

Syllabus for the Executive Trainees- Civil Engineering

Total Marks-150

Part A (120 Marks)

(1) Building Materials:

Stone, Lime, Glass, Plastics, Steel, FRP, Ceramics, Aluminum, Fly Ash, Basic Admixtures, Timber, Bricks and Aggregates: Classification, properties and selection criteria; **Cement:** Types, Composition, Properties, Uses, Specifications and various Tests; **Lime & Cement Mortars and Concrete:** Properties and various Tests; Design of Concrete Mixes: Properties of Concrete, workability of concrete, durability of concrete, Grades, Proportioning of aggregates and methods of mix design, Nominal Mix Concrete,

Production of concrete: Quality Assurance Measures, Batching, Mixing, formworks: Cleaning and Treatment of Formwork, Stripping Time, Transporting, placing, compaction and curing: transporting and handling, placing, compaction construction joints and cold joints, curing. concreting under special conditions: Work in Extreme Weather Conditions, Under-Water Concreting

(2) Solid Mechanics:

Elastic Constants, Stress, plane stress, plane strain, Mohr's circle of stress and strain, Elastic theories of failure, Principal Stresses, Bending, Shear and Torsion.

(3) Structural Analysis:

Basics of strength of materials, Types of stresses and strains, Bending moments and shear force, concept of bending and shear stresses; Analysis of determinate and indeterminate structures; Trusses, beams, plane frames; Rolling loads, Influence Lines, Unit load method & other methods; Free and Forced vibrations of single degree and multi degree freedom system; Suspended Cables; Concepts and use of Computer Aided Design.

(4) Design of Steel Structures:

Principles of Working Stress methods, Design of tension and compression members, Design of beams and beam column connections, built-up sections, Girders, Industrial roofs, Principles of Ultimate load design.

(5) Design of Concrete and Masonry structures:

Loads and forces: Dead Loads, Imposed Loads, Wind Loads and Snow Loads, Earthquake Forces, Shrinkage, Creep and Temperature Effects, Combination of Loads, Design Load, Limit state design for bending, shear, torsion, deflection, axial compression and combined forces; Design of beams: rectangular beams, T-Beams, L-beams, Deep Beams, Columns, Walls, Corbel, Solid Slabs, Ribbed Slabs, Flat slabs, Lintels, Foundations, retaining walls, Tanks: situated on the ground / underground and overhead, Staircases; Requirements governing reinforcement and detailing: Development of Stress in Reinforcement, Spacing of Reinforcement, Nominal Cover to Reinforcement, Minimum and maximum Requirements of Reinforcement for Structural Members. stability of the structure: Overturning, Sliding, Principles of pre-stressed concrete design including materials and methods; Earthquake resistant design of structures; Design of Masonry Structure.

(6) Construction Practice, Planning and Management:

Construction- Planning. Equipment, Site investigation and Management including Estimation with latest project management tools and network analysis for different Types of works; Analysis of Rates of various types of works; Tendering Process and Contract Management, Quality Control, Productivity, Operation Cost; Land acquisition; Labour safety and welfare.

(7) Flow of Fluids, Hydraulic Machines and Hydro Power:

(a) Fluid Mechanics, Open Channel Flow, Pipe Flow:

Fluid properties; Dimensional Analysis and Modeling; Fluid dynamics including flow kinematics and measurements; Flow net; Viscosity, Boundary layer and control, Drag, Lift, Principles in open channel flow, Flow controls. Hydraulic jump; Surges; Pipe networks.

(b) Hydraulic Machines and Hydro power:

Various pumps, Air vessels, Hydraulic turbines- types, classifications & performance parameters; Classification of hydroelectric Power plants on the Basis of Hydraulic Characteristics: Run of the river plants without pondage, Run of the river plant with pondage, storage reservoir plants, pumped storage plants, tidal plants; Classification of hydroelectric Power plants on the Basis of Operating Head on Turbines: Low head, Medium head and high head, Important Terms connected with Hydropower: Water Power Potential, Normal Water Level, Minimum & maximum Water Levels, Design head, rated head, Gross head, Installed Capacity of the Power House etc.; Principal Components of a Hydro-electric Scheme: Diversion structure, Intake structure, Surge tanks or surge chambers, Head race tunnel/channel, Penstocks, Hydraulic turbines, Power house, draft tubes, tail race, outlet gates, general arrangement of hydroelectric project and its operation, Power house- classification and layout, storage, pondage, control of supply.

(8) Hydrology and Water Resources Engineering:

(a) Hydrology:

Hydrological cycle, Ground water hydrology, Well hydrology and related data analysis; Streams and their gauging; River morphology; Flood, Flood Routing, Hydrograph, drought and their management; Capacity of Reservoirs, Tail Rating Curve.

(b) Water Resources Engineering:

Multipurpose uses of Water, River basins and their potential; Irrigation systems, water demand assessment; Resources - storages and their yields; Water logging, canal and drainage design. Hydraulic Jump and its usefulness in the Design of Irrigation Structures, Types of Dams: Gravity dams and their design, earthen Dams, Rockfill dams, Arch and Buttress Dams, Canal falls, Spillways, Energy dissipaters, theories of seepage and design of weirs & barrages, Intakes, trash racks, Pressure conduits: Water hammer pressure, Hydraulics of Flow and Discharging Capacities of Pressure Conduits; Distribution works, Cross drainage works and head-works and their design; Concepts in canal design, construction & maintenance; River training, measurement and analysis of rainfall.

(9) Environmental Engineering:

(a) Water Supply Engineering:

Sources, Estimation, quality standards and testing of water and their treatment; Rural, Institutional and industrial water supply; Physical, chemical and biological characteristics and sources of water, Pollutants in water and its effects, Estimation of water demand; Drinking water Standards, Water Treatment Plants, Water distribution networks.

(b) Waste Water Engineering:

Planning & design of domestic waste water, sewage collection and disposal; Plumbing Systems. Components and layout of sewerage system; Planning & design of Domestic Waste-water disposal system; Sludge management including treatment, disposal and reuse of treated effluents; Industrial waste waters and Effluent Treatment Plants including

(c) Solid Waste Management:

Sources & classification of solid wastes along with planning & design of its management system; Disposal system, Beneficial aspects of wastes and Utilization by Civil Engineers.

(d) Air, Noise pollution Ecology:

Concepts & general methodology.

(10) Geo-technical Engineering and Foundation Engineering:

(a) Geo-technical Engineering:

Soil exploration - planning & methods, Properties of soil, classification, various tests and inter-relationships; Permeability & Seepage, Compressibility, consolidation and Shearing resistance, Earth pressure theories and stress distribution in soil; Properties and uses of geo-synthetics.

(b) Foundation Engineering:

Types of foundations & selection criteria, bearing capacity, settlement analysis, design and testing of shallow & deep foundations; Slope stability analysis, Earthen embankments, Dams and Earth retaining structures: types, analysis and design, Principles of ground modifications.

(11) Surveying and Geology:

(a) Surveying:

Classification of surveys, various methodologies, instruments & analysis of measurement of distances, elevation and directions; Field astronomy, Global Positioning System; Map preparation; Photogrammetry; Remote sensing concepts; Survey Layout for culverts, canals, bridges, road/railway alignment and buildings, Setting out of Curves.

(b) Geology:

Basic knowledge of Engineering geology & its application in projects. Rocks: Their origin, structure, texture and classification & properties of igneous, sedimentary and metamorphic

rocks. Engineering classification of Rocks, Rock mass, Rock quality designation, Rock mass rating, Rock mass quality, Rock deformation: Folds, Faults, joints, unconformity and their classification, causes and relation to Civil engineering, Landslides, its causes, classification and preventive measures. Settlement & subsidence. Engineering. properties of rocks, Alkali aggregate reaction, Grouting, Geological investigations for site selection of Dams and reservoirs, tunnels, bridges and roads in hilly areas. Principles of Geophysical explorations methods for subsurface Investigation.

(12) Transportation Engineering:

Highways - Planning & construction methodology, Alignment and geometric design; Traffic Surveys and Controls; Principles of Flexible and Rigid pavements design.

Tunneling- Alignment, methods of construction, disposal of muck, drainage, lighting and ventilation.

Railways Systems- Terminology, Planning, designs and maintenance practices; track modernization.

Harbours-Terminology, layouts and planning.

Airports-Layout, planning & design.

Part B (30 Marks)

1. General Knowledge

2. General Aptitude

3. Reasoning

4. Mathematics

5. Language & Behavioural Aptitude