

**DEPARTMENT OF CIVIL ENGINEERING
ALIGARH MUSLIM UNIVERSITY, ALIGARH
SYLLABUS OF HYDRAULIC STRUCTURES FOR PHD ENTRANCE TEST 2018-19**

**SECTION - A
Multiple Choice Questions**

Part I - Multiple Choice Questions on Research Methodology **(40 marks)**

Writing Skill: Tenses, parts of speech, clauses, subject- verb agreement, Idioms and phrases, reading comprehension, word-meaning, synonyms-antonyms, hyponyms,

Logical and Analytical Reasoning.

Programming Skills: Data types, assignments, conditional statement, branching and looping, input and output statements.

Mathematics and Statistics: Algebra, Ordinary Differential Equation (ODE), Numerical Analysis, Real and Complex Analysis, Vector Analysis, Measure of Central Tendency, Probability Distribution Function.

Part II - Multiple Choice Questions from Syllabus of Civil Engineering. **(20 marks)**

**SECTION – B
Subjective Questions**

(20 marks)

Design of Irrigation Works: Principle of design of hydraulic structures on permeable foundation, Mechanics of failure of hydraulic structures on permeable soil, Design of barrage. Design of silt excluder and silt ejector, Design of guide banks and spurs. Design of subcritical canal transitions: Hind's method, Vittal and Chiranjeevi's method of transition design, Design of supercritical transition. Design of head and cross regulators, Design of falls.

Reservoir Engineering: Types of reservoir, Site selection for a reservoir, Area -elevation curve, Capacity- elation curve, Various zones of reservoir, Reservoir Capacity estimation, Flow mass curve, Sequent Peak, Algorithm, Estimation of maintainable demand. Reservoir sedimentation, Mechanics of sedimentation, Estimation of silt load, Distribution of sediment in reservoir. Wind setup and waves in reservoir, Reservoir operation. Peak flood estimation: Empirical methods, Rational method, Flood frequency analysis, Gumbel's extreme value distribution, Log-Pearson type III distribution, Concept of risk reliability and safety factor for a reservoir. Concept of flood routing, Factors responsible for flood routing, Routing classification, Reservoir routing.

Fluvial Hydraulics: Sediment properties, incipient motion of sediment, competent velocity, lift concept, critical tractive force of cohesion less and cohesive materials, Regimes of flow, ripple and dune regimes, anti-dune regime, importance and prediction of regimes of flow. Resistance to flow and velocity distribution in alluvial streams, Bed load equations based on dimensional considerations and semi theoretical equations, suspended load, general considerations about sediment distribution equation, prediction of reference concentrations. Total load transport, microscopic and macroscopic methods based on a single size and fraction wise size calculations, Sediment samplers and sampling, bed load and suspended load sampling. Design of stable channels in alluvium: variables in channel design, general comments on regime and tractive force methods of channel design. Bed level variation in alluvial streams, local scour, degradation, aggradation, silting of reservoir, River models, Sediment flow through pipes.

Rigid Dam: Dam: types, characteristics, relative merits and demerits, site investigations and selections, foundation grouting, forces acting on dam, Gravity dams: stability requirements, modes of failure and factor of safety, elementary profile of gravity dam, methods of analysis, zoning of gravity dams, design criteria. Stress analysis in gravity dams, normal and shear stresses, principal stresses, internal stresses, galleries in dams, stress concentration around openings, joints in dams, construction of gravity dams, instrumentation in gravity dam. Arch Dam: General consideration, types

and characteristics, Forces acting on Arch dams, Design criteria, Cylinder theory and elastic theory of design, Construction of arch dams. Buttress dam: Merits, Types and characteristics, Forces acting, design of deck, buttresses, Unit column theory, Construction of buttress dam.

Earth and Rock-fill Dams: Basic design aspects, Classification of embankment dams, Criteria for safe design, Free board, Upstream and downstream slope protection, cracking of earth dams, Hydraulic fracturing, Causes of cracking, Preventive and remedial measures. Seepage theory, Determination of free surface and seepage discharge through dams for isotropic as well as anisotropic soils. Flow net for earth dam under steady seepage condition, various methods of seepage control, Selection of core materials, Drainage of embankments, Design of transition filters, Use of geo-textiles. General characteristics of Rock fill dams, Materials for rock fill dams, testing of rock-fill material, Design of dam section, Types of membrane, Rock fill placement, Deformation of rock fill dams, Flow through and over rock-fill dam, Concrete faced rock-fill dam. Stability analysis, Method of slices, Graphical method, Foundation exploration for Earth and Rock fill dams, Treatment of foundations, Quality control and instrumentation, River diversion during construction of dam.

Advanced Engineering Hydrology: Design Storms, Probable Maximum Precipitation, Spillway design flood, Standard project flood, Probable maximum flood. Guide lines for selecting design flood. Random Variable and Probability, Statistical Analysis of random variables, Probability distribution function, Frequency analysis, Regression analysis, Risk and Reliability analysis of Hydraulic Engineering System. At site flood Frequency analysis, annual and partial duration series, Regional Flood Frequency Analysis, Reservoir and channel flood Routing. Hydrograph analysis, Separation of Stream Flow Components, Unit Hydrograph, Synthetic Unit Hydrograph, Instantaneous unit hydrograph, Dimensionless unit hydrograph, Distribution graph.

Hydro-Power Structures: Sources of energy, role of hydropower in a power system, Estimation of power potential of stream, Storage and Pondage studies, load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power and secondary power. Hydro-power plants, Elements, general arrangement of various Hydel plants such as run off river plants, valley dam plants, diversion canal plants, high head diversion plants, pumped storage power plants etc., Efficiency and Installed capacity of plants. Intakes, Types, losses, air entrainment, air vent, power channels, fore-bay, Tunnel, Penstocks, General classification, design criteria, economical diameter, anchor blocks, valves, bends and manifolds, Surge tanks, Classification, Analysis of simple surge, Water hammer. Selection, setting and cavitation in turbines, Draft tubes, classification, Dimensioning and laying of power houses, Safety measures during construction of power plants.

Advanced Hydraulics: Gradually Varied Flow: Computation of GVF profiles using analytical and numerical methods. Unsteady Flow: St. Venant's equations and their solution, hydraulic flood routing, Dam break problem. Rapidly Varied flow: thin plate weirs, special types of weirs such as linear proportional weir, Labyrinth weir, Piano key weir. Hydraulic jump in non-rectangular channels. Spatially Varied Flow: Side channel spillway, side weir, De Marchi equation, uniformly discharging side weir, Trench weir. Air-entrainment, Diffusion, Dispersion and their governing equations, some classical solutions of diffusion equations, Dispersion and diffusion coefficients.

Spillways and Energy Dissipators: Spillways: Introduction, Ogee spillway, Side channel spillway, Chute spillway, Shaft spillway, Siphon spillway: volute siphon and saddle siphon, Location of spillway. Design of Spillways: Introduction, Stability, Performance, Design of upstream profile of spillway, Design of downstream profile of spillway. Energy Dissipators: Energy dissipation below overflow spillways, Hydraulic jump, Jump height curve and Tail water curve, Stilling basins, Chute blocks, Sills and dented sills, Baffle piers, U.S.B.R. Basins. Intake works and Gates: Introduction, Sluiceways or dam outlet, Hydraulics of outlet works, River intakes: Simple submerged intakes, Intake towers, wet intake and dry intake, Trash Racks. Dropping shutters, stop logs and needles, Vertical lift gates, Radial or tainter gates, Drum gate, Intake gates and valves.

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