SYLLABUS FOR THE POST OF ASSISTANT EXECUTIVE ENGINEER / ASSISTANT ENGINEER (CIVIL)

1. CIVIL ENGINEERING MATERIALS AND CONSTRUCTION

Traditional materials: stone, brick, tiles-roofing and flooring, steel, timber, lime, cement, their manufacture, properties and codal requirements. Mortar, cement concrete, properties, specifications and tests for quality control. Reinforced concrete, fibre reinforced concrete and ferro-cement applications. Paints, enamels, varnishes, tar, bitumen, asphalt, properties and use. Modern materials: plastics, rubber, polymer, fibre reinforced plastics, manufacture, properties and use. Introduction to composites and smart materials.

Building Construction: Foundations; Stone Masonry; Brick Masonry -Rules for bonding, stretcher and header bonds and English Bond; Doors and Windows; Stairs - proportioning and designing of different types of staircases for residential and commercial buildings; Different types of roofs. RC Constructions - Lintels and sunshades, beams, one-way and two-way slabs. Plastering and pointing: types, preparation, properties, uses and defects. Formwork for construction. Damp proofing.

2. SOLID MECHANICS, STRUCTURAL ANALYSIS

SOLID MECHANICS: Fundamentals of force system. Concept of Rigid body and deformable bodies. Free body diagrams. Centroid and moment of inertia of plane areas. Simple stress and strain. Hooke's law. Mechanical properties of materials. Elastic constants. Simple flexure theory, Bending stress and shearing stress distribution across sections. Deflection of beams, Macaulay's method for deflection of statically determinate beams. Compound stresses - analytical method, graphical method - Mohr's circle of stresses. Torsion, transmission of power through hollow and solid shafts. Beams of uniform strength. Combined bending and torsion. Strain energy. Columns & struts. Elastic stability of columns. Bending moment and shear force diagrams for simply supported beams, cantilever beams and overhanging beams. Analysis of simple trusses.

STRUCTURAL ANALYSIS: Definition of statically determinate and indeterminate structures. Deflection of beams: moment area method, conjugate beam method, strain energy method and unit load method. Rolling loads and influence lines for statically determinate beams and bridge trusses. Three hinged arches, cables and suspension bridges. Analysis of indeterminate beams, frames and trusses: consistent deformation method, slope deflection method, moment distribution method, Kani's method. Plastic analysis of simple beams and frames.

3. CONCRETE TECHNOLOGY, REINFORCED CONCRETE STRUCTURES, STEEL STRUCTURES, PSC STRUCTURES

CONCRTE TECHNOLOGY: Concrete making materials - Manufacture of Cements, types of cements and aggregates, properties and testing, Water, admixtures. Fresh concrete, workability, compaction, curing. Strength of concrete, elasticity, shrinkage and creep. Durability of concrete. Testing of hardened concrete, destructive and non destructive testing methods, Concrete mix design, Quality control and acceptance criteria. Special Concretes. Concrete chemicals.

RC STRUCTURES: Strength properties and behaviour of concrete and reinforcing steel. Basic principles of working stress design. Limit state design concepts. Designing of members subjected to flexure, shear, torsion, axial forces and combinations, uniaxial and biaxial bending of columns. Design of simply supported and continuous beams and slabs; two way slabs, isolated and combined footings. Computation of deflection

and crack width. Design of staircases. Design of retaining walls - cantilever and counterfort type, Design of water tank- rectangular and circular tanks, underground and resting on ground. Design of framed structures.

STEEL STRUCTURES: General principles of elastic method of design of steel structures. Bolted and welded connections. Tension and compression members. Laterally supported and unsupported beams. Unsymmetrical bending. Built up beams. Plate girders. Members subjected to axial force and uniaxial and biaxial moments. Introduction to the limit state design philosophy of steel structures.

PSC STRUCTURES: Materials. Pre and post tensioning methods. Losses of prestress. Stresses in concrete due to prestress and loads. Prediction of long term and short term deflections. Limit state of collapse in flexure and shear. Limit state of serviceability. Transmission length. Anchorage zone stresses. Design of endblock. Design of pre and post tensioned beams. Analysis of composite beams.

4. FLUID MECHANICS, HYDROLOGY & WATER RESOURCES ENGINEERING

FLUID MECHANICS: Introduction and Terminology, Basic properties of fluids, Pressure and its measurement, Hydrostatic pressure on surfaces, Kinematics of fluid flow, Dynamics of fluid flow, Velocity and Accelerations, Stream Lines, Equation of Continuity, Bernouli's Equation, Irrotational and Rotational Flow, Velocity Potential and Stream Functions, Continuity, Momentum and Energy Equation, Navier Stoke's Equation, Euler's Equation of Motion, Application to Fluid Flow Problems, Pipe Flow, Darcy's Equation, Losses, Water hammer, Depth, velocity and Discharge measurements.

Dimensional analysis, Similitude and Model studies, Dimensionless Parameters, Laminar Flow Between Parallel, Stationary and Moving Plates, uniform flow in open channels, Non uniform flow, Critical flow, Rapid and gradually varied flow and its concept and Design, Hydraulic jump.

Centrifugal pumps- Vertical turbine pumps.

HYDROLOGY & WATER RESOURCES ENGINEERING: Hydrologic cycle, Water budget, Catchment. Precipitation: types, measurement, intensity, duration, temporal and spatial analysis. Infiltration, soil moisture, evaporation, transpiration, Groundwater. Runoff: components, factors, hydrographs, unit hydrograph, flood estimation. Irrigation: objectives, methods, irrigation water requirements. Components of irrigation system and design principles. Water Power Engineering: Basic principles, types of schemes.

5. HYDRAULIC STRUCTURES

Reservoir planning, Types and Design of Dams and Weirs, Types, methods and Design of Energy Dissipation Structures, Spillways- Types, Functions and Designs.

Flood control: Introduction, flood plain management, flood plain definition, hydrologic and hydraulic analysis of floods, storm water management. Flood control alternatives: structural and non-structural measures. Flood damage and net benefit estimation: damage relationships, expected damages, risk based analysis.

Canals – Types, Designs, Distribution Systems for Canal Irrigation, Canal Capacity, Canal Losses, Alignment of Canals, Most Efficient Section, Lined Canals, Their Design, Regime Theory, Critical Shear Stress, Bed Load, Design of Head Regulators Canal Falls, Aqueducts, Measuring Flumes, Canal Outlets, Sluice Gates, Gates for Outlet works, Valves for Outlet works, Canal drops, Escapes, CD Works, Design of river training works.

Retaining Walls, Bulk Heads, Rockfill Dam, Coffer Dam, Grouting.

Seepage and its control in Hydraulic structures. Failure and Restoration of Hydraulic structures.

Rivers, Their behaviour, Control and Training-River Morphology, Sedimentation of Reservoirs and Canals, Causes and Reclamation of Water Logged and Saline Soils for Agricultural purposes. Conjunctive Use of Surface and Groundwater in the command area.

Rain water harvesting.

6. SOIL MECHANICS AND FOUNDATION ENGINEERING

SOIL MECHANICS: Soil formation, Three phase system, Index properties of soils, Soil classification, Hydraulics of soils, Stress distribution in soils, Soil compaction, One dimensional consolidation, Effective stress and pore water pressure, Shear strength of soils. Soil exploration, Earth pressure and its determination. Bearing capacity - Theoretical methods and Insitu tests, Stability of slopes by various approaches, Load carrying capacity of single and group of piles. Ground improvement techniques.

FOUNDATION ENGINEERING: Loads for foundation design, Depth of foundation, proportioning of footings, Geotechnical and structural design of isolated, combined and raft foundations. Analysis of pile groups. Design of piles and pile cap. Design of cantilever, counterfort and soil reinforced retaining walls.

7. TRNSPORTATION ENGINEERING

Introduction and Terminology, Principles of transportation engineering.

Traffic Engineering: Vehicular and road user characteristics, traffic studies, junctions and signals, traffic control devices

Highway alignment and geometric design: Highway alignment, cross-sectional elements, horizontal alignment and vertical alignment

Highway design and construction: design of flexible and rigid pavements, WBM and bituminous concrete roads and highway maintenance, highway drainage.

Railways: Rail gauges; coning; adzing; railway track components, functions, requirements, and width of formation; creep; tractive resistance; geometric design; points and crossings; stations and yards; signaling and interlocking.

Docks & Harbors: Types of harbors, tides, wind and waves, breakwaters, docks, quays, Transit sheds, warehouses, navigational aids

Tunnels: Introduction to tunneling, tunneling through soils, soft and hard rocks, tunnel ventilation

Airports: Introduction to airport planning and development, Airport design standards

8. ENVIRONMENTAL ENGINEERING

Essentials of water and wastewater engineering systems, quantities, sources, water distribution systems, planning and analysis. Wastewater collection. House drainage. Water and wastewater characteristics. Drinking water standards. Unit operations and processes of water and wastewater treatment. Design of treatment units.

Water pollution control: Effluent standards. Disposal of wastewater. Stream sanitation. Water quality indices; Solid waste management: Characteristics, treatment disposal; Air Pollution Control: Sources and Characteristics, effects, Control; Noise Pollution Control, measurement & analysis; Hazardous solid waste: Classified wastes, Disposal of hospital wastes; EIA: Introduction, case studies

9. SURVEYING

Introduction and Terminology, Basic Principles of Surveying, Measurement of horizontal distances, Chain surveying, Compass surveying, Compass traversing, Introduction to leveling, Reduction of leveling, Contouring, Plane table surveying, Theodolite surveying, Trigonometric leveling.

Tacheometry, Curve setting, Computation of area and volumes, Electronic Distance measurement, Hydrographic surveying, Photogrametry and Remote sensing, Preparation of Maps, Map Reading, Errors and its Classification, Precision and Accuracy, Probability Analysis.

Principles and uses of Electronic Theodolite, EDM, Total station, Features of Total Station, Characteristics of Total Station, Modern Surveying, Remote Sensing (RS), Global Position System (GPS), Maps, Global Information System (GIS) Systems.

10. BRIDGE ENGINEERING

Bridge site investigation and planning, bridge hydrology, Standards of loading for highway and railway bridges, Culverts, bridge superstructures, Design of R.C.C. beam and slab bridges, load distribution methods, Bearings, Design of bridge substructures and foundations, Design principles of prestressed concrete, steel and composite bridges, Introduction to cable stayed and suspension bridges, flyovers, temporary and movable bridges, construction and maintenance of bridges and flyovers.

11. ESTIMATION, COSTING AND SPECIFICATIONS

Methods of estimating, line estimate and detailed estimate, measurements, taking out quantities, typical estimates for buildings, and Civil Engineering works, Specifications for all types of building items. Analysis of rates, data for various building items, Earthwork calculations. Valuation of buildings.

12. CONSTRUCTION AND PROJECT MANAGEMENT

Introduction: project forms, management objectives and functions, Organizational chart of a construction company, Manager's duties and responsibilities; public relations; Leadership and team - work; ethics, morale, delegation and accountability.

Man and Machine: Man-power planning, training, recruitment, motivation, welfare measures and safety laws.

Machinery for Civil Engineering: Earth movers and hauling costs, factors affecting purchase, rent, and lease of equipment, and cost-benefit estimation.

Planning, scheduling and Project Management: Planning stages, construction schedules project specification, monitoring and evaluation; Bar-chart, CPM, PERT, network- formulation and time computation.

Departmental Procedures: specifications, tendering, contracting and arbitration.

13. ENVIRONMENTAL STUDIES

Definition, scope and importance of Environmental Studies, Need for public awareness. Natural Resources Renewable and Non-renewable Resources. Natural resources and associated problems. Concept of an ecosystem: Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains and ecological pyramids, Biodiversity and Its Conservation, Environmental Pollution: Definition, Causes, effects and control measures. Pollution case studies. Disaster management, Social Issues and the Environment, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation, Consumerism and waste products, Acts related to Environment Protection, Issues involved in enforcement of environmental legislation, Human Population and the Environment.