadecimal) – Errors – Difference Table – Difference formula – Solution of non-linear equations: Bisection, secant, regula-falsi, Newton-Raphson, Fixed iteration. Solution of system of equations: Gauss Elimination, Jacobi, Gauss-Jordan, Gauss-Seidal, LU decomposition. Solution of ordinary differential equations: Taylor Series, Euler and modified Euler, Runge-Kutta method of order two and four, Milne-Simpson, Adams-Badsforth method.

8. Probability and Mathematical Statistics

Probability : Random events – Probability axioms – Combinatorial formulae – conditional probability-Bayes Theorem – Independent events – Random Variables – Distribution Function – Joint Distribution – Marginal Distribution – Conditional Distribution – Independent random variables – Function of random variables. Expectation – Moments – The Chebyshev Inequality – Absolute moments Cumulant Generating Function, Moment Generating Function and Probability Generating function – Properties of characteristic functions – Characteristic functions and moments – characteristic function of the sum of the independent random variables – Determination of distribution function by the Characteristic function - Probability generating functions. One point, two point, Binomial – Poisson distribution – Uniform (discrete and continuous) – normal-gamma distributions. Weak law of large numbers

– Central limit theorem (Lindberg Theorem and Lapunov Theorem) Borel-Cantelli Lemma – Kolmogorov Strong Law of large numbers.

Mathematical Statistics: Sampling: Sample mean, sample variance and their independence-Moments of sample mean and sample variance, t distribution, F distribution. Point Estimation : Unbiasedness, consistency, sufficiency, efficient and asymptotically most efficient-Method of moments: One parameter and two parameters cases-Maximum likelihood Estimation: One parameter and two parameter cases unbiasedness, mean square error, CR bound. Interval Estimation: Derivation of confidence interval:-The pivotal method, confidence limits, sample size, confidence interval for the normal distribution (mean, variance)-Confidence interval for Binomial and Poisson-Confidence interval for two sample problems (Two normal means, two population variances, two population propositions, two Poisson parameters, paired data). Hypotheses, test statistics, decision and errors: Hypotheses (Null, alternative, simple and composite), one sided and two sided tests, test statistics, errors (Type I and II errors), Best Test (smallest type-II error), p – values. Best Tests: Testing the value of a population mean, of population variance, of population proposition. Of the mean of Poisson. Best Tests: Testing the value of the difference between two population means, ratio of two population variances, difference between population propositions, difference between two Poisson means, paired data. Tests and confidence intervals: chi-square test, goodness of fit, contingency table for independence. ANOVA: One way and two way classifications.

9. Differential Geometry and Graph Theory

Space curve - Arc length – tangent – normal and binormal – curvature and torsion – contact between curves and surfaces- tangent surface – involutes and evolutes-Intrinsic equations – Fundamental Existence Theorem for space curves-Helics. Surface – curves on a surface – Surface of revolution – Helicoids – Metric – Direction coefficients – families of curves-Isometric correspondence- Intrinsic properties. Geodesics – Canonical geodesic equations – Normal property of geodesics- Existence Theorems – Geodesic parallels – Geodesics curvatures – Gauss-Bonnet Theorem – Gaussian curvature-surface of constant curvature. The second fundamental form-Principle curvature – Lines of curvature – Developable – Developable associated with space curves and with curves on surface – Minimal surfaces – Ruled surfaces. Compact surfaces whose points are umblics-Hilbert's lemma – Compact surface of constant curvature – Complete surface and their characterization – Hilbert's Theorem – Conjugate points on geodesics.

Graph Theory: Graphs and simple graphs – Graphs Isomorphism – The Incidence and Adjacency Matrices – Subgraphs – Vertex Degrees – Paths and Connections – Cycles – Trees – Cut Edges and Bonds – Cut Vertices. Connectivity - Blocks – Euler tours- Hamilton Cycles. Matchings – Matchings and Coverings in Bipartite

Graphs – Edge Chromatic Number. Vizing's Theorem. Independent sets – Ramsey's Theorem – Chromatic Number – Brooks' Theorem – Chromatic Polynomials. Plane and planer Graphs – Dual graphs – Euler's Formula – The Five – Colour Theorem and the Four-Colour Conjecture-Directed graphs.

10. Mathematical Programming and Fluid Dynamics

Convex sets-Hyperplane-Open and closed half spaces-Formulation of Linear Programming problem – Graphical solution – Types of solutions – Simplex procedure – method of penalty – Two – phase technique-special cases in simplex method applications – Duality – Economic Interpretation of duality- Dual Simplex method – Generalised simplex Tableau in Matrix Form – Efficient Computational algorithm – Transportation and Assignment problems as linear programming problems.

Fluid Dynamics : Real fluids and Ideal fluids- Velocity of a fluid at a point, Stream lines, path lines, steady and unsteady flows- Velocity potential – The vorticity vector – Local and particle rates of changes – Equations of continuity- Acceleration of a fluid – Conditions at a rigid boundary. Pressure at a point in a fluid at rest – Pressure at a point in a moving fluid -Conditions at a boundary of two inviscid immiscible fluids – Euler's equation of motion – Steady motion under conservative body forces. Sources, sinks and doublets – Images in a rigid infinite plane - Axis symmetric flows – Stokes stream function-Two dimensional flow – The stream function – The complex potential for two dimensional, irrotational in compressible flow- Complex velocity potentials for standard two dimensional flows – Two dimensional Image systems – The Milne Thomson circle Theorem. Stress components in a real fluid. Relations between Cartesian components of stress – Translational motion of fluid elements – The rate of strain quadric and principle stresses – Some further properties of the rate of strain quadric - Stress analysis in fluid motion – Relation between stress and rate of strain – The coefficient of viscosity and Laminar flow – The Navier – Stokes equations of motion of a Viscous fluid.

PHYSICS

Unit 1 : Mathematical Methods

Vector fields: Orthogonal curvilinear co-ordinate systems ï Expressions for gradient, divergence, curl and Laplacian- Linear vector spaces: Linear independence, basis, dimension, inner product ï Schwartz inequality ï Orthonormal basis ï Gram ï Schmidt orthogonalization process ï Linear operators ï Representation of vectors and operators in a basis ï Matrix theory- Cayley-Hamilton theorem ï Inverse of a matrix ï Diagonalisation of matrices ï Operational methods: Laplace transforms ï Solution of linear differential equations with constant coefficients ï Fourier integral ï Fourier transforms- Convolution theorems ï Applications ï Complex variables: Analytic function ï Cauchy-Riemann conditions ï Singular points- Multivalued function and branch points ï Cauchyôs integral theorem and formula ï Taylorôs and Laurentzôs expansions - Residue theorem and its applications.

Unit 2 : Classical Mechanics and Relativity

Lagrangian and Hamiltonian formulations ï Newtonôs equations and conservation laws for a system of particles ï DôAlembertôs principle and Lagrangeôs equations of motion ï Hamiltonian and Hamiltonôs equation of motion ï Application: Two-body central force problem ï Scattering by central potential, two particle scattering ï Cross section in Lab system-Small oscillations- Transformation to normal coordinates and frequencies of normal modes- Mechanics of rigid bodies: Angular momentum and kinetic energy ï Moment of inertia tensor ï Euler angels ï Eulerôs equation of motion ï Torque free motion ï Symmetric top ï Wave motion ï Phase velocity- Group velocity ï Dispersion ï Relativity: Special theory of relativity ï Lorentz transformation ï Addition of velocities ï Mass- energy equivalence.

Unit 3: Quantum Theory and its Applications

Basic principles: Wave ï particle duality ï Heisenbergôs uncertainty principle ï Postulates of quantum mechanics- Interpretation of wave function ï Schordingerôs wave equation and its application to particle in a box- Harmonic oscillator- tunneling through a barrier ï Motion in central field potential: Hydrogen atom ï angular momentum and spherical harmonics ï Addition of two angular momenta ï Approximate methods: Time independent perturbation theory for non-degenerate case ï application to anharmonic oscillator ï time dependent perturbation theory ï Fermiôs golden rule- Scattering theory: Scattering amplitude ï cross section ï Born approximation ï Partial wave analysis ï Identical particles and spin ï Symmetric and antisymmetric wave functions ï Representation theory ï Coordinate and momentum representations.

Unit 4: Electromagnetic Theory

Electrostatics ï Laplace and Poisson equations ï Boundary value problems ï Magnetostatics ï Ampereôs theorem-Biot- Savart law ï Electromagnetic induction ï Maxwellôs equations in free space and in linear isotropic media ï Boundary conditions on the fields at interfaces-Scalar and vector potentials ï Gauge invariance ï Electromagnetic waves- Reflection, refraction, dispersion, interference, diffraction and polarization- Electrodynamics of a charged particle in electric and magnetic fields ï Radiation from moving charges and from a dipole - Retarded potential.

Unit 5 : Thermodynamics and Statistical Mechanics

Laws of thermodynamics and their consequences ï Thermodynamic potentials and Maxwellôs relations ï Chemical potential and phase equilibria ï Phase space, microstates and macrostates- Partition function ï Free energy and its connection with thermodynamic quantities ï Classical and quantum statistics- Degenerate electron gas- Black body radiation and Planckôs distribution law ï Bose ï Einstein condensation ï Einstein and Debye models for lattice specific heat.

Unit 6 : Atomic and Molecular Physics

Quantum states of an electron in an atom ï Hydrogen atom spectrum ï Electron spin ï Stern-Gerlach experiment ï Spin - orbit coupling ï Fine structure ï Relativistic correction ï Spectroscopic terms and selection rules- Hyperfine structure- Exchange symmetry of wave functions ï Pauliôs exclusion principle - Periodic table ï Alkali-type spectra LS and JJ coupling ï Zeeman, Paschen ï Back and Stark effects ï X-rays and Auger transitions- Compton effect ï Principles of ESR, NMR - Molecular Physics: Covalent, ionic and Vander Waalôs interactions ï Rotation/vibration spectra ï Raman spectra ï Selection rules- Nuclear spin and intensity alternation ï Isotopic effects ï Electronic states of diatomic molecules ï Frank ï Condon principle ï Lasers: Spontaneous and stimulated emission ï Optical pumping ï Population inversion- Coherence (temporal and spatial) ï Simple description of ammonia maser ï co_2 and He-Ne lasers.

Unit 7 : Condensed Matter Physics

Crystal classes and systems ï 2d and 3d lattices ï Bonding in common crystal structures ï Reciprocal lattice ï Diffraction and structure factor - Elementary ideas about point defects and dislocations ï Lattice vibrations ï Phonons ï Specific heat of solids ï Free electron theory ï Fermi statistics ï Heat capacity ï Electron motion in periodic potential ï Energy bands in metals, insulators and semiconductors ï Tight binding approximation ï Impurity level in doped semiconductors ï Electronic transport from classical kinetic theory ï Electrical and thermal conductivities ï Hall effect and thermoelectric power ï transport in semiconductors ï Dielectrics ï

Polarization mechanism ï Clausius- Mossotti equation ï Piezo, pyro and ferroelectricity ï Dia and paramagnetism ï Exchange interactions ï Magnetic ordering : ferro, antiferro and ferrimagnetism ï Superconductivity: Basic phenomenology ï Meissner effect ï Type 1 and Type 2 superconductors ï BCS pairing mechanism.

Unit 8 : Nuclear and Particle Physics

Basic nuclear properties ï Size, shape, charge distribution, spin and parity ï binding energy ï empirical mass formula- liquid drop model ï Nuclear forces- Elements of two ï body problem ï Charge independence and charge symmetry of nuclear forces- Evidence of nuclear shell structure ï Single particle shell model ï Its validity and limitations ï Collective model ï Interactions of charged particles and e.m.rays with matter ï Basic principles of particle detectors ï Ionization chamber ï Proportional counter ï GM counter ï Scintillation and semiconductor detectors ï Radioactive decays: Basic theoretical understanding ï Nuclear reactions ï Elementary ideas of reaction mechanism ï Compound nucleus and direct reactions ï Elementary ideas of fission and fusion ï Particle Physics: Symmetries and Conservation laws ï Classification of fundamental forces and elementary particles ï Iso-spin ï Strangeness- Gell-Mann Nishijima formula ï Quark model ï C.P.T.invariance in different interactions ï Parity nonconservation in weak interaction.

Unit 9: Electronics

Physics of p-n junction ï Diode as a circuit element ï Clipping ï Clamping ï Rectification ï Zener regulated power supply ï Transistor as a circuit element - CC,CB and CE configuration ï Transistor as a switch, OR, AND, NOT gates ï Feedback amplifiers ï Operational amplifiers and its applications ï Inverting, non-inverting amplifier ï Adder ï Subtractor ï Integrator ï Differentiator ï Waveform generator ï Comparator ï Schmidt trigger ï Digital integrated circuits ï NAND and NOR gates as building blocks ï X- OR gate ï Simple combinational circuits ï Half and full adder ï Flip-flop ï Shift register ï Counters ï Basic principles of A/D and D/A converters- Simple applications of A/D and D/A converters ï Microprocessor 8085: Architecture ï Addressing modes ï Instruction sets ï Simple programming.

Unit 10 : Experimental Physics

Measurement of fundamental constants: e, h, c ï Measurement of high and low resistances, L and C ï Detection of X-rays, gamma rays, charged, particles, neutrons etc ï lionization chamber ï proportional counter ï GM counter ï Scintillation detectors ï Solid state detectors ï Emission and absorption spectroscopy ï Measurement of magnetic field. Hall effect ï Magnetoresistance ï X-ray and neutron diffraction ï Vacuum techniques ï Basic idea of conductance ï Pumping speed etc - Pumps: Mechanical pump ï Diffusion pump ï Gauges: Thermocouple ï Penning ï Pirani ï Hot cathode ï Low temperature: cooling a sample over a range upto 4 K and measurement of temperature ï Error analysis and hypothesis testing ï Propagation of errors ï Plotting of graph - Distributions ï Least squares fitting - Criteria for goodness of fits ï Chi square test.

CHEMISTRY

Unit -1

Analytical Chemistry: Classification of analytical Methods ï classical and instrumental. Errors and Evaluation: Definition of terms in mean and median ï Types of errors, propagation of errors, accuracy and precision, least squares analysis, average standard deviation.

Analytical Techniques: Principle and applications of adsorption, partition, ion exchange and solvent extraction chromatographic methods ï TLC HPLC and GC. Applications of atomic, molecular and emission spectroscopy in quantitative analysis Electroanalytical techniques ï cyclic and stripping voltametry, polarography, TGA, DTA, and DSC. Light scattering techniques including nepelometry and Raman spectroscopy.

Unit-2

Structure and Bonding: Atomic orbitals ï Types of chemical Bonds (weak and strong) intermolecular forces - Theories of bonding (VB and MO) - Concept of hybridization ï shapes of polyatomic molecules ï VSEPR theory ï Structure of simple ionic and covalent compounds ï lattice energy ï crystal defects ï Insulators and semiconductors, superconductors, Band theory of solids ï Solid state reactions.

Acids and Bases : Bronsted and Lewis acids and bases, pH and pKa, acid-base concept in nonaqueous media, HSAB concept, Buffer solution.

Redox Reactions: Oxidation numbers, Redox potential, electrochemical series, Redox indicators, Chemical principles involved in extractions and purification of Iron, Copper, Lead, Zinc and Aluminium.

Unit-3

Nuclear Chemistry: Radioactive decay and equilibrium, Nuclear reactions: Q valve, cross sections, types of reactions, Nuclear transmutations, fission and fusion Radioactive techniques-tracer technique, neutron activation analysis. G.M, Ionization and proportional counters. Radiolysis of water ï G value, dosimeters and Hydrated electron.

Chemistry of Non-transition elements: General properties and structure of their halides and oxides. Polymorphism of carbon, phosphorus and sulphur. Synthesis, properties and structure of boranes, carboranes and metallo carboranes - Wadeςs rule - preparation, properties and structure of borazines & phosphazenes.

Sulphur-nitrogen compounds-Oxides and oxyacids of nitrogen, phosphorous, sulphur and halogens. Interhalogen and noble gas compounds. Isopoly and heteropoly acids and salts.

Unit-4

Chemistry of Transition elements: Co-ordination Chemistry of transition metal ions-Wernerςs theory ï nomenclature and stereo chemistry of co-ordination compounds ï stability constants and their determinations ï CFT, splitting of d orbitals, CFSE, Jahn Teller effect, charge transfer spectra- spectrochemical series- Term states for d^n ions, Orgel and Tanable- sugano diagram, calculation of D_q B and б parameters.

Inorganic reaction mechanism: Inert and labile complexes-substitution reactions ï trans effect ï redox and electron transfer reactions. Photochemistry of chromium, ruthenium and cobalt complexes, Chemistry of lanthanides and actinides. Metal carbonyls and metal clusters, Organometallic reagents in organic synthesis- Cayatylic reactions- (hydrogeneation, hydroformylation, isomerization and polymerization) pi-acid metal complexes.

Bioinorganic Chemistry: Metal ions in Biology, Photosynthesis, PSL, PSH, Nitrogen fixation, Oxygen transport and storage, Hemeproteins haemoglobin, cytochrome and ferrodoxins.

Spectroscopy : Applications of nmr,nqr and esr to inorganic compounds.

Unit-5

Chirality. Differentiation of assymmetric and dyssymmetric molecules. Identification of prochiral carbons enantio and diastereoptropic hydrogens in a molecule. Stereochemistry of disubstituted four, five, and six membered saturated alicyclic molecules. Conformational analysis of mono and disubstituted cyclohexanes and piperidines. E-Z nomenclature for isomeric olefins. Stereochemistry of aliphatic nucleophilic substitutions in acyclic and bicyclic systems. Stereochemistry (specific or selective) of dihydroxylations, halogen addition, hydroborations and Diels Alder reaction of suitably substituted olefinic double bonds. Sterospecific E-2 eliminations in erythroï threo isomers. Reduction of ring substituted cyclohexanones to cyclohexanols.

Unit-6

Mechanism of SN-1, reactions in substrates with various types of NGP. Methods of generation and mechanisms of reactions proceeding via carbenes and nitrenes. Concreted reactions: Mechanism of electrocyclic and chelotropic reactions and sigmatropic rearrangements. Photochemical reactions: Mechanisms of Norrish ï I and II types, Paterno Buchi and Barton reactions, di-ɓ-methane rearrangements. Rearrangments: Mechanisms of rearrangements proceedings via carbonium ions (Wagner Meerwin pinacol ï pinacolone and Demjanov type) and electrophilic heteroatoms (Baeyer Villiger and Curtius type).
Mechanism of nucleophilic substitution in activated aryl halides. Regiochemistry of aryne generation and subsequent additions of o, m and p-substituted aryl halides.

Unit-7

Organic synthesis: Synthesis and any di and trisubstituted benzene derivatives from any mono substituted benzene or benzene itself. Synthesis of simple compounds using C-C bond forming reactions involving Wittig, Wittig Honner, Gilmann Reagents, organolithiums, Grignards, Robinson annulation, Dickmann condensation, Knovenagel, Mannisch, Stork enamine, and Vilsmeyer reactions and Umplolung. (1,3-dithane). Synthetic transformations involving Swern oxidation, Birch Wolf Kishner and metal hydride reductions, catalytic hydrogenations and reagents like tributyltin hydride, trimethylsilyl iodide, LDA, n-BuLi, Raney nickel, NBS Chromium reagents, DCC and Pd. Application of protective group concept (aldelydes, ketones and carboxylic acids) during multistep synthesis. Spectral identification of organic intermediates by IR (functional group) PMR and CMR and mass spectra. (simple molecules only).

Unit-8

Numbering and synthesis of unsubstituded (parent) and alkyl, aryl or acyl (wherever methods are available) substituted furans, pyrroles, thiophene, quionline, iso quinoline and indoles. Reactivity of these compounds towards electrophiles or necleophiles. A study of other non benzenoid aromatics (ferrocences, azulenes, annulenes and fulvenes).

Unit 9

Quantum Chemistry: Plancksô quantum theory, Compton effect, wave particle duality, uncertainty principle, operators: linear and Hermitian, Schrodinger wave equation, postulates of quantum mechanics. Application of Schrodinger equation to particle in a box, harmonic oscillator, rigid rotator and hydrogen atom. Angular momentum: commutation relation, spin orbit interaction Approximation methods: variation theorem, application of variation method to harmonic oscillator, hydrogen and helium atoms. Perturbation theory ï application to helium atom. Born ï Oppenheimer approximations: LCAO ï MO and VB treatments of H_2 molecule. Huckel theory: application to ethylene, butadiene and benzene. Calculation of

electron density and bond order. Semi empirical methods: Slater orbital and HF-SCF methods.
Macromolecules: Techniques, mechanism and kinetics of polymerisation, Kinetics of copolymerisation-Molecular weights and their determination. Properties of polymers: glass transition temp. crystallinity of polymers- polymer processing techniques.

Unit-10

Chemical Kinetics: Theories of reaction rate, collision theory, ARRT, comparison-potential energy surfaces- treatment of unimolecular reaction.

Complex reactions: simultaneous, parallel and consecutive reactions. Chain reactions: H_2-Cl_2 H_2ï Br_2 branching reaction- explosion limit.

Reactions in solution: factors determining reaction rate in solution, dielectric constant and ionic strength, Kinetic isotopic effect, Linear free energy relations. Hammett and Taft equations.

Homogenous Catalysis: acid base catalysis, enzyme catalysis Heterogeneous catalysis: Adsorption, Langmuir and BET adsorption isotherms ï mechanism of heterogeneous catalysis.

Thermodynamics: First and second Laws of thermodynamics- relation between c_p and c_v in terms of coefficients of expansion and compressibility. Maxwell relations-partial molar properties- GlibbsôDuhem equation- variation of chemical potential with temperature and pressure-fugacity- Third law and calculation of entropy.

Statistical thermodynamics: Maxwell Boltzmann, Bose-Einstein and Fermi-Dirac distribution- Partition function, translational, rotational and vibrational partition function, calculation of thermodynamic functions, equilibrium constant and heat capacity from partition functions. Einstein and Debye theories of heat capacity of solids., concept of negative absolute temperature.

Nonequilibrium, thermodynamics: Phenomenological laws- Onsagersô reciprocity relation- application to Diffusion potential, electrokinetic phenomena- entropy production.

Unit 11

Group theory: Symmetry elements and symmetry operations, point groups, reducible and irreducible representations ï Direct product representation. Orthogonality theorem and its consequences- construction of Character Tale (C_{2v} C_{3v} and C_{2h}) Applications: Selection rules for IR, Raman and electronic spectra, Determining Symmetries of normal vibrational modes of non linear molecules, construction of hybrid orbitals, application to electronic spectra of ethylene and formaldehyde.

Spectroscopy: Rotational Spectra of rigid and non-rigid diatomic rotors, simple polyatomic molecules.

Vibrational Spectra: harmonic and anharmonic oscillator, overtones, Fermi resonane-Raman Spectra. Vibration-rotation Spectra-PQR branches, parallel and perpendicular vibrations.

Electronic Spectroscopy: Spectra of diatomic molecules- Frank condon principle-Morse function. Polyatomic molecules, types of transition, solvent effects.

Spin resonance Spectroscopy: NMR: Origin of nmr signal, Chemical Shift, factors affecting chemical shift and spin spin coupling. NMR Spectra of simple AX and ABX type molecules. ^{13}C and ^{19}F nmr.

ESR: Origin, g-factor, hyperfine structure- Mc Connel equations, Theory and simple applications of Mossbauer and Photoelectron Spectroscopy.

Unit-12

Electrochemistry: Ion-solvent interaction- Born treatment- solvation number and its determination. Ion-ion interaction: activity co-efficient, Debye-Huckel equation for activity coeff - limitations and extension to concentrated solutions. Ion transport: Debye Huckel Orsager equation for conductance- experimental validity. Ion association: its effect on conductance and activity coefficient.

Electrode-electrolyte interface: Structure of double layer- electrode kinetics-overvoltage. Butler ï Volmer equation for one electron transfer. Corrosion and Stability of metals: construction and use of Pourbaix and Evansôdiagram-Prevention of corrosion, Primary and Secondary cells- Various fuel cells.

Photochemistry: Photophysical processes- Theory of radiationless transition-fluorscence, phosphorescence, fluorescence quenching- Stern-Volmer equation, excimer, exciplexes, Quantum yield measurement, Kinetics of Photochemical reac.