

Management

Unit – I

Management – Concept, Process, Theories and Approaches, Management Roles and Skills

Functions – Planning, Organizing, Staffing, Coordinating and Controlling. Communication – Types, Process and Barriers. Decision Making – Concept, Process, Techniques and Tools Organisation Structure and Design – Types, Authority, Responsibility, Centralisation, Decentralisation and Span of Control Managerial Economics – Concept & Importance

Demand analysis – Utility Analysis, Indifference Curve, Elasticity & Forecasting Market Structures – Market Classification & Price Determination National Income – Concept, Types and Measurement Inflation – Concept, Types and Measurement Business Ethics & CSR Ethical Issues & Dilemma Corporate Governance Value Based Organisation

Organisational Behaviour – Significance & Theories Individual Behaviour – Personality, Perception, Values, Attitude, Learning and Motivation Group Behaviour – Team Building, Leadership, Group Dynamics Interpersonal Behaviour & Transactional Analysis Organizational Culture & Climate Work Force Diversity & Cross Culture Organisational Behaviour Emotions and Stress Management Organisational Justice and Whistle Blowing Human Resource Management – Concept, Perspectives, Influences and Recent Trends Human Resource Planning, Recruitment and Selection, Induction, Training and Development Job Analysis, Job Evaluation and Compensation Management.

Strategic Role of Human Resource Management Competency Mapping & Balanced Scoreboard Career Planning and Development Performance Management and Appraisal Organization Development, Change & OD Interventions Talent Management & Skill Development Employee Engagement & Work Life Balance Industrial Relations: Disputes & Grievance Management, Labour Welfare and Social Security Trade Union & Collective Bargaining International Human Resource Management – HR Challenge of International Business Green HRM Accounting Principles and Standards, Preparation of Financial Statements

Financial Statement Analysis – Ratio Analysis, Funds Flow and Cash Flow Analysis, DuPont Analysis Preparation of Cost Sheet, Marginal Costing, Cost Volume Profit Analysis Standard Costing & Variance Analysis Financial Management, Concept & Functions

Capital Structure – Theories, Cost of Capital, Sources and Finance Budgeting and Budgetary Control, Types and Process, Zero base Budgeting

Leverages – Operating, Financial and Combined Leverages, EBIT–EPS Analysis, Financial Breakeven Point & Indifference Level.

Value & Returns – Time Preference for Money, Valuation of Bonds and Shares, Risk and Returns;

Capital Budgeting – Nature of Investment, Evaluation, Comparison of Methods; Risk and Uncertainty Analysis

Dividend – Theories and Determination

Mergers and Acquisition – Corporate Restructuring, Value Creation, Merger Negotiations, Leveraged Buyouts, Takeover

Portfolio Management – CAPM, APT

Derivatives – Options, Option Payoffs, Option Pricing, Forward Contracts & Future Contracts

Working Capital Management – Determinants, Cash, Inventory, Receivables and Payables Management, Factoring

International Financial Management, Foreign exchange market

Strategic Management – Concept, Process, Decision & Types

Strategic Analysis – External Analysis, PEST, Porter's Approach to industry analysis, Internal Analysis – Resource Based Approach, Value Chain Analysis

Strategy Formulation – SWOT Analysis, Corporate Strategy – Growth, Stability, Retrenchment, Integration and Diversification, Business Portfolio Analysis - BCG, GE Business Model, Ansoff's Product Market Growth Matrix

Strategy Implementation – Challenges of Change, Developing Programs McKinsey 7s Framework

Marketing – Concept, Orientation, Trends and Tasks, Customer Value and Satisfaction

Market Segmentation, Positioning and Targeting

Product and Pricing Decision – Product Mix, Product Life Cycle, New Product development, Pricing – Types and Strategies

Place and promotion decision – Marketing channels and value networks, VMS, IMC, Advertising and Sales promotion

Consumer and Industrial Buying Behaviour: Theories and Models of Consumer Behaviour

Brand Management – Role of Brands, Brand Equity, Equity Models, Developing a Branding Strategy; Brand Name Decisions, Brand Extensions and Loyalty

Logistics and Supply Chain Management, Drivers, Value creation, Supply Chain Design, Designing and Managing Sales Force, Personal Selling

Service Marketing – Managing Service Quality and Brands, Marketing Strategies of Service Firms
Customer Relationship Marketing – Relationship Building, Strategies, Values and Process
Retail Marketing – Recent Trends in India, Types of Retail Outlets.

Emerging Trends in Marketing – Concept of e-Marketing, Direct Marketing, Digital Marketing
and Green Marketing
International Marketing – Entry Mode Decisions, Planning Marketing Mix
for International Markets

Statistics for Management: Concept, Measures Of Central Tendency and Dispersion, Probability
Distribution – Binominal, Poison, Normal and Exponential Data Collection & Questionnaire Design
Sampling – Concept, Process and Techniques Hypothesis Testing – Procedure; T, Z, F, Chi-square
tests Correlation and Regression Analysis
Operations Management – Role and Scope Facility Location
and Layout – Site Selection and Analysis, Layout – Design and Process
Enterprise Resource Planning – ERP Modules, ERP implementation
Scheduling; Loading, Sequencing and Monitoring
Quality Management and Statistical Quality Control, Quality Circles, Total Quality Management – KAIZEN,
Benchmarking, Six Sigma; ISO 9000 Series Standards
Operation Research – Transportation, Queuing
Decision Theory, PERT / CPM.

International Business – Managing Business in Globalization Era; Theories of International Trade;
Balance of payment Foreign Direct Investment – Benefits and Costs
Multilateral regulation of Trade and Investment under WTO
International Trade Procedures and Documentation; EXIM Policies
Role of International Financial Institutions – IMF and World Bank
Information Technology – Use of Computers in Management Applications; MIS, DSS
Artificial Intelligence and Big Data
Data Warehousing, Data Mining and Knowledge Management – Concepts
Managing Technological Change

Entrepreneurship Development – Concept, Types, Theories and Process, Developing
Entrepreneurial Competencies
Intrapreneurship – Concept and Process
Women Entrepreneurship and Rural Entrepreneurship
Innovations in Business – Types of Innovations, Creating and Identifying Opportunities,
Screening of Business Ideas
Business Plan and Feasibility Analysis – Concept and Process of Technical, Market and Financial Analysis
Micro and Small Scale Industries in India; Role of Government in Promoting SSI
Sickness in Small Industries – Reasons and Rehabilitation
Institutional Finance to Small Industries – Financial Institutions, Commercial Banks,
Cooperative Banks, Micro Finance.

Chemistry

Physical Chemistry

Structure: Postulates of quantum mechanics. Operators. Commutation relations and expectations values; the role of the wave function and its absolute squares, time dependent and time independent Schrödinger equations. Born interpretation. Dirac bra-ket notation. Examples of model solvable quantum mechanical systems.

Particle in a Box: Solutions and interpretations for finite length and infinite potential barrier; concept of tunnelling; particle in 1D, 2D and 3D-boxes; applications.

Harmonic Oscillator: Exact solutions of wave functions, properties of Hermite polynomials. eigenvalues in one dimension. Calculation of expectation values for potential and kinetic energy, harmonic and anharmonic potentials.

Rotational Motion: Angular momentum operators (orbital and spin), spherical harmonics and their properties.

Hydrogen and Hydrogen-like Atoms: Atomic orbitals; radial and angular distribution functions and their probabilities; Atomic units, Multi-electron atoms: Orbital approximation; electron spin; Pauli exclusion principle; Slater determinants. Variational method and secular determinants; first order non-degenerate perturbation techniques.

Molecular Structure and Chemical Bonding: Born-Oppenheimer approximation; Valence bond theory treatment for hydrogen molecule and linear combination of atomic orbitals – molecular orbitals (LCAO-MO) theory.

Concept of hybridization and hybrid orbitals. Applications of LCAO-MO theory to H_2 , H_2^+ ; Molecular orbital

theory (MOT) of homo- and heteronuclear diatomic molecules. Hückel theory, applications to simple molecules, small conjugated π -electron systems.

Group Theory: Symmetry elements and symmetry operations. Basic postulates of groups and group multiplication tables. Classes, reducible and irreducible representations of symmetry elements. Classification and labelling of molecular point groups. Symmetry based selection rules and their application to electronic and vibrational spectroscopy. Internal coordinates and symmetry labelling of vibrational modes; symmetry adapted linear combination of atomic orbitals (LCAO-MO); construction of hybrid orbitals using molecular point group symmetry.

Spectroscopy: Atomic spectroscopy; Russell-Saunders coupling; Term symbols and spectral details; origin of selection rules. Rotational, Vibrational, Electronic and Raman spectroscopy of diatomic and simple polyatomic molecules. Line broadening and line widths; simple properties of Gaussian and Lorentzian line shapes. Molecular spectroscopy: Absorbance, Beer-Lambert's law, Einstein's coefficient, Jablonski diagram. Relationship of transition moment integral with molar extinction coefficient and oscillator strength. Basic principles of Nuclear Magnetic Resonance: Gyromagnetic ratio; Chemical shift, nuclear coupling.

Equilibrium: Laws of thermodynamics. Standard states. Thermochemistry. Thermodynamic functions and their relationships: Gibbs-Helmholtz and Maxwell relations, Gibbs-Duhem equation, Van't Hoff equation. Criteria of spontaneity and equilibrium. Absolute entropy. Partial molar quantities. Thermodynamics of mixing. Chemical potential. Fugacity, Activity and Activity coefficient. Chemical equilibria. Dependence of equilibrium constant on temperature and pressure.

Solutions: Ideal and non-ideal solutions, Raoult's Law and Henry's Law.

Electrochemistry: Standard electrode potential and electrochemical cells. Nernst Equation and its application, relationship between electrode potential and thermodynamic quantities, Potentiometric and conductometric titrations. Ionic mobility and conductivity. Kohlrausch's law, Debye-Hückel limiting law. Debye-Hückel-Onsager equation.

Phase Equilibria: Phase rule. Clausius- Clapeyron equation. Phase diagram of one component system: CO₂, H₂O, S; two component systems: liquid-vapor, liquid-liquid and solid-liquid systems. Fractional distillation.

Azeotropes and Eutectics.

Statistical Thermodynamics: Micro-canonical, Canonical and Grand canonical ensembles, Boltzmann distribution, Partition functions and thermodynamic properties. Statistical mechanics of non-interacting systems, ideal monoatomic, diatomic gases, translational, rotational, vibrational and electronic partition functions.

Kinetics and Reaction Dynamics: Elementary, parallel, opposing, and consecutive reactions. Steady state approximation. Mechanism of complex reactions. Unimolecular reactions. Potential energy surface and classical trajectories, Concept of saddle points, Transition state theory: Eyring equation, thermodynamic aspects. Kinetics of polymerization. Catalysis concepts and enzyme catalysis. Kinetic isotope effects. Fast reaction kinetics: relaxation and flow methods. Diffusion controlled reactions. Kinetics of unimolecular and bimolecular photophysical processes, Quantum yield calculation, static and dynamic quenching.

Surfaces and Interfaces: Physisorption and chemisorption. Langmuir, Freundlich and Brunauer-Emmett-Teller (BET) isotherms. Surface catalysis: Langmuir-Hinshelwood mechanism. Surface tension, viscosity, Self-assembly/ physical chemistry of colloids, micelles and macromolecules.

Inorganic Chemistry

Main Group Elements: Shapes and structures of molecules using VSEPR postulates, Hydrides, halides, oxides, oxoacids, nitrides, sulfides - shapes and reactivity. Structure and bonding of boranes, carboranes, silicones, silicates, boron nitride, borazine and phosphazenes: electron counting in polyhedral boranes, isolobal analogy. Allotropes of carbon, phosphorus and sulfur. Industrial synthesis of compounds of main group elements such as NH₃, H₂SO₄ and HNO₃. Chemistry of noble gases and interhalogen compounds. Acid-base concepts and principles (Lewis, Brønsted, HSAB and acid-base catalysis).

Transition Metals: Coordination chemistry – structure and isomerism, theories of bonding (VBT, CFT, and MOT). Metal-metal multiple bonds. Energy level diagrams in various crystal fields, CFSE, applications of CFT, Jahn-Teller distortion. Electronic spectra of transition metal complexes: spectroscopic term symbols, selection rules, Orgel and Tanabe-Sugano diagrams, nephelauxetic effect and Racah parameter, charge-transfer spectra. Magnetic properties of transition metal complexes. Ray-Dutt and Bailar twists, Reaction mechanisms: kinetic and thermodynamic stability, associative, dissociative substitution and redox reactions.

Lanthanides and Actinides: Recovery. Periodic properties, spectral and magnetic properties.

Organometallics: 18-Electron rule; metal-alkyl, metal-carbonyl, metal-olefin and metal-carbene complexes and metallocenes. Fluxionality in organometallic complexes. Types of organometallic reactions. Homogeneous catalysis – Hydrogenation, hydroformylation, methanol to acetic acid process, olefin metathesis and Wacker oxidation. Heterogeneous catalysis – Fischer-Tropsch reaction, Ziegler-Natta polymerization.

Bioinorganic Chemistry: Ion (Na^+ and K^+) transport, oxygen binding, transport and utilization, electron transfer reactions, nitrogen fixation, metalloenzymes containing magnesium, molybdenum, iron, cobalt, copper and zinc.

Solids: Crystal systems and lattices, Miller planes, crystal packing, crystal defects, Bragg's law, ionic crystals, structure of AX, AX₂, ABX₃ type compounds, spinels, band theory, metals and semiconductors, Zeolites and their applications.

Instrumental Methods of Analysis: UV-visible, fluorescence and FT-IR spectrophotometry, NMR and ESR spectroscopy, mass spectrometry, atomic absorption spectroscopy, Mössbauer spectroscopy (Fe and Sn) and X-ray crystallography. Electroanalytical methods – cyclic voltammetry, ion-selective electrodes. Thermo-analytical methods: TGA, DTA and DSC.

Organic Chemistry

General Concepts: Structure dependence on properties such as basicity and acidity. Role of aromatic stability on physical properties of organic compounds.

Stereochemistry: Chirality and symmetry of organic molecules with or without chiral centres and determination of their absolute configurations and optical purity. Relative stereochemistry in compounds having more than one stereogenic centre. Homotopic, enantiotopic and diastereotopic atoms, groups and faces. Conformational analysis of acyclic and cyclic compounds. Geometrical isomerism and optical isomerism. Configurational and conformational effects, atropisomerism, and neighbouring group participation on reactivity and selectivity/specificity. Stereoselective and stereospecific synthesis. Enantiomeric excess.

Reaction Mechanisms: Basic mechanistic concepts and energy profile diagrams - kinetics versus thermodynamic control, Hammond's postulate and Curtin-Hammett principle. Methods of determining reaction mechanisms through kinetics, identification of products, intermediates and isotopic labelling. Solvent effects in substitution and elimination reactions. Linear free-energy relationship – Hammett and Taft equations.

Types of Reactions: Nucleophilic and electrophilic substitution reactions (both aromatic and aliphatic). Addition reactions to carbon-carbon and carbon-heteroatom (N and O) multiple bonds. Elimination reactions. Reactive intermediates – carbocation, carbanion, carbenes, nitrenes, arynes and free radicals. Molecular rearrangements. Barton decarboxylation and Barton-McCombie reaction, Hunsdiecker reaction.

Organic Synthesis: Synthesis, reactions, mechanisms and selectivity involving the following classes of compounds – alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids, esters, nitriles, halides, nitro compounds, amines and amides. Uses of Mg, Li, Cu, B, Zn, P, S, Sn and Si based reagents in organic synthesis. Carbon-carbon bond formation through coupling reactions – Heck, Suzuki, Stille, Sonogashira, Negishi, Kumada, Hiyama, Tsuji-Trost reactions; olefin metathesis, McMurry coupling and Buchwald-Hartwig amination reactions. Baylis-Hillman, Henry, Ritter, Sakurai, Tebbe olefination, Pauson-Khand and Nazarov cyclization reactions. Concepts of multistep synthesis – retrosynthetic analysis, strategic disconnections, synthons and synthetic equivalents. Atom economy and green chemistry, Umpolung reactivity – formyl and acyl anion equivalents. Selectivity in organic synthesis – chemo-, regio- and stereoselectivity. Protection and deprotection of functional groups. Concepts of asymmetric synthesis – resolution (including enzymatic), desymmetrization and use of chiral auxiliaries, organocatalysis. Carbon-carbon and carbonheteroatom bond forming reactions through enolates (including boron enolates), enamines and silyl enol ethers. Stereoselective addition to C=O groups (Cram, Prelog and Felkin-Anh models). Asymmetric aldol reactions – Evans reaction and proline catalyzed reaction.

Oxidation: Oxidation of alcohols involving metal and non-metal-based (chromium, manganese, DMSO, and hypervalent iodine) reagents. Peracid oxidation of alkenes and carbonyls. Alkenes to diols (manganese and osmium-based reagents), alkenes to carbonyls with bond cleavage (ozonolysis), and alkenes to alcohols/carbonyls without bond cleavage (hydroboration-oxidation). Asymmetric epoxidations (Sharpless and Jacobsen) and Sharpless asymmetric hydroxylation.

Reduction: Catalytic homogeneous and heterogeneous hydrogenation. Metal based reductions using Li/Na in liquid ammonia, magnesium, zinc, titanium, and samarium. Hydride transfer reagents: NaBH₄, L-selectride, K-selectride, Luche reduction, LiAlH₄ and DIBAL-H. Pericyclic Reactions and Photochemistry: Electrocyclic, cycloaddition and sigmatropic reactions. Diels-Alder reaction, Claisen and Cope rearrangements and their applications in organic synthesis. FMO method of analysis. Woodward-Hoffmann rules. Photochemistry of alkenes, arenes and carbonyl compounds. Photo-oxidation and photo-reduction. Di- π -methane rearrangements, Norrish type-I and II reactions. Paternó-Büchi reaction, Photo-Curtius and Wolff rearrangements. Barton and Hofmann-Löffler-Freytag reactions.

Heterocyclic Compounds: Nomenclature of mono- and bicyclic, as well as mono- and di-heteroatomic compounds, Structure, preparation, properties and reactions of furan, pyrrole, thiophene, pyridine, indole, quinoline and isoquinoline.

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

Experimental Techniques in Organic Chemistry: Optical rotation (polarimetry). Application of various chromatographic techniques such as thin-layer, column, HPLC and GC. Applications of UV-visible, IR, NMR spectroscopy and Mass spectrometry in the structural determination of organic molecules

Physics

Measurements and Error Analysis

Units and dimensions, dimensional analysis; least count, significant figures; Methods of measurement and error analysis for physical quantities associated with various measurements; 2-probe and 4-probe methods for resistance measurement; Grounding for electrical circuits, Ground loops; Design of DC power supply, Signal processing through lock-in amplifiers.

Mathematical Physics

Linear vector spaces: basis, orthogonality and completeness; matrices: similarity transformations, diagonalization, eigenvalues and eigen vectors; linear differential equations: simple applications of first and second order linear differential equations and solutions; complex analysis: Cauchy-Riemann conditions, Cauchy's theorem, singularities, residue theorem and applications; Fourier analysis; tensors: tensor transformations, covariant and contravariant tensors.

Classical Mechanics

D'Alembert's principle, Euler-Lagrange equation, Hamilton's principle, calculus of variations; symmetry and conservation laws; central force motion: Kepler problem; small oscillations: coupled oscillations and normal modes; rigid body dynamics: inertia tensor, orthogonal transformations, Euler angles, torque free motion of a symmetric top; Hamiltonian and Hamilton's equations of motion; canonical transformations: Poisson bracket. Special theory of relativity: Lorentz transformations, relativistic kinematics, mass-energy equivalence.

Thermodynamics and Statistical Mechanics

Laws of thermodynamics; macrostates and microstates; phase space; 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, phase equilibria, critical phenomena.

Electromagnetic theory

Solutions of electrostatic and magnetostatic problems including boundary value problems; method of images; separation of variables; dielectrics and conductors; magnetic materials; multipole expansion; Maxwell's equations; scalar and vector potentials; Coulomb and Lorentz gauges; electromagnetic waves in free space, non-conducting and conducting media; reflection and transmission at normal and oblique incidences; polarization of electromagnetic waves; Poynting vector, Poynting theorem, energy and momentum of electromagnetic waves.

Optical Physics

Wave equation: plane and spherical waves, superposition of waves, standing waves, phase and group velocities; Interference: spatial and temporal coherence, dielectric films, Newton's ring, multiple-beam interference, Michelson interferometer, Fabry-Perot interferometer and etalon; diffraction: Fresnel and Fraunhofer diffraction, rectangular and circular aperture, Rayleigh criterion of resolution, diffraction from double slit and many slits. dispersion by a grating; polarization: Jones vectors and matrices for linear, circular and elliptical polarization,

birefringence, ray-transfer matrix for mirrors and lenses; lasers: Einstein coefficients, population inversion, two and three level laser systems.

Quantum Mechanics

Basic ideas of quantum mechanics; uncertainty principle; linear vectors and operators in Hilbert space; time independent Schrodinger equation; one dimensional potentials: step potential, finite rectangular well, tunnelling from a potential barrier, particle in 1,2,3-dimensional box, particle in single and double delta function potentials, 1,2,3 dimensional harmonic oscillator: concept of degeneracy; central potentials; hydrogen-like atoms; orbital and spin angular momenta; addition of angular momenta; variational method, time independent perturbation theory; elementary scattering theory, Born approximation.

Atomic and Molecular Physics

Spectra of one-and many-electron atoms; spin-orbit interaction: L-S and j-j coupling schemes; fine and hyperfine structures; Zeeman, Paschen-Back and Stark effects; electric dipole transitions and selection rules; rotational and vibrational spectra of diatomic molecules; electronic transitions in diatomic molecules, Franck-Condon principle; Raman effect and basics of Raman spectroscopy; NMR, ESR, X-ray and Mossbauer spectroscopies.

Solid State Physics

Elements of crystallography; diffraction methods for structure determination; bonding in solids; lattice vibrations and thermal properties of solids; free electron theory; band theory of solids: nearly free electron model; metals, semiconductors and insulators; conductivity, electron and hole statistics in intrinsic and extrinsic semiconductors, mobility and effective mass; metal-semiconductor junctions; ohmic and rectifying contacts; dielectric properties of solids; polarizability, ferroelectricity; magnetic properties of solids; dia, para, ferro, antiferro and ferri magnetism, ferromagnetic domains; superconductivity: type-I and type II superconductors, Meissner effect, London equation, BCS theory, flux quantization.

Nuclear and Particle Physics

Nuclear binding energy, electric and magnetic moments; semi-empirical mass formula; nuclear models; liquid drop model, 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; conservation laws, isospin symmetry, charge conjugation, parity and time-reversal invariance.

Electronics

p-n diodes, bipolar junction transistors, field effect transistors; negative and positive feedback circuits; oscillators, operational amplifiers and their applications, active filters; wave form generators: sine wave, square wave and triangular wave; basics of digital logic circuits, combinational and sequential circuits, flip-flops, timers, counters, registers, A/D and D/A conversion.

Mechanical Engineering

Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling resistance, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; plane trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations.

Mechanics of Materials: Stress and strain, elastic constants and their relationships; stress and strain components transformations in 2D; Mohr's circle for plane stress and plane strain; thin-walled pressure vessels; shear force and bending moment diagrams; bending and shear stresses; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; Mechanical properties of materials, toughness, hardness, impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations: Free and forced vibration of linear systems with single and two degrees of freedom, damping estimation and effects; vibration isolation, transmissibility ratio; resonance; critical speeds of shafts; Control system, PID controller, transfer function.

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

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; concept of velocity potential; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings; One dimensional high speed compressible fluid flow; flow through converging and converging-diverging nozzles.

Heat Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes; boiling and condensation; effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth, first and second laws of thermodynamics, calculation of work, heat, energy changes and entropy changes in various processes; application of first

and second laws for analysis of closed and open systems; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Applications: Power Engineering: vapour and gas power cycles, concepts of regeneration and reheat; I.C. Engines: Air-standard Otto, Diesel and dual cycles; Basics of Combustion: Air-Fuel Ratio, Equivalence Ratio; Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles, properties of moist air, psychrometric chart, basic psychrometric processes; Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines, steam and gas turbines, Air and gas compressors, pumps and pump characteristics

Materials, Manufacturing and Industrial Engineering

Engineering Materials: Crystal structure of common metals, phase diagrams, heat treatment; Properties and applications of engineering materials - metals and alloys, polymers, composites and ceramics; Engineering and true stress-strain diagrams.

Casting, Forming and Joining Processes: Different types of casting processes; Patterns, moulds and core; Solidification and cooling, riser and gating design, casting defects; Plastic deformation and yield criteria; Hot working and cold working; Principles of bulk forming and sheet forming processes and estimation of load in these processes; Fundamentals of powder metallurgy and its applications; Principles of welding, brazing, soldering; Solid-state welding processes, adhesive bonding; Non-destructive testing methods.

Machining and Machine Tool Operations: Basic machining operations and machine tools; Single-point and multipoint cutting tools; Geometry of single-point turning tools - ASA and ORS systems; Mechanics of machining; Cutting tool materials, tool life and tool wear; Economics of machining; Abrasive machining processes; Principles and applications of non-traditional machining processes; Principles of work holding, jigs and fixtures.

Additive Manufacturing: Principles of different types of additive manufacturing processes for engineering materials; Additively manufactured products – advantages, limitations, and applications.

Metrology and Inspection: Limits, fits and tolerances; Linear and angular measurements; Comparators; Interferometry; Form and finish measurement; Alignment and testing methods; Tolerance analysis in manufacturing and assembly; Principle of coordinate-measuring machine (CMM).

Computer Aided Manufacturing and Automation: Basic concepts of CAD/CAM and their integration tools; NC/CNC machines and CNC programming; Pneumatic, electro-pneumatic, and hydraulic actuators for automation; Programmable logic controllers.

Production Planning and Control: Work study, Productivity, Forecasting models, Aggregate production planning, Scheduling, Materials requirement planning, Six sigma, Lean manufacturing, Inventory Control – deterministic models, safety stock, inventory control systems, Quality and reliability concepts for product lifecycle analysis.

Operations Research: Linear programming, Simplex method, Transportation, Assignment, Network flow models, Simple queuing models, PERT and CPM.

Electronics and Communication Engineering

Networks, Signals and Systems

Circuit Analysis: Node and mesh analysis, superposition, Thevenin's theorem, Norton's theorem, reciprocity. Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, wye-delta transformation.

LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Continuous-time Signals: Fourier series and Fourier transform, Nyquist sampling theorem, sampling and reconstruction.

Discrete-time Signals: DTFT, DFT, z-transform, FIR and IIR filter design.

Electronic Devices

Formation of energy bands in solids, energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors.

Carrier Transport: Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers, Poisson and continuity equations.

P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, scaling in MOSFETs, LED, photo diode and solar cell.

Analog Circuits

Diode Circuits: Clipping, clamping and rectifiers.

BJT and MOSFET Amplifiers: Biasing, AC coupling, small signal analysis, frequency response. Current mirrors and differential amplifiers.

Op-amp Circuits: Amplifiers, summers, differentiators, integrators, active filters, Schmitt trigger and oscillators, dominant-pole (Miller) compensation, phase margin.

Digital Circuits

Number Representations: Binary, integer and floating-point- numbers. Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders.

Sequential Circuits: Latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.

Data Converters: Sample and hold circuits, ADCs and DACs. Semiconductor Memories: ROM, SRAM, DRAM.

Computer Organization: Machine instructions and addressing modes, ALU, data-path and control unit, instruction pipelining.

Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; compensators, PID controller; State variable model and solution of state equation of LTI systems.

Communications

Random Processes: Autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

Analog Communications: Amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

Information Theory: Entropy, source coding, mutual information and channel capacity theorem.

Digital Communications: PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER. Fundamentals of error correction, Hamming codes, CRC.

Electromagnetics

Maxwell's Equations: Differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

Plane Waves and Properties: Reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Transmission Lines: Equations, characteristic impedance, impedance matching, impedance transformation, Sparameters, Smith chart. Rectangular and circular waveguides, light propagation in optical fibers, dipole and monopole antennas, linear antenna arrays.

ELECTRICAL AND ELECTRONICS ENGINEERING

Electric circuits

Network Elements: Ideal voltage and current sources, dependent sources, R, L, C, M elements; Network solution methods: KCL, KVL, Node and Mesh analysis; Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer theorem; Transient response of DC and AC networks, sinusoidal steady-state analysis, resonance, two port networks, balanced three phase circuits, star-delta transformation, complex power and power factor in AC circuits.

Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits, Self and Mutual inductance of simple configurations.

Signals and Systems

Representation of continuous and discrete time signals, shifting and scaling properties, linear time invariant and causal systems, Fourier series representation of continuous and discrete time periodic signals, sampling theorem, Applications of Fourier Transform for continuous and discrete time signals, Laplace Transform and Z transform.

R.M.S. value, average value calculation for any general periodic waveform.

Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three-phase transformers: connections, vector groups, parallel operation; Auto-transformer, Electromechanical energy conversion principles; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, speed control of dc motors; Three-phase induction machines: principle of operation, types, performance, torque-speed characteristics, no-load and blocked-rotor tests, equivalent circuit, starting and speed control; Operating principle of single-phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance and characteristics, regulation and parallel operation of generators, starting of synchronous motors; Types of losses and efficiency calculations of electric machines.

Power Systems

Basic concepts of electrical power generation, AC and DC transmission concepts, Models and performance of transmission lines and cables, Economic Load Dispatch (with and without considering transmission losses), Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and

Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential, directional and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Control Systems

Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Stability analysis using Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, Solution of state equations of LTI systems.

Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multi-meters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Analog and Digital Electronics

Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers: characteristics and applications; single stage active filters, Active Filters: Sallen Key, Butterworth, VCOs and timers, combinatorial and sequential logic circuits, multiplexers, demultiplexers, Schmitt triggers, sample and hold circuits, A/D and D/A converters.

Power Electronics

Static V-I characteristics and firing/gating circuits for Thyristor, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost Converters; Single and three-phase configuration of uncontrolled rectifiers; Voltage and Current commutated Thyristor based converters; Bidirectional ac to dc voltage source converters; Magnitude and Phase of line current harmonics for uncontrolled and thyristor based converters; Power factor and Distortion Factor of AC to DC converters; Single-phase and three-phase voltage and current source inverters, sinusoidal pulse width modulation.

CIVIL ENGINEERING

Structural Engineering:

Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass.

Solid Mechanics: Bending moment and shear force in statically determinate beams; Transformation of stress (Mohr's circle); Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion; Combined stresses; Column buckling.

Structural Analysis: Principle of superposition; Work and energy methods: Principle of virtual work, Castigliano's second theorem; Deflections of statically determinate beams, frames, and trusses; Analysis of statically indeterminate structures by force and displacement methods (method of consistent deformations, slope-deflection method, moment distribution method); Influence lines and moving loads; Stiffness matrix method; Analysis of determinate arches and cables.

Concrete Structures: Working stress and limit state design concepts; Design and detailing of beams, slabs, columns, and isolated footings; Bond and development length.

Steel Structures: Working stress and limit state design concepts; Design of tension and compression members, beams and beam-columns, column bases; Connections – simple and eccentric, beam-column connections; Concept of plastic analysis – beams and portal frames.

Geotechnical Engineering:

Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability – one dimensional flow, Seepage through soils – two-dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One-dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters; Stress-strain characteristics of clays and sand; Stress paths.

Sub-surface investigations – Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories – Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Sheet Piles; Stress distribution in soils – Boussinesq's theory; Pressure bulbs; Shallow foundations – Terzaghi's and Meyerhof's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – static formulae, axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction; Ground improvement techniques.

Water Resources Engineering:

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics – Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles; Prismatic and mobile channels, steady and unsteady flows, rapidly varied flow and hydraulic jump; Flow past sharp crested weirs.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration; Streamflow measurements, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface runoff models, ground water hydrology – steady state well hydraulics and aquifers; Application of Darcy's Law.

Irrigation: Types of irrigation systems and methods; Crop water requirements – Duty, delta, evapo-transpiration; Gravity dams and spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures; River training structures; Earthen dams; Seepage through dams; Well irrigation.

Environmental Engineering

Water and Waste Water Quality and Treatment: Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Water requirement; Water distribution system; Drinking water treatment.

Sewerage system design, quantity of domestic wastewater, primary, secondary and tertiary treatment. Effluent discharge standards; Sludge treatment and disposal; Reuse of treated sewage for different applications.

Air Pollution: Types of pollutants, their sources and impacts, air pollution control, air quality standards, Air quality index 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); Basics of landfill design and operation.

Transportation Engineering

Transportation Infrastructure: Geometric design of roadways using IRC codes – crosssectional elements, sight distances, classifications of roadways, design vehicle, horizontal and vertical alignments.

Geometric design of railway Track – Speed and cant.

Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials – desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes.

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic

signs; Signal design by Webster's method; Types of intersections and interchanges; Highway capacity and level of service.

Transportation Planning: Four step travel demand modelling – trip generation, trip distribution, mode choice, traffic assignment and its applications.

Geomatics Engineering

Principles of surveying; Plane and geodetic surveying, GNSS surveying, errors and their adjustment; Maps – Scale, coordinate system; Distance and angle measurement – Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Principles of topographic, cadastral, engineering; Introduction to cartography, map projections.

Photogrammetry – Introduction to photogrammetry, digital photogrammetry, photographic scale, flying height; Space resection, parallax equations, elevations by parallax differences, camera calibration.

Construction Materials and Management

Construction Materials: Steel – Composition, material properties and behaviour; Cement – composition, hydration and microstructure, chemical and mineral admixtures; Concrete – Constituents, mix design, short-term and long-term properties.

Construction Management: Types of construction projects; Estimation and costing – Quantity estimation using long wall and short wall method, center line method, analysis of rates; Project planning and scheduling: AOA and AON network analysis – PERT and CPM; Project updating and monitoring; Construction equipment – Equipment for earthwork, concreting, hoisting and transportation of materials; Types of contracts.

COMPUTER SCIENCE AND ENGINEERING

Section 1:	Digital Logic
Boolean algebra and minimization – algebraic technique, Karnaugh map, tabular method. Design of combinational and sequential circuits. Number representation and arithmetic (fixed and floating point).	
Section 2:	Computer Organization and Architecture
Instruction set and addressing modes. Design of arithmetic and logic unit (ALU). Design of control unit – hardwired and microprogrammed. Memory interfacing and hierarchy: performance, cache memory mapping. I/O interface (interrupt and DMA). Instruction pipelining, pipeline hazards.	
Section 3:	Programming and Data Structures
Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.	
Section 4:	Algorithms
Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph traversals, minimum spanning trees, shortest paths.	
Section 5:	Theory of Computation
Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.	
Section 6:	Compiler Design
Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimisation, Data flow analyses: constant propagation, liveness analysis, common sub expression elimination.	
Section 7:	Operating System
System calls, processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU and I/O scheduling. Memory management and virtual memory. File systems.	

Section 8:	Databases
ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.	
Section 09:	Computer Networks
Principles of Layering; Basics of switching (circuit, packet and virtual circuit) and performance metrics; Data link layer: error detection, Medium Access Control, Ethernet; Distance vector and link state routing; IPv4 - Fragmentation, CIDR Notation, Network Address Translation; TCP- flow control and congestion control, socket API; DNS and HTTP.	

Malla Reddy (MR) Deemed to be University

Maisammaguda, Medchal-Malkajgiri, Telangana-500100

Research Methodology

Syllabus

(Common for all Engineering & Technology, Management & Humanities and Sciences)

Unit-I:

Meaning, Objective and Motivation in Research: Types of Research, Research Approaches, Research Process, Validity and Reliability in Research

Unit-II:

Research Design: Features of Good Design, Types of Research Design, Basic Principles of Experimental Design

Unit-III:

Sampling Design: Steps in Sampling Design, Characteristics of a Good Sample Design, Random Samples and Random Sampling Design

Unit-IV:

Measurement and Scaling Techniques: Errors in Measurement, Tests of Sound Measurement, Scaling and Scale Construction Techniques, Forecasting Techniques, Time Series Analysis, Interpolation and Extrapolation,

Unit-V:

Methods of Data Collection: Primary Data, Questionnaire and Interviews, Collection of Secondary Data, Cases and Schedules

Mathematical Sciences

Module-I:

Analysis

Elementary set theory; finite, countable and uncountable sets; real number system as a complete ordered field; Archimedean property; supremum and infimum. Sequences and series; convergence; limsup and liminf; Bolzano–Weierstrass theorem; Heine–Borel theorem.

Continuity; uniform continuity; differentiability; mean value theorem. Sequences and series of functions; uniform convergence. Riemann sums and Riemann integral; improper integrals.

Monotonic functions; types of discontinuity; functions of bounded variation; Lebesgue measure; Lebesgue integral.

Functions of several variables; directional derivative; partial derivative; derivative as a linear transformation; inverse and implicit function theorems. Metric spaces; compactness; connectedness. Normed linear spaces. Spaces of continuous functions as examples.

Module-II:

Linear Algebra

Vector spaces; subspaces; linear dependence; basis; dimension; algebra of linear transformations. Algebra of matrices; rank and determinant of matrices; linear equations. Eigenvalues and eigenvectors; Cayley–Hamilton theorem. Matrix representation of linear transformations.

Change of basis; canonical forms; diagonal forms; triangular forms; Jordan forms. Inner product spaces; orthonormal basis. Quadratic forms; reduction and classification of quadratic forms.

Complex Analysis

Algebra of complex numbers; the complex plane; polynomials; power series; transcendental functions such as exponential, trigonometric and hyperbolic functions.

Analytic functions; Cauchy–Riemann equations. Contour integral; Cauchy’s theorem; Cauchy’s integral formula; Liouville’s theorem; maximum modulus principle; Schwarz lemma; open mapping theorem. Taylor series; Laurent series; calculus of residues. Conformal mappings; Möbius transformations.

Algebra

Permutations; combinations; pigeonhole principle; inclusion–exclusion principle; derangements. Fundamental theorem of arithmetic; divisibility in $\mathbb{Z}$; congruences; Chinese Remainder Theorem; Euler’s ϕ -function; primitive roots.

Groups; subgroups; normal subgroups; quotient groups; homomorphisms; cyclic groups; permutation groups; Cayley’s theorem; class equations; Sylow theorems. Rings; ideals; prime and maximal ideals; quotient rings; unique factorization domain; principal ideal domain; Euclidean domain. Polynomial rings and irreducibility criteria. Fields; finite fields; field extensions; Galois theory.

Topology

Basis; dense sets; subspace and product topology; separation axioms; connectedness and compactness.

Module-III:

Ordinary Differential Equations (ODEs)

Existence and uniqueness of solutions of initial value problems for first-order ordinary differential equations; singular solutions of first-order ODEs; systems of first-order ODEs. General theory of homogeneous and non-homogeneous linear ODEs; variation of parameters; Sturm–Liouville boundary value problem; Green’s function.

Partial Differential Equations (PDEs)

Lagrange and Charpit methods for solving first-order PDEs; Cauchy problem for first-order PDEs. Classification of second-order PDEs. General solution of higher-order PDEs with constant coefficients. Method of separation of variables for Laplace, heat and wave equations.

Numerical Analysis

Numerical solutions of algebraic equations; method of iteration and Newton–Raphson method; rate of convergence. Solution of systems of linear algebraic equations using Gauss elimination and Gauss–Seidel methods. Finite differences; Lagrange, Hermite and spline interpolation. Numerical differentiation and integration. Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge–Kutta methods.

Module-IV:

Statistics and Probability

Descriptive statistics; exploratory data analysis. Sample space; discrete probability; independent events; Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables; marginal and conditional distributions. Characteristic functions. Probability inequalities (Markov, Jensen). Modes of convergence; weak and strong laws of large numbers; Central Limit Theorems (i.i.d. case).

Markov chains with finite and countable state spaces; classification of states; limiting behaviour of n-step transition probabilities; stationary distribution; Poisson and birth-and-death processes.

Standard discrete and continuous univariate distributions; sampling distributions; standard errors and asymptotic distributions; distribution of order statistics and range.

Methods of estimation; properties of estimators; confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests; likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large-sample tests.

Simple non-parametric tests for one- and two-sample problems; rank correlation and test for independence. Elementary Bayesian inference.

Operations Research

Linear programming problem; simplex methods; duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1; M/M/1 with limited waiting space; M/M/C; M/M/C with limited waiting space; M/G/1.

MRDU - Ph.D. Entrance Test (English Literature) Syllabus

Unit I: British Literature

- Chaucer to the Renaissance
- Restoration and Neo-Classical Age
- Romantic Literature
- Victorian Literature
- Modern and Contemporary Literature

Unit II: American Literature

- Poetry, Drama, Fiction and Prose
- Major Literary Movements and Writers

Unit III: Indian Writing in English

- Poetry, Drama, Fiction and Prose
- Indian Literary Criticism
- Translation Studies

Unit IV: Language and Linguistics

- History of English Language
- Phonetics and Phonology
- Morphology and Syntax
- Semantics and Pragmatics
- Sociolinguistics and Applied Linguistics

Unit V: Literary Criticism

- Classical Criticism
- Neo-Classical Criticism
- Romantic Criticism
- Victorian Criticism

- Modern Criticism

Unit VI: Literary Theory

- Structuralism and Post-Structuralism
- Deconstruction
- Marxism
- Feminism
- Psychoanalytic Criticism
- Reader-Response Theory
- New Historicism
- Postcolonial Theory
- Ecocriticism
- Queer Theory

Unit VII: Cultural Studies

- Gender Studies
- Popular Culture
- Media and Cultural Theory
- Subaltern Studies

Unit VIII: Commonwealth and Postcolonial Literatures

- African Literature
- Caribbean Literature
- Canadian Literature
- Australian Literature
- Diaspora Studies

Unit IX: World Literature and Comparative Literature

- Major World Authors and Texts
- Comparative Literature
- Translation Studies

