

GET- Civil

Structural Engineering

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

Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

Construction Materials and Management: Construction Materials: Structural Steel - Composition, material properties and behaviour; Concrete - Constituents, mix design, short-term and long-term properties. Construction Management: Types of construction projects; Project planning and network analysis - PERT and CPM; Cost estimation.

Concrete Structures: Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

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, plate girders and trusses; Concept of plastic analysis - beams and frames.

Geotechnical Engineering

Soil Mechanics: 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.

Foundation Engineering: 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; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

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 and secondary treatment. Effluent discharge standards; Sludge 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).

Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments.

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; Highway capacity.

Geomatics Engineering

Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Photogrammetry and Remote Sensing - Scale, flying height; Basics of remote sensing and GIS

GET- Mechanical

Applied Mechanics and Design

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

Mechanics or Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; 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; testing of materials with universal testing machine; testing of hardness and 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 single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

Machine 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, gears, 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; 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; basics of compressible fluid flow.

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, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, 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, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations,

Applications: *Power Engineering*: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. *I.C. Engines*: Air-standard Otto, Diesel and dual cycles. *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.

Materials, Manufacturing and Industrial Engineering

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

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. 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. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; 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, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.

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; concepts of coordinate-measuring machine (CMM).

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

Production Planning and Control. Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.

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

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

GET- Instrumentation

Electricity and Magnetism

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.

Electrical Circuits and Machines

Voltage and current sources: independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductance and capacitor; transient analysis of RLC circuits with dc excitation.

Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems.

Peak-, average- and rms values of ac quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements. transient analysis of RLC circuits with ac excitation.

One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Types of losses and efficiency calculations of electric machines.

Signals and Systems

Periodic, aperiodic and impulse signals; Laplace, Fourier and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

Control Systems

Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, PI, PID, cascade, feedforward, and ratio controllers, tuning of PID controllers and sizing of control valves.

Analog Electronics

Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of ideal and practical operational amplifiers; applications of opamps: adder, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, precision rectifier, active filters, oscillators, signal generators, voltage controlled oscillators and phase locked loop, sources and effects of noise and interference in electronic circuits.

Digital Electronics

Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flipflops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, Embedded Systems: Microprocessor and microcontroller applications, memory and input/output interfacing; basics of data acquisition systems, basics of distributed control systems (DCS) and programmable logic controllers (PLC).

Measurements

SI units, standards (R,L,C, voltage, current and frequency), systematic and random errors in measurement, expression of uncertainty - accuracy and precision, propagation of errors, linear and weighted regression. Bridges: Wheatstone, Kelvin, Megohm, Maxwell, Anderson, Schering and Wien for measurement of R, L, C and frequency, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

Sensors and Industrial Instrumentation

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (variable head, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement. 4-20 mA two-wire transmitter.

Communication and Optical Instrumentation

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, quadrature amplitude, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photodiode, light dependent resistor, square law detectors and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing. UV-VIS Spectro photometers, Mass spectrometer.

GET- Electrical

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.

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, 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, Economic Load Dispatch (with and without considering transmission losses).

Control Systems

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

Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, 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, 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.

GET- Chemical

Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and nonreacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Fluid Mechanics and Mechanical Operations

Fluid statics, surface tension, Newtonian and non-Newtonian fluids, transport properties, shell-balances including differential form of Bernoulli equation and energy balance, equation of continuity, equation of motion, equation of mechanical energy, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, velocity profiles, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Heat Transfer

Equation of energy, steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations; design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption, membrane separations(microfiltration, ultra-filtration, nano-filtration and reverse osmosis).

Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, kinetics of enzyme reactions (Michaelis-Menten and Monod models), non-ideal reactors; residence time distribution, single parameter model; non-isothermal

reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis; rate and performance equations for catalyst deactivation

Instrumentation and Process Control

Measurement of process variables; sensors and transducers; P&ID equipment symbols; process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; transducer dynamics; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Plant Design and Economics

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as heat exchangers and multistage contactors.

Chemical Technology

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers).

GET- Computer Science

New Age Technology: AI, ML, Data Science, Video Analytics, Block chain, RPA.

Digital Logic

Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Computer Organization and Architecture

Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining, pipeline hazards. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Programming and Data Structures

Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.

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

Theory of Computation

Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and contextfree languages, pumping lemma. Turing machines and undecidability.

Compiler Design

Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation. Local optimisation, Data flow analyses: constant propagation, liveness analysis, common subexpression elimination.

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.

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.

Computer Networks

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

GET- Metallurgy

Metallurgical Thermodynamics

Laws of thermodynamics: First law – energy conservation, Second law - entropy; Enthalpy, Gibbs and Helmholtz free energy; Maxwell's relations; Chemical potential; Applications to metallurgical systems, solutions, ideal and regular solutions; Gibbs phase rule, phase equilibria, binary phase diagram and lever rule, free-energy vs. composition diagrams; Equilibrium constant, Activity, Ellingham and phase stability diagrams; Thermodynamics of point defects, surfaces and interfaces, adsorption and segregation phenomena. Electrochemistry: Single electrode potential, Electrochemical cells, Nernst equation, Potential-pH diagrams

Transport Phenomena and Rate Processes

Momentum transfer: Concept of viscosity, shell balances, Bernoulli's equation, mechanical energy balance equation, flow past plane surfaces and through pipes. Heat transfer: Conduction, Fourier's Law, 1-D steady state conduction Convection: Heat transfer coefficient relations for forced convection Radiation: Black body radiation, Stefan-Boltzman Law, Kirchhoff's Law Mass transfer: Diffusion and Fick's laws, Mass transfer coefficients Dimensional analysis: Buckingham Pi theorem, Significance of dimensionless numbers Basic laws of chemical kinetics: First order reactions, reaction rate constant, Arrhenius relation, heterogeneous reactions, oxidation kinetics Electrochemical kinetics: Polarization

Mineral Processing and Extractive Metallurgy

Comminution techniques, Size classification, Flotation, Gravity and other methods of mineral beneficiation; Agglomeration: sintering, pelletizing and briquetting Material and Energy balances in metallurgical processes; Principles and processes for the extraction of nonferrous metals – aluminum, copper and titanium Iron and steel making: Material and heat balance in blast furnace; Structure and properties of slags and molten salts – basicity of slags - sulphide and phosphate capacity of slags; Production of metallurgical coke Other methods of iron making (COREX, MIDRE) Primary steel making: Basic oxygen furnace, process dynamics, oxidation reactions, electric arc furnace Secondary steel making: Ladle process – deoxidation, argon stirring, desulphurization, inclusion shape control, principles of degassing methods; Basics of stainless steel manufacturing Continuous Casting: Fluid flow in the tundish and mould, heat transfer in the mould, segregation, inclusion control

Physical Metallurgy

Chemical Bonding: Ionic, covalent, metallic, and secondary bonding in materials, Crystal structure of solids – metals and alloys, ionic and covalent solids, and polymers X-ray Diffraction – Bragg's law, optical metallography, principles of SEM imaging Crystal Imperfections: Point, line and surface defects; Coherent, semi-coherent and incoherent interfaces Diffusion in solids: Diffusion equation, steady state and error function solutions; Examples- homogenization and carburization; Kirkendall effect; Uphill diffusion; Atomic models for interstitial and substitutional diffusion; Pipe diffusion and grain boundary diffusion Phase transformation: Driving force, Homogeneous and heterogeneous nucleation, growth kinetics Solidification in isomorphous, eutectic and peritectic systems, cast structures and macrosegregation, dendritic solidification and constitutional supercooling, coring and

microsegregation Solid state transformations: Precipitation, spinoidal decomposition, ordering, massive transformation, discontinuous precipitation, eutectoid transformation, diffusionless transformations; Precipitate coarsening, Gibbs-Thomson effect Principles of heat treatment of steels, TTT and CCT diagrams; Surface hardening treatments; Recovery, recrystallization and grain growth; Heat treatment of cast iron and aluminium alloys Electronic, magnetic and optical properties of materials Basic forms of corrosion and its prevention

Mechanical Metallurgy

Strain tensor and stress tensor, Representation by Mohr's circle, elasticity, stiffness and compliance tensor, Yield criteria, Plastic deformation by slip and twinning Dislocation theory: Edge, screw and mixed dislocations, source and multiplication of dislocations, stress fields around dislocations; Partial dislocations, dislocation interactions and reactions Strengthening mechanisms: Work/strain hardening, strengthening due to grain boundaries, solid solution, precipitation and dispersion Fracture behaviour, Griffith theory, linear elastic fracture mechanics, fracture toughness, fractography, ductile to brittle transition Fatigue: Cyclic stress strain behaviour - low and high cycle fatigue, crack growth Mechanisms of high temperature deformation and failure; creep and stress rupture, stress exponent and activation energy

Manufacturing Processes

Metal casting: Mould design involving feeding, gating and risering, casting practices, casting defects Hot, warm and cold working of metals: Metal forming – fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming Metal joining: Principles of soldering, brazing and welding, welding metallurgy, defects in welded joints in steels and aluminum alloys Powder metallurgy: production of powders, compaction and sintering Non-destructive Testing (NDT): Dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle inspection methods

Assistant Officer –Commercial (Trainee)

UNIT:- Costing

Meaning of cost, Installation of costing system; cost unit, cost centres, classification of costing methods and techniques; elements of cost, preparation of cost sheet, Importance and need for material control; Material purchase procedure; Stores functions: receiving, inspecting, storing, issue of materials; materials costing – pricing of receipts, pricing of issues; LIFO and FIFO methods, stores ledger, inventory control techniques – EOQ, levels of inventory, ABC analysis, Perpetual Inventory System. Labour cost, remuneration and incentive different methods of labour remuneration, incentive schemes – (Halsey & Rowan). Labour turnover- causes and effects, and its measurement, Meaning of idle time, overtime, work study, method study, Time and Motion Study, Direct and Indirect Expenses, Treatment of Interest on capital, depreciation, idle facilities and research and development expenses, Overheads, Cost Records, Process & Contract Costing and preparation of Contract Account.

Standard costing and Variance Analysis

Relevant costs for decision making, Decision in pricing, product mix, make or buy, shut down etc. Value analysis, cost control and cost reduction, and productivity, cost efficiency and effectiveness. Cost accounting records and cost audit under companies Act 2013, cost accounting record Rules 2011, Cost compliance reports by cost accountants. Activity based costing; Target Costing, Life Cycle Costing, Throughput Accounting Human Resource Accounting; Environmental Accounting, Management Audit.

UNIT: Accounting Standards

Brief description of Indian Accounting Standards (AS 1, AS 2, AS 3, AS 6, AS 9, AS10, AS 14, AS 21); Compliance requirement of accounting standards; Applicability of accounting standards and their enforcement. International Accounting Standards Committee Foundation (IASCF) and its objectives and responsibilities; International Accounting Standards Board and its objectives and responsibilities; International Financial Reporting Interpretations Committee (IFRIC); Scope and process of issuing International Financial Reporting Standards (IFRS).

UNIT-Branch Accounting Meaning, need and objectives of branch accounting classification of branches for accounting purpose, System of Branch accounting; under Synthetic or Debtors system, analytical system or stock and debtors system; final accounting system and independent branch including foreign branch –accounting system.

UNIT –: Departmental Accounts and Valuation of Goodwill

(a) Meaning, objectives, system of preparation of departmental trading and profit and loss accounts, allocation of common expenses, inter-departmental transfer.

(b) Meaning and types of goodwill; need for valuation; methods of valuation, relevant provisions in Accounting Standards, Problems on valuation of Goodwill.

Unit- : Concept of Management Accounting

Meaning, Nature, scope and functions, Role of management accounting in decision making process, Management Accounting Vs financial accounting, different tools and techniques of management accounting, Use of accounting information for management purpose. Marginal Costing, Budget and Budgetary Control

Unit : The Conceptual framework for the preparation and presentation of financial statements conceptual framework: I. Issued by the ICAI, and II. Issued by the International Accounting Standards Board ('IASB') – under IFRS covering (i) objectives and users of financial statements, (ii) the reporting entity, (iii) the qualitative characteristics that determine the usefulness of information in financial statements, (iv) the definition of the elements of financial statements, (v) the recognition of the elements from which financial statements are constructed (vi) the measurement of assets and liabilities reported in financial statements and (vii) concepts of capital and capital maintenance.

Unit : Reporting Criteria: Criteria for information appearing in a published income statement and balance sheet; Reporting comprehensive income; Segmental reporting; Accounting policies; Directors' report; Notes to the accounts.

Application of Accounting Ratio's in Decision Making: 4 Predictive Value of Accounting Ratios. Ratio Analysis for Performance, Liquidity Analysis Application of Accounting Ratios in the Analysis of Working Capital and Inter Firm Comparison, Valuation of Assets, Liabilities and Owners' Equity; Application of relevant Accounting Standards.

Unit Financial Markets- Types; Money Market: Nature and Scope, Types of money markets and instruments: Call Money Market, Treasury Bill Market, Commercial Bills, Certificate of Deposits, and Repos.

UNIT : Cost of Capital: Cost of debt, cost of preference capital, cost of equity capital, cost of retained earnings, Weighted Average Cost of Capital, Beta estimation and cost of capital, Cost of equity using CAPM; Operating, financial and combined leverage. Capital Structure Theories: Net Income Approach, Net Operating Income Approach, Traditional Approach, Modigliani and Miller Approach.

UNIT: Appraisal Techniques of Capital Investment proposals: Payback Period, Discounted Payback, ARR, NPV, IRR, Profitability Index; Replacement of existing assets. Working capital management: Estimation of working capital; Receivables Management; Inventory Control and Management; Cash Management; Financing working capital: sources, regulation of bank finance and recommendations of various committees.

Unit : Investment: concept of investment, concept of portfolio management, phases of portfolio management; risk and return, types of risk, measurement of risk. Portfolio Analysis

Portfolio Revision: meaning, significance and strategies; portfolio evaluation meaning, performance measurement of portfolios, Sharpe's, Treynor's and Jensens's measure of portfolio performance, Derivative & evaluation of derivatives, options, futures, portfolio management using futures and options.

Unit: Tax planning and tax management- planning, tax evasion and tax avoidance.

Tax planning through selection of suitable form of business organization, selection of type of business and industry and location; diversion of income and application of income. Tax planning through the provisions of section 10 of the Income Tax Act. Relating to 'tax free incomes' - tax planning in regard to salary income of an individual; deductions and exemptions allowed in computing income from

salaries and income from house property. Tax planning in regard to setting up and dates of commencement of business, make or buy decision; valuation of stock and export and domestic sales decision. Capital assets in the context of capital gains and assets outside the purview of capital gainstaxation of long term and short term capital gains and exemptions thereof, for tax planning purposes. Tax planning in regard to residuary and non-residuary headings of income from other sources; taxability of interest on government securities and dividend from Indian companiesTax planning and clubbing of incomes under section 64 of the IT Act. Tax planning by a partnership firm . Tax planning by a company Fringe benefit tax.

Unit-: E-Commerce: E-business model based on relationship of transaction types- Brokerage Model, Aggregator Model, Info-mediary model, community model, value chain model; scope and promises of E-commerce, future of E-commerce. Technology in E-commerce: Privacy and Security in E-commerce: Security methods, Encryption and Authentication, E-payment Systems: Online payment categories, Micro payment system, E-cash –properties and legal issues, Idea of digital currency and E-cheque, Designing E-payment systems, E-banking

Assistant Accounts Officer

1. Applications of Accounting Standards:

AS 1 : 2: 3: 4: 5: 7: 9: 10, 11, 12: 13: 14, 16, 17, 18, 19,
20, 22, 24, 26, 29

2. Company Accounts

- (i) Preparation of financial statements – Statement of Profit and Loss, Balance Sheet and Cash Flow Statement;
- (ii) Managerial Remuneration;
- (iii) Profit (Loss) prior to incorporation;
- (iv) Accounting for Special Transactions:
- (v) Special Type of Accounting

3. The Companies Act, 2013 – Sections 1 to 148

Preliminary , Incorporation of Company and Matters Incidental thereto, Prospectus and Allotment of Securities, Share Capital and Debentures, Acceptance of Deposits by companies, Registration of Charges, Management and Administration, Declaration and payment of Dividend, Accounts of Companies, Audit and Auditors,

4.. The Indian Contract Act, 1872

5. The Negotiable Instruments Act, 1881:

6. The General Clauses Act, 1897:

7. Interpretation of statutes:

8. Ascertainment of Cost and Cost Accounting System

- a. Material Cost, Employee Cost, Overheads
- b. Concepts of Activity Based Costing (ABC)
- c. Recording and Accounting of Costs

9. Methods of Costing

- a. Single Output/ Unit Costing, Job Costing, Batch Costing, Contract Costing
- b. Process/ Operation Costing

10. Costing of Service Sectors

11. Cost Control and Analysis

- a. Standard Costing, Marginal Costing, Budget and Budgetary Control

12. INCOME TAX LAW

- Residential status and scope of total income
- Incomes which do not form part of total income (other than charitable trusts and institutions, political parties and electoral trusts)
- Heads of income and the provisions governing computation of income under different heads
- Income of other persons included in assessee's total income
- Aggregation of income; Set-off, or carry forward and set-off of losses
- Deductions from gross total income
- Computation of total income and tax liability of individuals
- Advance tax, tax deduction at source and introduction to tax collection at source
- Provisions for filing return of income and self-assessment

13. INDIRECT TAXES: Goods and Services Tax(GST) Laws

14. Special Aspects of Company Accounts

15. Reorganization and liquidation of Companies

16. Banking Companies and Non-Banking Financial Companies and regulatory requirements thereof.

17. Consolidated Financial Statements

18. Dissolution of partnership firms including piecemeal distribution of assets; Amalgamation of partnership firms; Conversion of partnership firm into a company and Sale to a company; Issues related to accounting in Limited Liability Partnership.

19. AUDITING AND ASSURANCE

20. STRATEGIC MANAGEMENT

1. Dynamics of Competitive Strategy
2. Business Level Strategies
3. Functional Level Strategies
4. Organisation and Strategic Leadership
5. Strategy Implementation and Control

21. FINANCIAL MANAGEMENT

1. Financial Management and Financial Analysis
 - (i) Financial Analysis through Ratios
 - a) Users of the financial analysis

- b) Sources of financial data for analysis
 - c) Calculation and Interpretation of ratios:
 - Analysing liquidity, Analysing leverage, Analysing solvency
 - Analysing efficiency/ activity, Analysing profitability
 - d) Limitations of ratio analysis
2. Financing Decisions
 - (i) Sources of Finance
 - (ii) Cost of Capital
 - (iii) Capital Structure Decisions
 - (iv) Leverages
 3. Capital Investment and Dividend Decisions
 - (i) Capital Investment Decisions
 - (ii) Adjustment of Risk and Uncertainty in Capital Budgeting Decision
 - (iii) Dividend Decisions
 4. Management of Working Capital

22. ECONOMICS FOR FINANCE

1. Determination of National Income
2. The Money Market
3. Public Finance
 - Fiscal functions: An Overview, Market Failure, Government Interventions to Correct Market Failure, Fiscal Policy
4. International Trade
 - Theories of International Trade, Trade Policy – The Instruments of Trade Policy
 - Trade Negotiations, Exchange Rates and its economic effects
 - International Capital Movements: Foreign Direct Investment