

SYLLABUS FOR WRITTEN TEST FOR MANAGEMENT TRAINEE POSTS
(POST/DISCIPLINE WISE)

Post	Stream (As per Advertisement)	Subjects/Topics
Management Trainee (Civil)	B.E. / B. Tech in Civil Engg.	• Engineering Geology • Building Technology and Architectural Planning • Mechanics of structure • Geotechnical Engineering • Concrete Technology • Infrastructure Engineering and Construction Techniques • Structural Design –I • Advanced Surveying • Project Management and Engineering Economics • Foundation Engineering • Environmental Engineering – I • Quantity Surveying, Contracts, and Tenders • Environmental Science • Engineering drawing • Introduction to Computing
Management Trainee (Chemical)	B.E. / B. Tech in Chemical Engg.	• Physical Chemistry • Process Calculations • Mathematics • Chemical Engineering Thermodynamics • Heat Transfer • Mass Transfer • Mechanical Operations • Process Instrumentation • Mass Transfer II • Chemical Reaction Engineering • Energy Technology and Management • Chemical Process Industries • Chemical Engineering Practice • Numerical Methods and Special Functions • Mass Transfer III • Chemical Reaction Engineering II • Process Design of Chemical Equipment • Process Dynamics & Control • Mechanical Design of Chemical Equipment • Industrial Management • Transport Phenomena • Chemistry ,Chemistry- II • Physics ,Physics-II • Introduction to Computing • Maths , Maths –II

Management Trainee (Mechanical)	B.E. / B. Tech (Mechanical/ Production Engg.)	• Environmental Science • Engineering Drawing • Introduction to Computing • Thermodynamics • Applied Thermodynamics • Strength of Materials • Manufacturing Process • Machine Design • Heat and Mass Transfer • Theory of Machines • Dynamics of Machine Elements • I C Engines • CAD / CAM • Automobile Engineering • Engineering Economy & Financial Management • Management Principles & Concepts • Mechatronics • Material Science • Measurements & Instrumentation • Probability & Statistics
Management Trainee (Electrical)	B.E. / B. Tech (Electrical / Instrumentation/ Electrical & Electronics / Electrical & Instrumentation)	• Basic Electrical and Electronics • Physics, Physics - II • Maths, Maths – II • Electrical Machines • Electromagnetic Theory • Electronic Devices • Control Systems • Electronic Instrumentation & Instrumentation Technology • Transducers and Measurement Systems • Power Electronics • Industrial Instrumentation & Control • Electric Circuits • Fluid Mechanics and Thermal Engineering • Microprocessor and Microcontroller • Biomedical Instrumentation • Industrial Automation (PLC, Pneumatics, Control Circuits, SCADA etc.) • Power System (Transformers, Transmission System, Circuit Breakers, Protection Devices etc.) • Electrical measurements and measuring instruments • Linear and digital IC applications (OPAMPS, Active Filters, Oscillators etc.) • Electrical circuit analysis (Single Phase, Three Phase Circuits, Network Topology etc.) • Basics of Industrial drives and controls
Management Trainee (Metallurgy)	B.E. / B. Tech (Metallurgy/ Material Science)	1. Physical metallurgy Atomic structure and interatomic bonding: Metallic, Ionic, covalent and secondary bonding of materials

		and their energies and properties. Structure materials (metals, alloys and polymers). Composite materials. Slip and twinning mechanisms. Miller indices, planar and linear density. Different types of solid solutions. Crystal imperfections in solids: Point defects, line, surface and volume defects. Diffusion in solids: Diffusion mechanisms, steady-state, and nonsteady-state diffusion (Fick's laws). Phase transformation and solidification: Homogeneous and heterogeneous nucleation, growth kinetics. Solidification of different alloy systems. Dendritic growth in pure metals and alloys. Constitutional super cooling, coring, micro and macro segregation Solid state transformations: Age hardening, spinoidal decomposition, massive and diffusionless transformations. Heat treatment of steels: CCT and TTT diagrams, annealing, normalising, hardening, hardenability, tempering and surface hardening of steels. Recovery, recrystallization and grain growth. Electronic, magnetic and optical properties of materials. Classifications of steels, cast irons and non ferrous metals and alloys. Oxidation and Corrosion: Forms of corrosion and its prevention. Corrosion kinetics, Cathodic and anodic protection. Galvanic series, EMF series, Pourbaix diagrams, polarisation diagrams and passivity, mechanisms, kinetics, pilling bedworth ratio and control of oxidation. Phase diagrams: Unary, binary and ternary phase diagrams. Invariant reactions. Phases in Fe-Fe₃C phase diagram. Tie-line and lever rule, Characterisation techniques: Principles and applications of Optical microscopy, X-Ray Diffraction and Scanning Electron Microscopy. 2. Mechanical Metallurgy Stress and strain relationships for elastic behaviour. Elements of theory of plasticity. Plastic deformation of single crystals, Dislocation theory, Strengthening mechanisms, fracture. Material testing: Tension, Hardness, torsion, Fracture mechanics, Fatigue of metals, Creep, stress rupture, brittle fracture and impact testing. 3. Manufacturing process Metal casting: Different types casting practices and casting defects. Plastic forming of metals: Fundamental of metal working, Forging, Rolling, Extrusion, drawing, sheet metal forming of metals/alloys. Metal joining: Fusion and solid state welding practices, advantages and disadvantages.
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		Powder metallurgy: Principles of different powder metallurgy practices. Compaction and different sintering practices. Non Destructive testing (NDT): Visual, Ultrasonic, dye-penetrant, radiography, eddy current, acoustic emission and magnetic particle inspection practices and its applications. 4. Mineral Processing and extractive metallurgy: Ores, minerals, particle size analysis, comminution techniques, Size classification, froth floatation, gravity concentration, dense medium separation magnetic and other mineral extraction practices. Material and energy balances. Processes and principles of extraction of copper, nickel, aluminium, titanium, tungsten. Iron and steel making practices, primary steel making, secondary steel making, degassing techniques and continues casting. 5. Thermodynamics of materials: laws of thermodynamics. Interpretation of entropy, enthalpy , heat capacity, Auxiliary functions, Maxwell relations, chemical potential, gibbs phase rule, phase equilibria , ideal and regular solutions, behaviour of gases, equilibrium constant, Ellingham and phase stability diagrams, binary phase diagrams. Electrochemistry: Nernst equation, different electrochemical cells. 6. Transport phenomena and rate processes: Conduction, convection, radiation. Different order reactions, reaction rate constants. Momentum, mass transfers and heat transfer.
Management Trainee (Ceramic)	B.E. / B. Tech in Ceramic Engg.	1) Structure and Properties of Ceramic Materials: Bonding in ceramics, various structures in ceramics, Defects in Ceramics, Diffusion in ceramics, Electrical properties, Mechanical properties, Thermal properties, Magnetic properties, optical properties. 2) Ceramic Phase diagrams and phase equilibria: - Phase rule, Phase equilibrium in a single component system, Clausius-Clapeyron equation, Phase equilibrium diagrams for Water, Silica, Zirconia. - Two Component systems: Cooling behaviour and phase compositions for important ceramic systems such as $\text{SiO}_2\text{-Al}_2\text{O}_3$, $\text{MgO-Al}_2\text{O}_3$, CaO-SiO_2, $\text{CaO-Al}_2\text{O}_3$, CaO-MgO etc. - Ternary System: Representation of composition on triangle, Liquidus projection, Isoplethal analysis, Iso-thermal Sections, Crystallization Paths. Cooling behaviour and

		phase compositions in important ternary systems such as CaO-SiO₂-Na₂O, MgO-SiO₂-Al₂O₃, SiO₂-FeO-Fe₂O₃, CaO-MgO-SiO₂. d) The application of phase diagrams in refractories 3) Phase Transformation: Review of Thermodynamics, Gibbs free energy-composition diagrams, stability criteria, metastability. Theory of nucleation. Solidification: Eutectic, Peritectic. Diffusional transformations in Solid: Eutectoid, Peritectoid, Precipitation, Ordering. Diffusion less Transformations: Martensitic Transformation. Spinodal decomposition, Glass Transition. 4) Sintering and Grain Growth: Kinetics and driving force for Solid State Sintering, liquid state sintering, vitrification. Coarsening and grain growth kinetics, Hot pressing and Hot Isostatic Pressing. 5) Techniques for Materials Characterization: a) Powder Characterization, b) Thermo- chemical Analysis: Principles of Differential thermal analysis (DTA), Thermogravimetric analysis (TGA) and Differential scanning calorimetry (DSC) and their applications in processing and Characterization of ceramics. c) X – Ray Diffraction d) Spectroscopy: IR spectroscopy and its application in structural analysis of ceramic systems. Optical systems and operation of FTIR. e) Electron Microscopy: SEM, TEM 6) Refractories: a) Introduction to refractories, selection of refractory raw materials b) Manufacturing and properties of silica, alumina, alumino-silicate, magnesite, magnesite-chrome, chrome-magnesite, magnesia-spinel, dolomite, forsterite, carbon, high alumina, high and low temperature insulating refractories. c) Properties and their measurement: High temper measurement ,PCE, HMOR, RUL , Physical properties: (porosity, bulk density, permeability, water absorption, specific gravity), Chemical properties: wet chemical analysis, x-ray fluorescence, evolution of hydration resistance, Mechanical properties:
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		compressive strength, bending strength, tensile strength, creep behaviour, elastic modulus, fracture toughness, abrasion resistance, Thermal properties: Thermal expansion, PLCR, thermal conductivity, thermal expansion and spalling. d) Monolithics refractories (castables, plastic and rammimg mixes, gunning mixes, refractory mortar) ceramic fibres, advantage of monolithic refractories over shaped refractories, insulating refractories of different kinds, their manufacturing and properties. Microstructural study and its importance to characterize refractory product observation of refractories, e) Carbon containing refractories (Magnesia-C, Dolomite-C), Al_2O_3-C for steel refining: (Al_2O_3-SiC-C and Al_2O_3-MgO-C), Al_2O_3-C for steel Casting: (slide gate, sliding nozzle, sliding valve plate), ladle shroud, submerged entry nozzles., Reaction of refractories by slags, flue gases glasses, CO, acid, alkali, corrosion of regenerator refractories by flue gases. f) Applications of refractories in electric arc furnace, ladles, continuous casting, refractory application in induction furnaces. 7) Steel Plant Refractories: a) Introduction to steel making and type of furnaces used at different stages, blast furnace, coke oven, requirements for refractory raw materials for steel production-modern trends. b) Details of electric arc furnaces, its variations, sequence of EAF operations c) Secondary steel making processes, ladle furnaces (L.F.), vacuum systems and vacuum treatment of steel, gases in steel, LF-VD processes and AOD, VOD, VAD techniques, influence of inclusions on mechanical properties of steel d) Ladle shroud, rinsing, slide plates, tundish, monoblock tundish stopper, submerged entry nozzle, casting, ingot casting: types of moulds, advantages and disadvantages. e) Identification of different refractory linings for primary and secondary steel making operations. f) Magnesite base refractories, dolomite, high alumina, composites, composites lining. g) Use of non-oxide ceramic materials in metallurgy. h) Non shaped refractories – classification,
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		castables of different types, high cement and low cement castables, no cement castables. Alumina spinel castables, repeated repair involving gunning. 8) Fuels, Furnaces and Pyrometry: Composition, classification and characterization of industrial fuels: coal and its qualities, petroleum, oil and natural gas, LPG, producer gas, water gas and carbureted-water gas. Chemistry of combustion, types of combustion, combustion of solids, liquid and gaseous fuels, fuels flame characteristics. Classification, design and description of different types of furnaces used in ceramic and metallurgical industries as tunnel kiln, chamber furnace, glass tank furnace, rotary kiln, roller hearth furnace, blast furnace, Electric Arc Furnace, Induction furnaces, open-hearth furnace, bessemer-converter, coke-oven batteries, Heat saving devices i.e. regenerators, recuperators. Preheating of air, gas and fuel oil, flame systems, temperature and its control. General idea of temperature measuring devices i.e. thermocouple, radiation and optical pyrometer. 9) Geology & Mineralogy: Interior & exterior of the earth, abundance of elements, Igneous & Sedimentary rocks, Concepts of petrology. Mineralogy: Definition, classification & composition of minerals, system of crystallization, physical properties of minerals as a tool of identification, optical properties of minerals, physical & optical properties of some important minerals. Structure: Fundamental principles of silicates structure, structure of Quartz & feldspar, clay minerals, talc, alumina, sillimanite minerals, magnesia. Silica & silicate minerals: Polymorphic forms of silica & their transformation. Different natural forms of silica of industrial importance – their properties & uses – quartzite, ganister, flint, silica sand. Properties, composition, effect of heat, use & availability of pyrophyllite, talc, sillimanite minerals, zircon etc. 10) Basics of Metallurgy: Steel making process, Classification of steels, Application of carbon steel, Influence of the constituents on steel, Alloy steel, Effect of alloying elements on steel.
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Management Trainee (Safety)	B.E. / B.Tech (Industrial Safety) or equivalent	• Factories Act, 1948 • Process Safety Management (PSM) • Principles of Safety • Safety in Electrical systems • Legal Aspects Safety, Health & Environment • Safety in Construction • Basics of Fire Safety Engineering • Occupational Health, Safety & Emergency procedures • Work Permit System & Unsafe Acts/conditions • Incident/Accident Investigation & Disaster Management System • Hazard Identification & risk Assessment (HIRA) • Basic importance of Personal Protective Equipments • Basics of ISO 45001:2018(OHSMS) • Basics of Environmental Management System (EMS)
Management Trainee (Admin/HR)	Degree Preferably in Engg/ Physical Science and 2 years post graduate degree in MA(IR&PM)/ MSW(IR&PM)/MBA (HR) or equivalent	• Human Resource Planning, Management and Development • Recruitment and Selection • Performance Management System • Competency Mapping and based HR Processes • Training and Development • Rewards and Recognition • Organisational structure and Design and Change Management • Organisational Behavior (Leadership,

		Personality, Motivation, Power, Conflict Management, Decision Making, Perception, Learning, Negotiation, Collective Bargaining, etc) • Industrial Relations & its mechanism, Trade Union Movement & Act, Principles of Natural Justice • Labour Codes & various Labour Laws and related provisions of Indian Constitution • Business Ethics, Corporate Governance & Social Responsibilities • MIS and HRIS • Government Guidelines on HRM • Welfare Measures • Discipline & Appeal Rules, Domestic Enquiry • Compensation Management and Wages/Salaries Administration
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