

**Tentative Syllabus for the Post of Junior Laboratory Assistant (Technical)**  
**School of School of Civil & Environmental Engineering**  
**Post Code- 001**  
**Advertisement No. IIT Mandi/Recruit./NTS/2025/05 dated 17.12.2025**

### **1. Transportation Engineering**

Geometric design principles of highways, including design of horizontal and vertical curves, sight distance, superelevation, and cross-sectional elements. Fundamentals of traffic engineering, including traffic flow characteristics, capacity analysis, traffic surveys, intersection design basics, and road safety concepts.

Testing and specifications of paving materials such as bitumen, aggregates, and soil subgrade. Design principles of bituminous mixes including hot mix asphalt, warm mix asphalt, and cold mix technology. Quality control tests for road construction works, including Marshall stability, bitumen content, field density, and surface regularity.

Pavement evaluation methods and distress identification, including rutting, cracking, potholes, and deflection-based tests. Basic concepts of flexible and rigid pavement design, including ESAL, CBR method, Westergaard theory, and IRC pavement design guidelines. Knowledge of relevant Indian standards and codes such as IRC specifications, MoRTH standards, and IS codes related to highway materials and construction.

### **2. Geotechnical Engineering**

Fundamentals of soil mechanics, including soil as a three-phase system, phase relationships, index properties, and soil classification as per the Indian Standard system (IS 1498). Physical and engineering properties of soils, with familiarity of IS 2720 series standards.

Soil index and laboratory tests, including determination of natural moisture content, specific gravity of soil solids, grain size distribution by sieve and hydrometer analysis, liquid limit, plastic limit, shrinkage limit, and soil classification procedures. Compaction and permeability characteristics of soils, including Standard and Modified Proctor compaction tests, determination of optimum moisture content and maximum dry density, constant head and falling head permeability tests, and basic seepage concepts.

Shear strength and compressibility of soils, including direct shear test, unconfined compression test, laboratory vane shear test, one-dimensional consolidation test, determination of compression index and coefficient of consolidation, and interpretation of stress–strain and settlement behaviour. Foundation- and pavement-related field/lab tests including California Bearing Ratio (CBR), free swell index, swell pressure test, core cutter and sand replacement field density tests, and basic understanding of the plate load test.

### **3. Water Resources Engineering**

Properties of fluids and fluid statics, including pressure measurement and hydrostatic forces. Fluid kinematics and dynamics, including continuity, momentum, and energy equations with applications

to pipe and channel flow. Laminar and turbulent flow concepts, Reynolds number, head losses, Darcy–Weisbach equation, and friction factors. Flow measurement techniques in pipes and open channels, including Venturimeter, orifice meter, weirs, and flumes. Coefficient of discharge and calibration principles.

Basics of hydraulic machines, including pumps and turbines. Introduction to open channel flow, uniform and non-uniform flow, specific energy, critical depth, and hydraulic jump. Hydrology fundamentals including Darcy’s law, infiltration, soil-water properties, precipitation measurement, runoff estimation, discharge measurement, evaporation, and evapotranspiration.

Awareness of relevant IS codes and standards related to hydraulic testing and measurements.

#### **4. Environmental Engineering**

Drinking water quality standards and guidelines, including IS 10500 and WHO recommendations. Unit operations and unit processes involved in surface water treatment such as screening, sedimentation, coagulation-flocculation, filtration, and disinfection.

Physical, chemical, and biological characteristics of wastewater, including suspended and dissolved solids, BOD, COD, dissolved oxygen, pathogens, and interpretation of the oxygen sag curve. Wastewater treatment concepts including primary, secondary, and tertiary treatment processes. Wastewater recycling and reuse, effluent discharge standards, and sludge treatment, disposal, and management practices.

Major air pollution phenomena including acid rain, photochemical smog, greenhouse effect, and particulate pollution. Air quality standards, criteria pollutants, Air Quality Index (AQI), and CPCB guidelines. Operating principles and applications of laboratory instruments such as Ion Chromatography, Liquid Chromatography, and UV–Visible Spectroscopy.

Knowledge of relevant IS standards, WHO guidelines, and environmental regulations.

#### **5. Structural Engineering**

Fundamentals of structural mechanics, including types of loads, stress–strain behaviour, elastic constants, and basic concepts of bending, shear force, and axial deformation. Properties and testing of construction materials such as cement, concrete, and steel reinforcement. Standard laboratory tests including compressive strength of concrete cubes, split tensile strength, flexural strength of beams, and tensile testing of steel bars.

Basic understanding of reinforced concrete structural elements such as beams, slabs, and columns. Concepts of limit state design and structural safety principles.

Introduction to non-destructive testing (NDT) methods such as rebound hammer test, ultrasonic pulse velocity test, and basic structural health monitoring concepts.

Familiarity with relevant Indian codes including IS 456, IS 800, IS 875, and IS 10262.

## **6. General Laboratory Knowledge and Safety**

Laboratory safety practices, handling of chemicals and construction materials, use of personal protective equipment (PPE), calibration and maintenance of laboratory equipment, and proper documentation of laboratory test results.

Basic record keeping, inventory management, and familiarity with standard laboratory reporting formats.

### **Recommended Standards and Codes**

- IS 2720 series (Soil Testing)
- IS 1498 (Soil Classification)
- IS 456 (Plain and Reinforced Concrete)
- IS 800 (Steel Structures)
- IS 875 (Structural Loads)
- IS 10500 (Drinking Water Standards)
- IRC Codes (Highway Design and Pavements)
- MoRTH Specifications (Road Works)
- CPCB / WHO Environmental Standards