INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Engineer (RE- Civil)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

1: 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.

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

Finishing of floors, walls and grade slab of various buildings.

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.

2: 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.

Site levelling and Grading, earthwork calculations.

3: 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.

4: 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.

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off 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, evapotranspiration, Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

5: 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).

6: Transportation Engineering

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, 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; Highway capacity.

7: 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. DGPS survey, Topography using drones.

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

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Engineer (RE- Mechanical)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

1: Turbomachines

Classification - Basic laws and equations.
Hydraulic turbines; Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines.
Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps.
Centrifugal and axial flow compressors; slip, surging and choking.

2: Strength of Materials

Axial and shear stresses and strains
Shear force and bending moment diagrams for beams subjected to different types of loads – Theory of simple bending and assumptions.
Springs
Torsion of solid and hollow circular shafts – Power transmission, strength and stiffness of shafts.
Testing of Materials & Strength

3: Engineering Thermodynamics

Review of basic concepts of thermodynamics
Vapour power cycles - Rankine cycle - Otto, Diesel, dual, Stirling and Brayton cycles.

4: Thermal Engineering

Reciprocating air compressors - types - construction - Compressor efficiencies and mean effective pressure.
Working of two and four stroke engines for SI and CI engines

5: Material Science & Engineering Metallurgy

Atomic Arrangement and Phase Diagrams - Structure of metals and alloys, Critical temperature - Plain carbon steel and other steels.
Heat Treatment of steel.
Structure of Composites, Plastics, Adhesives
Corrosion & its Prevention
Testing of Materials - tensile testing procedure, stress strain curve Hardness testing, Fatigue testing: Creep testing.

6: Mechanics of Machines

Mechanisms - classification of mechanisms, Kinematic inversions, slider crank mechanism
Gears Trains - Law of gearing - profile for gears
Static and dynamic force analysis of mechanisms, Balancing of rotating/reciprocating masses, Governors
Vibrations - free and forced vibrations, degree of freedom; Vibration control - Passive and active control

7: Design of Mechanical Drives

Introduction to transmission elements - Positive and friction based drives.
Design of material handling & conveying systems - flat and V-belts, rope and chain drives.
Design of various types of gears - Force analysis
Design of Shafts, couplings, screws, fasteners

8: Fluid Mechanics

Basic concepts - Fluid properties - Basic hydrostatic equation - Submerged and floating bodies.
Hydrostatic equations for incompressible and compressible fluids
Buoyancy and equilibrium of floating bodies
Fluid dynamics - Laminar and turbulent flows - Flow through pipes, Boundary layer concept - Lift & Drag

9: Industrial Economics

Demand and Supply – Forecasting techniques – Cost and Revenues.
Trade cycle – Inflation – Index numbers – Capital budgeting – Cash flow analysis – Balance sheet.
Exchange Rate determination – Marketing research – Branding.

10: Renewable Energy

Solar energy - Solar radiation - Heat transfer equations - Solar thermal energy conversion - Efficiencies - Solar photo voltaic energy.
Wind energy - Data and energy estimation, Conversion - Wind mill - Performance, applications
Hydrogen & Fuel cell concepts
Bio energy - Conversion - bio degradation - Biogas generation - Fuel properties - Biomass gasifier.

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Engineer (RE- Electrical)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

- Design, erection, testing and commissioning of EHV and MV Substation/Switchyard, EHV and MV equipment like CT, CVT, CB, LA, ISOLATORS, EARTH SWITCHES etc., EHV & MV Transmission line, Power transformer, MV & LV Switchgear.
- Equipment and switchyard Earthing system design and philosophy.
- Lightning protection philosophy and design for substations/switchyards and buildings
- Numerical Protection system: Different types of protections for transmission Line, transformer, Switchyard, Switchgear, feeders and their working principle.
- Substation automation system and their working principle and communication protocols, data telemetry.
- Fundamental laws of electrical engineering circuit parameters, elementary network theory forced and transient response, sinusoidal steady state response three-phase circuits, magnetic circuit and transformers, Kirchhoff's Laws: KCL, KVL and their limitations.
- Classification of devices of an electrical circuit; Basic devices: resistors, controlled sources, diodes, capacitors and inductors, ideal transformers.
- Basic circuit analysis methods: nodal, mesh and modified nodal analysis. Transient analysis of RL, RC and RLC circuits.
- Network Theorems: superposition theorem, Thevenin-Norton theorem, substitution theorem, reciprocity theorem, Maxpower-transfer theorem, star-delta- transformation.
- Steady state sinusoidal analysis: phasors, phasor diagrams; Power in ac circuits, network analysis methods and network theorems recalled; Polyphase circuits. Circuits with ideal transformers.
- Semiconductor Diodes: Barrier formation in metal-semiconductor junctions, PN homo- and hetero-junctions; CV characteristics and dopant profiling; IV characteristics.
- Components of a power system; Modelling and representation of transformers, synchronous machines, and sub- systems; Per-unit representation. Transmission Lines: ABCD parameters; Classification; Travelling wave equation for a long line; Surge impedance; Voltage profile along the line; Ferranti effect; Steady-state performance - efficiency and regulation.
- Load-flow studies: Steady-state analysis of power network; Gauss-Seidel and Newton-Raphson methods; Reactive power compensation and Flexible AC Transmission Systems (FACTS) devices; Tap-changing and phase-shifting transformers. Penalty factors including real losses; Automatic generation and control; Steady-state analysis and dynamic response of a single area system. Fault analysis: Symmetrical 3-phase faults; Symmetrical components; Unsymmetrical faults. Transient stability studies: Swing equation Equal area criterion; Step-by-step solution of swing curve. Introduction to protection; Introduction to HVDC systems.
- Power electronic devices: Power diodes, power transistors, thyristors, GTO, their characteristics, ratings, protection, and cooling; Power circuit topologies: Series parallel operation of devices; Firing and typical control circuits.
- Power electronic converters: Phase controlled (AC/DC), 1-phase/3-Phase, semi/full; Analysis and performance with passive load, typical control circuit; Harmonics and power factor; Voltage controllers (AC/DC), 1-phase/3-phase.

- Network communication: Communication protocols, network topology, communication architecture, cyber security guidelines, firewalls, controllers, network switches, communication cables, instrumentation cables, concept of master slave, server-client.
- Design, erection, testing and commissioning of Power and control cables, battery system and energy management system, energy meters.

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Engineer (RE- Contracts & Materials)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

1: Basic Science and Concepts of Renewable Energy

Energy, Power and their SI units and relations. Types of Renewable Energy. Solar Energy, NP and PN Junctions, components in Solar Plant, Types of Modules, Monoperc, bifacial. Albido effect. Efficiency of Modules. Trackers. PR Ratio. PG Test and O&M in Solar Plants. Wind Energy, Components of Wind Energy, micro citing. Turbine Capacities. Onshore and Off-shore Wind Energy Plants. Concept of CUF. Waste Management in Renewable Energy Sector and its importance. Other types of Renewable Energy such as Geo Thermal, Tidal etc. Concept of International Solar Alliance.

2: Basic Concepts of C&M Functions

Types of tendering, open tender, limited tender, single tender etc. Invitation for Bids, Bid evaluation and award of contract. Qualifying Requirements. Price Variation Formulae. Reverse Auction and advantages and disadvantages of Reverse Auction. CVC guidelines for negotiation. Terms of payment. Billing Break up. Earnest Money Deposit, Performance Bank Guarantee.

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Engineer (RE- IT)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

- Programming C, Python and OOPS (Object Oriented Programming)
- Data Structures 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. Graph traversals, minimum spanning trees, shortest paths.
- Operating 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, SQL. Integrity constraints, normal forms.
- File organization, indexing, Transactions and concurrency control.
- Computer Networks OSI and TCP/IP Protocol, Data link layer, Routing protocols, Fragmentation and IP addressing, IP protocols, NAT, Transport layer, Application layer protocols.
- Web Technologies HTML, CSS, MVC Architecture (Model View Controller), HTTP methods.

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Executive (RE- Finance)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

1: Financial Accounting

- Accounting Standards
- Corporate Accounts
- Indirect & Direct - Tax Management
- Auditing
- Corporate & Industrial Laws

2: Cost & Management Accounting

- 02.1. Costing Techniques
- 02.2. Cost Audit
- 02.3. Project Planning, Financing, Analysis and Management
- 02.4. Quantitative Techniques
- 02.5. Operation & Project Management Control

3: Financial Management

- 03.1. Management Science
- 03.2. International Financial Management
- 03.3. Risk Management
- 03.4. Capital Market Analysis
- 03.5. Financial Derivatives
- 03.6. Security Analysis and Investment Management

4: General

- 04.1. Managerial Economics
- 04.2. Management Information Systems
- 04.3. Computer Applications in Business
- 04.4. Management Control System

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge

INDICATIVE SYLLABUS: Engineer / Executive on Fixed Term Basis (Advt. No. 01/25)

Syllabus for the post of Executive (RE- HR)

PART A (TECHNICAL/ SUBJECT KNOWLEDGE) (50 questions)

- Human Resource Management
- Human Resource Planning
- Recruitment & Selection
- Human Resource Development: Strategies and Systems
- Performance Management & Appraisal
- Competency Mapping
- Training and Development
- Management of Compensations and Benefits
- Rewards & Recognition
- Human Capital Management & HR Audit
- Organizational Structure Design/Development and Change
- Management Process and Organizational Behaviour
- Management of Change and Organization Effectiveness
- Managing Interpersonal and Group Processes
- Emotional Intelligence and Managerial Effectiveness
- Transactional Analysis
- Corporate Communication
- Industrial Relations & Trade Unions
- Labour Laws
- Conflict Management
- Collective Bargaining and Negations process
- Grievance Management
- Contemporary IR
- Business Ethics, Corporate Governance & Social Responsibility
- Understanding Society and Social Structure
- Computer Applications in Business
- Management Information Systems
- Human Resource Information System
- Total Quality Management (TQM)
- Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013

PART B (APTITUDE) (50 Questions)

This part will consist of **50 objective type** questions on:

1. Verbal Ability/General English
2. Quantitative Aptitude & Logical Reasoning
3. General Knowledge