भारतीय प्रौद्योगिकी संस्थान तिरुपति
INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
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Yerpedu – Venkatagiri Road, Yerpedu Post, Tirupati District, A.P – 517619
Tel: +91 877 250 3532 ADMISSIONS Email: admissions@iittp.ac.in

Syllabus for M.S.(R) & Ph.D. Written test/ Interview – January 2026 semester

Department of Civil and Environmental Engineering

M.S. (R)

Written Exam: No Screening Test.

M.S. Interview Syllabus: Gate Syllabus of the Respective Research Area

Ph.D.

Written Exam Syllabus

GATE Exam Level - General Aptitude and English.

Ph.D. Interview Syllabus

1. Environmental Engineering

Overview of pollutants in water, Water quality requirements, Water quality criteria and objectives, Water quality Indices, Principles of water treatment, Process flow sheeting, Conventional water treatment processes, Advanced treatment processes

Fundamentals of mass balance; reaction kinetics; Reactor analysis and modeling, Wastewater treatment processes; Suspended and attached growth processes; Modelling of suspended growth systems: Anaerobic processes.

Sustainability and Life Cycle Analysis -Introduction to sustainability concepts and life cycle analysis, life cycle inventory, and impact assessment.

Climate Change Mitigation, Adaptation and Resilience - Introduction to Climate Change; vulnerability and its impact, sectoral strategies for climate change mitigation, adaptation, and resilience

Air Pollution - Air pollution types; sources and their effects; air pollution monitoring, standards and regulations; air pollution meteorology, air quality modelling - dynamics of pollutant dispersion and disposal: chemical and physical processes that transform and transport air pollutants in the atmosphere; Gaussian plume models; source apportionment and receptor modelling; air pollution control and removal, air quality management.

Advanced treatment processes of Wastewater

Advanced treatment processes of wastewater and Management.

Solid and Hazardous Waste Management

Solid waste management; Waste hierarchy; Rules and regulations for solid waste management in India.

Solid waste management: Sources, generation, characteristics, collection and transportation, waste processing and disposal (including reuse options, biological methods, energy recovery processes and landfilling). Characteristics, generation, and fate of materials in the environment.

2. Water Resources Engineering

Introduction to Water Resources Management: Basics of Water Resources and their Importance, Water Availability and Demand, Integrated Water Resources Management (WRM), Sustainable Water Management Practices

Hydrology: Hydrological Cycle, Water Balance Equation

Precipitation: Types, Measurement, and Analysis

Evapotranspiration: Concepts and Estimation Methods

Infiltration: Factors Affecting and Measurement Techniques

Runoff: Process, Measurement, and Factors Affecting Runoff

Groundwater Hydrology: Aquifer Properties and Groundwater Flow

Surface Water and Groundwater Hydrology

Surface Water Hydrology, River and Stream Flow Processes, Flow Measurement Techniques.

Hydrographs
Components and Analysis, Unit Hydrograph Theory and Applications

Streamflow Routing
Muskingum and Other Methods

River Basin Management and Watershed Hydrology
Hydrological Modeling Techniques (Overview)

Groundwater: Introduction to Groundwater, Overview of Groundwater Hydrology, Aquifer Types and Properties, Groundwater Recharge and Discharge, Interaction between Surface Water and Groundwater

Climate Change and Water Resources
Impacts of Climate Change on Water Availability, Adaptation and Mitigation Strategies in Water Resources Management, Climate Variability and Water Resources.

Flood and Drought Management
Flood Frequency Analysis, Drought Classification and Indices, Mitigation and Management Techniques for Floods and Droughts.

3. Geoinformatics/ Remote Sensing

Remote Sensing: Basic concept, Electromagnetic spectrum, Spectral signature, Resolutions-Spectral, Spatial, temporal, and Radiometric, Platforms and Sensors, Remote Sensing Data Products - PAN, Multispectral, Microwave, Thermal, Hyperspectral, Visual and digital interpretation methods.

GIS: Introduction, Data Sources, Data Models and Data Structures, Algorithms, DBMS, Creation of Databases (spatial and non-spatial), Spatial analysis -Interpolation, Buffer, Overlay, Terrain Modeling and Network analysis.

Maps: Types of maps, Scales and uses, Plotting accuracy, Map sheet numbering. Coordinate systems: Cartesian and geographical, map projections, map datum-MSL, Geoid, spheroid, WGS-84, Digital Elevation Model (DEM). GNSS: Principles used, Components of GNSS, Data collection methods, DGPS.

Errors in observations and corrections: Engineering Mathematics: Surveying measurements, Accuracy, Precision, most probable value, Errors, and their adjustments, Regression analysis, Correlation coefficient, least square adjustment, statistically significant value, Chi-square test.

4. Transportation Engineering

Traffic Engineering, Pavement Engineering, and Transportation Planning

5. Structural Mechanics and Design

Engineering Mechanics:
System of forces, free-body diagrams, equilibrium equations; Internal forces in structures. Frictions and its applications; Centre of mass; Free Vibrations of an undamped SDOF system.

Strength of Materials:
Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams, bending and shear stresses. concept of shear center; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; combined and direct bending stresses.

Structural Analysis:
Statistically determinate and indeterminate structures by force/ energy methods, Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods: Influence lines.

Design of Reinforced Concrete Structures
Design of beams/one-way slab for flexure, shear, torsion and bond; Design of RC two-way slab; Design of RC short columns under axial compression and biaxial bending; Design of RC footings.

Design of Steel Structures
Limit state design, Design of tension members, compression members and laterally supported and unsupported beams; bolted and welded connections, simple base plates and Plate girders.

6. Construction Materials and Technology

Strength of Materials
Equilibrium of forces, Rigid and deformable solids, Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain;

thin cylinders, shear force and bending moment diagrams; bending and shear stresses; concept of shear center; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; combined and direct bending stresses.

Building Material

Cement: Composition; Production; Types: Properties; Testing for fineness, consistency strength, and soundness; Aggregates: Types; Properties; Testing; Chemical admixtures; Mineral admixtures; Special concrete: Self-compacting concrete, 3D-printable concrete, Fiber-reinforced concrete, High-strength concrete. Fresh concrete: Factors influencing workability, Workability tests; Hardened concrete: Compression test; Flexure test; Split tensile strength test. Non-destructive testing of concrete; Durability of concrete structures: Corrosion of reinforcement, Carbonation, sulfate attack, alkali-aggregate reaction, freeze-thaw damage.

7. Geotechnical Engineering

Soil Mechanics

Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition;Compaction of soils; One dimensional consolidation, time rate of consolidation; Shear Strength, Mohr’s circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

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Foundation Engineering

Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Soil Dynamics, Ground Improvement, Rock Mechanics.