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Bihar Public

Service Commission

(BPSC Mains)

Optional Subject -

Civil Engineering

CIVIL ENGINEERING

Section- I

Part- A Theory and Design of Structures:

(a) Theory of structures: Energy theorems – Castigliano theorems I and II, unit load method and method of consistent deformation applied to beams and pinjointed plane frames, Slope deflection, moment distribution and Kani method of analysis applied to indeterminate beams and rigid frames. Moving loads, criteria, for maximum shear force and bending moment in beams traversed by a system of moving loads. Influence Lines for simply supported plane pinjointed girders. Arches: Three hinged, two hinged and fixed archesrib shortening and temperature effects Influence lines. Matrix methods of analysis: Force method and displacement method.

(b) Structural steel: Factors of safety and load factors. Design of tension and compression members, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battons and lacings, Slab and gusseted braces. Design of highway and railway bridges- Through and deck type plate girder, Warren girder and Pratt Truss.

(c) Reinforced concrete. Limit state method design- Recommendations of IS codes- Design of one way and two-way slabs, staircase slabs, simple and continuons beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, footings, isolated and combined. Retaining walls, cantilever and counterfort types- Methods and systems of prestressing, Anchorages. Analysis and design of sections for flexure, loss of prestress.

Part- B Fluid Mechanics:

Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curved surfaces.

Kinematics and Dynamics of Fluid Flow: Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flows, velocity potential and stream function, flow-nets and methods of drawing flow net, sources and sinks, flow separation and stagnation. Euler's equation of motion, energy and momentum equations and their applications to pipe flow, free and forced vortices, plane and curved stationary and moving vanes, sluice gates, weirs, orifice meters and venturimeters. Dimensional Analysis and similitude: Buckingham's Pi-theorem,

similarities, model laws, undistorted and distorted models, movable bed models, model calibration.

Laminar Flow: Laminar flow between parallel stationary and moving plates, flow through tubes, Reynolds' experiments, lubrication principles.

Boundary Layers: Laminar and turbulent boundary layer on a flat plate, laminar sub-layer, smooth and rough boundaries, drag and lift. Turbulent Flow Through Pipes: Characteristics of turbulent flow, velocity distribution and variation of friction factor, hydraulic grade line and total energy line, siphons, expansions and contractions in pipes, pipe network, water hammer. Open Channel Flow: Uniform, non-uniform flows, specific energy and specific force, critical depth, resistance equations and variation of roughness coefficient, Rapidly varied flow, flow in contractions, flow at sudden drop, hydraulic jump and its applications, surges and waves, Gradually varied Flow, differential equation of gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation.

Part- C Soil Mechanics and foundation Engineering:

Soil Composition, influence of clay minerals on engineering behavior, Effective stress principle, change in effective stress due to water flow condition, static water table and steady flow conditions permeability and compressibility of soils.

Strength behavior, strength determination through direct and triaxial tests, total and effective stress strength parameters, total and effective stress path. Methods of site exploration, planning a subsurface exploration programme, sampling procedures and sampling disturbance, penetration tests and plate load tests and data interpretation.

Foundation types and selection, footings, rafts, piles, floating foundations, effect of footing shape, dimensions, depth of embedment, load inclination and ground water on bearing capacity, settlement components, computation for immediate and consolidation settlements, limits on total and differential settlement, correction for rigidity.

Deep foundations, philosophy of deep foundations, piles, estimation of individual and group capacity, static and dynamic approaches, pile load tests, separation into skin friction and point bearing, under-reamed piles, well foundations for bridges and aspects of design.

Earth pressure, states of plastic equilibrium, Culmann's procedure for determination of lateral thrust, determination of anchor force and depth of penetration, reinforced earth retaining walls, concept, materials and applications.

Machine foundations, modes of vibration, determination of natural frequency, criteria for design, effect of vibration on soils, vibration isolation.

Part- D Computer Programming:

Types of computers, components of computers, history and development, different languages. FORTRAN/Basic programming, constants, variables, expressions, arithmetic statements library functions, control statements, unconditional GO-TO Statements, computed GO-TO statements, IF and DO statements, CONTINUE, CALL RETURN, STOP, END statement, I/O statements, FORMATS, field specifications.

Subscripted variables, arrays, DIMENSION statement, function and subroutines, sub-programmes, application to simple problems with flow charts in civil engineering.

Section- II

Note:- Candidate shall answer questions from any two parts:- Out of four parts below.

Part – A

Building Construction:

Physical and mechanical properties of construction materials, factors influencing selection, brick and clay products, limes and cements, polymorphic materials and special uses, damp-proofing materials.

Brickwork for walls, types, cavity walls, design of brick masonry walls per I.S. code, factors of safety, serviceability and strength requirements, detailing of walls, floors, roofs, ceiling, finishing of buildings, plastering, pointing, painting.

Functional planning of building, orientation of buildings, elements of fire-proof construction, repairs to damaged and cracked buildings, use of ferrocement, fibre-reinforced and polymer concrete in construction, techniques and materials for low cost housing.

Building estimates and specifications, construction scheduling PERT and CPM methods.

Part – B

Transportation Engineering:

Roads, Traffic engineering and traffic surveys, intersections, road signs, signals and markings.

Classification of roads, plannings and geometric design.

Design of flexible and rigid pavements, Indian Road Congress guidelines on pavement layers and design methodologies.

Part – C

Water Resources and Irrigation Engineering,

Hydrology: Hydrologic cycle, precipitation, evaporation, transpiration, depression storage, infiltration, hydrograph, unit hydrograph, frequency analysis, flood estimation.

Ground water flow: Specific yield, storage co-efficient, co-efficient of permeability, confined and unconfined aquifers, radial flow into a well under confined and unconfined conditions, tube-wells, pumping and recuperation tests, ground water potential.

Water resources planning: Ground and surface water resources, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation, flood routing through reservoirs, economics of water resources projects.

Water requirement for crops: consumptive use of water, quality of irrigation water, duty and delta, irrigation methods and their efficiencies.

Canals: Distribution system for canal irrigation, canal capacity, canal Losses, alignment of main and distributary canals, most efficient section, lined channels, their design, regime theory, critical shear stress, bed load and suspended load transport cost analysis of lined and unlined canals, drainage behind lining.

Water logging: causes and control, drainage system design, salinity.

Canal structures: Design of regulation, cross drainage and communication works, cross regulators, head regulartors, canal falls, aqueducts metering flumes and canal outlets.

Diversion head works: Principles of design of weirs on permeable and impermeable foundations, Khosla's theory, energy dissipation, stilling basins, sediment exclusion.

Storage works: Types of dams, design principles of rigid gravity and earth dams, stability analysis, foundation treatment, joints and galleries, control of seepage. construction methods and machinery.

Spillways: Types, crest gates, energy dissipation.

River training: objectives of river training, methods of river training.

Part – D

Environmental Engineering: Water supply: Estimation of water resources, ground and surface water, ground water hydraulics, predicting demand of water, impurities of water and their significance, Physical, chemical and bacteriological analysis, water borne diseases, standards for potable water

Intake of Water: Pumping and gravity schemes.

Water treatment: Principles of coagulation, flocculation and sedimentation, slow, rapid, pressure, biflow and multi-media filters, chlorination, softening removal of taste, odour and salinity.

Water storage and distribution: Storage and balancing, reservoirs types. location and capacity.

Distribution System: layout, hydraulics of pipelines, pipe fittings, valves including check and pressure reducing valves, meters, analysis of distribution systems using Hardy Cross methods general principles of optimal design based on cost headloss ratio criterion, leak detection, maintenance of distribution systems, pumping stations and their operations.

Sewerage system: domestic and industrial wastes, storm, sewage separate and combined system, flow through sewers, design of sewers, sewer appurtenances, manholes inlets, junctions, siphon. Sewage characterisation: BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

Sewage treatment: working, Principles, units, chambers, sedimentation tank, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.

Solid waste: Collection and Disposal.

Environmental Pollution: ecological balance, water pollution control acts. radioactive wastes and disposal environmental impact assessment for thermal power plants, mines.

Sanitation: site and orientation of buildings, ventilation and damp proof courses, houses drainage, conservancy and waterborne system of waste disposal, sanitary appliances, latrines and urinals, rural sanitation.