

UPSC CSE Civil Engineering Syllabus 2024

The Civil Engineering optional syllabus covers structural analysis, construction materials, hydraulics, geotechnical engineering, environmental engineering, and other topics. Aspirants have to study design, estimation, infrastructure planning, and execution for this paper. The UPSC CSE civil engineering syllabus evaluates fundamental concepts and their real-world applications relevant for civil service roles in public works and infrastructure development.

UPSC CSE Civil Engineering Syllabus 2024 Paper 1

1. Engineering Mechanics:

- Units and Dimensions, SI Units
- Vectors
- Concept of Force
- Concept of particle and rigid body
- Concurrent, Non-Concurrent, and parallel forces in a plane
- Moment of force
- Free body diagram
- Conditions of equilibrium
- Principle of virtual work
- Equivalent force system
- First and Second Moment of area
- Mass moment of Inertia
- Static Friction
- Kinematics in Cartesian Coordinates
- Motion under uniform and nonuniform acceleration
- Motion under gravity
- Kinetics of particle: Momentum and Energy principles
- Collision of elastic bodies
- Rotation of rigid bodies

2. Strength of Materials:

- Simple Stress and Strain
- Elastic constants
- Axially loaded compression members
- Shear force and bending moment
- Theory of simple bending
- Shear Stress distribution across cross sections
- Beams of uniform strength
- Deflection of beams: Macaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method
- Torsion of Shafts
- Elastic stability of columns
- Euler's Rankine's and Secant formula

3. Structural Analysis:

- Castigliano's theorems I and II
- Unit load method of consistent deformation applied to beams and pin jointed trusses
- Slope Deflection
- Moment distribution
- Rolling loads and Influences lines
- Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads
- Arches: Three hinged, two hinged and fixed arches, rib shortening and temperature effects
- Matrix methods of analysis: Force method and displacement method of analysis of indeterminate beams and rigid frames
- Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, statical method, Mechanism method
- Unsymmetrical bending: Moment of inertia, the product of inertia, the position of Neutral Axis and Principal Axis, calculation of bending stresses

4. Design of Structures: Steel, Concrete and Masonry Structures

- Structural Steel Design: Structural Steel, Factors of safety and load factors
- Riveted, bolted, and welded joints and connections
- Design of tension and compression members, beams of a built-up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings
- Design of Concrete and Masonry Structures: Concept of mix design
- Reinforced Concrete: Working Stress and Limit State method of design- Recommendations of I.S. codes
- Design of one-way and two-way slabs, staircase slabs, simple and continuous beams of rectangular, T, and L sections
- Compression members under direct load with or without eccentricity, Cantilever and Counterfort type retaining walls
- Water tanks: Design requirements for Rectangular and circular tanks resting on the ground
- Prestressed concrete: Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress
- Design of brick masonry as per I.S. Codes

5. 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
 - Streamlines
 - Equation of continuity
 - Irrotational and rotational flow
 - Velocity potential and stream functions
- Continuity, momentum, and energy equations
- Navier-Stokes equation
- Euler's equation of motion
- Application to fluid flow problems
- Pipe flow, sluice gates, weirs

- Dimensional Analysis and Similitude
 - Buckingham's Pi-theorem
 - Dimensionless parameters
- Laminar Flow
 - Laminar flow between parallel, stationary, and moving plates
 - Flow through tubes
- Boundary layer
 - 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 pipe friction factor
 - Hydraulic grade line and total energy line
- Open channel flow
 - Uniform and non-uniform flows
 - Momentum and energy correction factors
 - Specific energy and specific force
 - Critical depth
 - Rapidly varied flow
 - Hydraulic jump
 - Gradually varied flow
 - Classification of surface profiles
 - Control section
 - Step method of integration of varied flow equation

6. Hydraulic Machines and Hydropower:

- Hydraulic turbines
 - Types classification
 - Choice of turbines
 - Performance parameters
 - Controls
 - Characteristics
 - Specific speed
- Principles of hydropower development

7. Geotechnical Engineering:

- Soil Type and structure
 - Gradation and particle size distribution
 - Consistency limits
- Water in soil
 - Capillary and structural
 - Effective stress and pore water pressure
 - Permeability concept
 - Field and laboratory determination of permeability
 - Seepage pressure
 - Quicksand conditions

- Shear strength determination
 - Mohr Coulomb concept
- Compaction of soil
 - Laboratory and field tests
- Compressibility and consolidation concept
 - Consolidation theory
 - Consolidation settlement analysis
- Earth pressure theory and analysis for retaining walls
 - Application for sheet piles and braced excavation
- Bearing capacity of soil
 - Approaches for analysis
 - Field tests
 - Settlement analysis
 - Stability of slope of earth walk
- Subsurface exploration of soils
 - Methods Foundation
 - Type and selection criteria for foundation of structures
 - Design criteria for foundation
 - Analysis of the distribution of stress for footings and pile
 - Pile group action-pile load test
- Ground improvement techniques

UPSC CSE Civil Engineering Syllabus 2024 Paper 2

1. Construction Technology, Equipment, Planning and Management:

- **Construction Technology:**
 - Engineering Materials: Physical properties of construction materials
 - Specific use of materials like Ferro cement, fibre reinforced concrete, and timber
- **Construction:**
 - Masonry principles and construction detailing
 - Types of plastering, pointing, flooring, roofing, and common repairs
 - Functional planning of buildings and Building code provisions
- **Construction Planning and Management:**
 - Construction activity schedules and organization
 - Quality assurance principles
 - Basic principles of network analysis (CPM and PERT)
 - Economic analysis and methods
 - Project profitability and financial planning

2. Surveying and Transportation Engineering:

- **Surveying:**
 - Methods and instruments for distance and angle measurement
 - Basic principles of photogrammetry and remote sensing
- **Railway Engineering:**
 - Permanent way components, turnouts, and crossings
 - Design of stations and yards
- **Highway Engineering:**

- Highway alignments and geometric design elements
- Pavement structure, construction methods, and drainage arrangements
- Traffic surveys and traffic planning

3. Hydrology, Water Resources and Engineering:

- **Hydrology:**
 - Hydrological cycle, precipitation, evaporation, infiltration, hydrograph
 - Flood frequency analysis and routing
- **Groundwater flow:**
 - Aquifers, specific yield, storage coefficient, permeability
- **Water Resources Engineering:**
 - Ground and surface water resources, reservoir storage capacity
- **Irrigation Engineering:**
 - Water requirements of crops, irrigation methods, canals, canal structures
 - Diversion headworks, storage works, spillways, river training

4. Environmental Engineering:

- **Water Supply:**
 - Demand prediction, water impurities, water treatment principles
- **Sewerage systems:**
 - Domestic and industrial wastes, sewer design, sewage characterization
- **Sewage treatment:**
 - Working principles, treatment units, disposal of sludge, recycling of wastewater
- **Solid waste management:**
 - Collection, disposal, and long-term effects management
- **Environmental pollution:**
 - Sustainable development, radioactive waste disposal, air pollution control, pollution control acts