TEERTHANKER MAHAVEER UNIVERSITY

(Established under Govt. of U. P. Act No. 30, 2008)
Delhi Road, Moradabad (U.P.)

SYLLABUS FOR RESEARCH APTITUDE TEST IN CIVIL ENGINEERING

The syllabus for Research Aptitude Test (RAT) in Civil is divided in two parts viz. Part A & Part B described below:

PART – A

Part A of the RAT shall be designed to assess the research skills/aptitude of the candidate consisting of questions from the following areas:

1. **Research Methodology:** meaning, characteristics, and ethical issues in research; types of research; research methods

2. **Logical Reasoning:** arguments, deductive and inductive research; logical and Venn diagram; inferences; analogies.

3. **Data Interpretation:** interpretation of data; mapping and analysis of data, tools for data analysis; quantitative and qualitative research.

4. **General Awareness about Basic Science:** basic science up to the level of SSC.

5. **Mathematical Reasoning:** number series, letter series, codes; relationships, classification.

PART – B

Part-B of RAT is designed to assess subject specific knowledge of the candidate covering the syllabus given as below:

Concrete Technology: Constituent materials and their properties, types of cement& their properties, different type of tests on cement. fresh concrete, workability; strength, elasticity and fracture of hardened concrete: Time dependent properties of concrete, durability of concrete; Concrete admixtures, mix design methods; Manufacture and processes Codal provisions Special concretes.

Fluid Mechanics: Bernoulli's theorem, applications of energy and momentum equations. Impact of jet on fixed and moving plates and vanes, resistance to flow, elementary concept of viscous shear. Laminar and turbulent flow through pipes and velocity distributions. Elements of Boundary layer theory, drag and lift, elements of aero-foil theory. Dimensional analysis parameters of flow and their significance, Hydraulic similitude and scale models .Flow measurements by pitot tube, venturimeter, orifice meter. Flow through orifices, mouthpieces, notches and weirs. Hydraulic turbines: types, selection, impulse and reaction turbines, governing of turbines, turbine characteristics. Pumps: Centrifugal pumps, Characteristics, Introduction of Modern Pumping machinery, Reciprocating Pumps, Cavitations in turbine and pumps.

Environmental Engineering: Ecology, Environment and Human Health - their linkages Sources of water surface, ground and others. Ground water engineering Basic aquifer parameters and hydraulics, well system, ground water pollution and control. Water quality parameters: Their role and standards. Water demand for various purposes; Estimation of population growth. Basic hydraulics (including pumping) related to water supply & wastewater collection, pipe network design. Sewerage system Types of collection & disposal system, design approach to sanitary and storm sewers, sewer appurtenances, street inlets, inverted siphon. House plumbing for water supply & wastewater drainage. Different sources of pollution Important cases for atmospheric, hydrosphere and land pollution and related control strategies. Water-borne, air-borne and vector-borne common diseases – Transmission modes and control measures. Excreta disposal in unsewered areas- various options and their selection. Noise pollution and engineering approaches for its abatement.

Engineering Geology & Rock Mechanics: Scope of Engineering Geology in construction Jobs & water resources development, geology in regional & town planning, Engineering Considerations of structural features (folds, faults & joints) of rocks in mega projects like construction of dams, tunnels ,bridges & reservoirs, Engg. Properties of rocks as material for construction & sites for construction, Groundwater potential & its exploration, Natural disasters (earthquakes, mass movement) & their engineering considerations, Geophysical investigations, site improvement techniques used in rocks.

Structural Design: Materials for reinforced concrete. Concrete mix design. Limit state & working stress concepts for under reinforced balanced and over reinforced sections, rectangular, T-beam and design of singly and doubly reinforced & L beams. One way and two way slabs. Columns, isolated and combined footings, retaining walls, stair cases. Short term and long deflections, estimation of probable maximum crack width.

Advanced structural Design & Analysis: Analysis and design of building frames subjected to wind load; Earthquake forces and structural response. Ductile detailing of RCC frames. Design of beam-column joints ; Design of deep beam. Design of shear walls. finite element method, Methods of structural analysis; flexibility and stiffness matrices; analysis of trusses, beams and frames.

Steel design: Structural Steel & their properties. Riveted, bolted and welded connections. Tension, compression and flexural members. Roof trusses, plate girders, gantry girders & industrial buildings. Column bases & Grillage foundations

Structural Mechanics: Slope and deflection of beams by integration, area, moment and conjugate beam methods. Thin and thick cylinders. Theories of elastic failures. Close coiled, open coiled and leaf springs Basic concepts, Analysis of statically determinate structures: trusses, frames, three hinged arches, cables and suspension bridges. Moving loads on beams and trusses –influence line. Strain energy due to axial, bending, shear and torsional loads, Castigliano's theorem. Deflection of beams and frames, Buckling of columns, critical loads, axially and eccentrically loaded columns, initially curved columns, various theories. Analysis of beam columns. Shear center and unsymmetrical bending.

Geotechnical Engineering: Introduction to geotechnical problems in civil engineering; Soil types and formation Simple soil properties, Grain size distribution, Atterberg limits; Soil identification and classification; Total, effective and neutral stresses; Darcy's law; Permeability and capillarity of soil, Seepage, Flow nets, Piping, Stress distribution in soils; Laboratory compaction and field compaction One-dimensional consolidation and simple settlement analysis Shear strength Determination of total and effective strength parameters; Earth pressure : classical theories, graphical methods stability of slopes. Foundation requirements and selection; Different

methods for determining bearing capacity of shallow foundations; Settlement considerations, Allowable, total and differential settlements, Settlement of structures; Eccentrically loaded footings, Methods of proportioning; Raft foundations; Pile foundations, types of Piles; Allowable load of piles, Pile driving, Pile load test, Dynamic formulae, Group action; Well and caisson foundations, Design principles; Bearing capacity analysis and methods of construction; Excavation and bracings.

Pre-stressed Concrete Design: Materials, pre-stressing systems, losses in pre-stress. Analysis and design of simple and continuous beams by working stress and limit-state methods. Deflection and cracking consideration. Anchorage and bond. End block stresses.

Advanced Foundation Engineering: Bearing capacity: Shallow and deep foundations; Settlement analysis: Shallow and deep foundations; Different types of foundations and their designs: Raft, Piles, and Well foundation; Sheet pile walls: Cantilevered and anchored; Excavation and bracings; Design of retaining walls. Foundations subjected to dynamic loads; Design of machine foundations. Shallow foundations: All types of footings and raft subjected to axial, eccentric and lateral loads; Pile foundations: Types, design and placement; Well foundations Types, design and methods of construction; Retaining Structures

Water Resources Engineering: Hydrologic-cycle, Meteorological aspects of hydrology. Rain-fall, types, measurement, average depth over a basin, depth duration curves. Water losses; Interception, evaporation, transpiration. Runoff, factors affecting. runoff. Stream flow measurement and hydrograph representation, estimation of runoff from rain fall by empirical formulae, rational & infiltration method, unit hydrograph method and Scurve method. Urban runoff: Hydrological models. Construction and use of mass and flow duration curves, Floods, Hydrologic Routing, reservoir routing, channel routing-analytical and graphical methods. Elements of Sediment transportation. River engineering - Stages of river, meanders, river training. Land erosion and control. Ground water: Aquifers, ground water availability and yield. Groundwater withdrawals, infiltration wells and galleries, artesian, open and tubewells. Remote sensing applications in hydrology.

Construction Economics and Management: Engineering Economics :Cash flow diagram, Tune value of money, Inflation, Interest, Depreciation, Present worth and capitalized cost, Equivalent uniform annual cost and rate of return evaluations, Benefit cost analysis, Analysis of variable costs, Types of capital financing, Valuation. Tendering and Contract: Organizational structure, Methods of tendering, Specifications, Conditions of contract, Contract law, Disputes and Arbitrations. Construction Planning and Management; Time, Cost and research management of projects for planning, Scheduling, Control and forecasting using networks with CPM/PERT. Personnel, Material and Finance Management, Safety Engineering Construction Equipments.