

CIVIL ENGINEERING OPTIONAL SYLLABUS FOR UPSC CSE MAINS PDF DOWNLOAD

There will be two papers in the UPSC Civil Engineering Optional Syllabus. Each paper of the UPSC syllabus Civil Services optional would be of 250 marks, totalling 500 marks. The time allowed for attempting each of them will be three hours. Each paper would have objective answer-type questions. There is no negative marking.

Overview of UPSC Civil Engineering

Sl. No.	UPSC IAS Mains Papers	Subject	Mark
1	Paper VI	Optional Subject Paper-I	250
2	Paper VII	Optional Subject Paper-II	250
Total			500
Time Duration			3 hours

UPSC Civil Engineering Optional Syllabus: Paper 1

UPSC IAS Syllabus for Civil Engineering Optional Paper 1

Topics	Sub-Topics
Engineering Mechanics, Strength of Materials, and Structural Analysis	
Engineering Mechanics	<p>Units and Dimensions, SI Units, Vectors, Concept of Force, Concept of particle and rigid body.</p> <p>Concurrent, Non-Concurrent, and parallel forces in a plane, moment of force, free body diagram, conditions of equilibrium.</p> <p>Principle of virtual work, equivalent force system.</p> <p>First and Second Moment of area, Mass moment of Inertia.</p>

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Topics	Sub-Topics
Strength of Materials	<p>Static Friction.</p> <p>Kinematics and Kinetics: Kinematics in Cartesian Coordinates, motion under uniform and non-uniform acceleration, motion under gravity.</p> <p>Kinetics of particles: Momentum and Energy principles, collision of elastic bodies, rotation of rigid bodies.</p>
	<p>Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending.</p> <p>Shear Stress distribution across cross sections, and Beams of uniform strength.</p> <p>Deflection of beams: Mecauly's method, Mohr's Moment area method, Conjugate beam method, and unit load method.</p> <p>Torsion of Shafts, Elastic stability of columns, Euler's, Rankine's, and Secant formula.</p>
Structural Analysis	<p>Castigliano's theorems I and II, the unit load method, of consistent deformation applied to beams and pin-jointed trusses.</p> <p>Slope-deflection, moment distribution.</p> <p>Rolling loads and Influences lines: Influences lines for Shear Force and Bending moment at a section of a beam.</p> <p>Criteria for maximum shear force and bending moment in beams traversed by a system of moving loads.</p>

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Topics	Sub-Topics
	<p>Influences lines for simply supported plane pin-jointed trusses.</p> <p>Arches: Three-hinged, two-hinged, and fixed arches, rib shortening, and temperature effects.</p> <p>Matrix methods of analysis: Force method and displacement method of analysis of indeterminate beams and rigid frames.</p> <p>Plastic Analysis of beams and frames: Theory of plastic bending, plastic analysis, static method, Mechanism method.</p> <p>Unsymmetrical bending: Moment of inertia, product of inertia, position of Neutral Axis and Principal axes, calculation of bending stresses.</p>
Design of Structures: Steel, Concrete, and Masonry Structures	
Structural Steel Design	<p>Structural steel: Factors of safety and load factors. Riveted, bolted, and welded joints and connections.</p> <p>Design of tension and compression members, beams of built-up section, riveted and welded plate girders, gantry girders, stanchions with battens, and lacings.</p>
Design of Concrete and Masonry Structures	<p>Concept of mixed design. Reinforced Concrete: Working Stress and Limit State method of design—Recommendations of I.S. codes.</p> <p>Design of one-way and two-way slabs, staircase slabs, simple and continuous beams of rectangular, T, and L sections.</p>

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Topics	Sub-Topics
	<p>Compression members under direct load with or without eccentricity.</p> <p>Cantilever and Counterfort-type retaining walls.</p> <p>Water tanks: Design requirements for Rectangular and circular tanks resting on the ground.</p> <p>Prestressed Concrete: Methods and systems of prestressing, anchorages, Analysis, and design of sections for flexure based on working stress, and loss of prestress.</p> <p>Design of brick masonry as per I.S. Codes.</p>
Fluid Mechanics, Open Channel Flow, and Hydraulic Machines	
Fluid Mechanics	<p>Fluid properties and their role in fluid motion, fluid statics, including forces acting on plane and curved surfaces.</p> <p>Kinematics and Dynamics of Fluid Flow: Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential, and stream functions.</p> <p>Continuity, momentum, energy equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, sluice gates, and weirs.</p>
Dimensional Analysis and Similitude	<p>Buckingham's Pi-theorem, dimensionless parameters.</p>

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Topics	Sub-Topics
Laminar Flow	Laminar flow between parallel, stationary, and moving plates flows through the tube.
Boundary Layer	<p>Laminar and turbulent boundary layer on a flat plate, laminar sub-layer, smooth and rough boundaries, drag and lift.</p> <p>Turbulent flow through pipes: Characteristics of turbulent flow, velocity distribution, and variation of pipe friction factor, hydraulic grade line, and total energy line.</p>
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 equations.
Hydraulic Machines and Hydropower	<p>Hydraulic turbines, types classification, Choice of turbines' performance parameters, controls, characteristics, specific speed.</p> <p>Principles of hydropower development.</p>
Geotechnical Engineering	<p>Soil Type and Structure—gradation and particle size distribution—consistency limits.</p> <p>Water in soil—capillary and structural—effective stress and pore water pressure—permeability concept—field and laboratory determination of permeability—Seepage pressure—quick sand conditions—Shear strength determination—Mohr-Coulomb concept.</p> <p>Compaction of soil—Laboratory and field tests.</p>

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Topics	Sub-Topics
	<p>Compressibility and consolidation concept—consolidation theory—consolidation settlement analysis.</p> <p>Earth pressure theory and analysis for retaining walls, Application for sheet piles, and Braced excavation.</p> <p>Bearing capacity of soil—approaches for analysis—Field tests—settlement analysis—stability of slope of earth walk.</p> <p>Subsurface exploration of soils—methods.</p> <p>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.</p> <p>Ground improvement techniques.</p>

UPSC Civil Engineering Optional Syllabus: Paper 2

UPSC IAS Syllabus for Civil Engineering Optional Paper 2

Topics	Sub-Topics
Construction Technology, Equipment, Planning, and Management	
Construction Technology	<p>Physical properties of construction materials with respect to their use in construction—Stones, Bricks, and Tiles; Lime, Cement, different types of Mortars, and Concrete.</p> <p>Specific use of ferro cement, fibre reinforced C. C., High-strength concrete.</p>

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Topics	Sub-Topics
Construction	<p>Timber: Properties, defects—common preservation treatments.</p> <p>Use and selection of materials for specific uses like Low-Cost Housing, Mass Housing, and High Rise Buildings.</p> <p>Masonry principles using Brick, stone, Blocks—construction detailing and strength characteristics.</p> <p>Types of plastering, pointing, flooring, roofing, and construction features.</p> <p>Common repairs in buildings.</p> <p>Principle of functional planning of building for residents and specific use—Building code provisions.</p> <p>Basic principles of detailed and approximate estimating, specification writing, and rate analysis principles of valuation of real property.</p> <p>Machinery for earthwork, concreting, and their specific uses—Factors affecting the selection of equipment—operating cost of equipment.</p>
Construction Planning and Management	<p>Construction activity—schedules—organization for the construction industry—Quality assurance principles.</p> <p>Use the Basic principle of network analysis in the form of CPM and PERT—their use in construction monitoring, Cost optimization, and resource allocation.</p> <p>Basic principles of Economic analysis and methods.</p>

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Topics	Sub-Topics
	Project profitability—Basic principles of Boot approach to financial planning, simple toll fixation criteria.
Surveying and Transportation Engineering	
Surveying	<p>Surveying: Common methods and instruments for distance and angle measurement for CE work—their use in plane table, traverse survey, leveling work, triangulation, contouring, and topographical maps.</p> <p>Basic principles of photogrammetry and remote sensing.</p>
Railways Engineering	<p>Permanent way—components, types, and their function—Functions and Design constituents of turn and crossing—Necessity of geometric design of track—Design of station and yards.</p>
Highway Engineering	<p>Principles of Highway alignments—classification and geometrical design elements and standards for Roads.</p> <p>Pavement structure for flexible and rigid pavements—Design principles and methodology of pavements.</p> <p>Typical construction methods and standards of materials for stabilized soil, WBM, Bituminous works, and CC roads.</p> <p>Surface and sub-surface drainage arrangements for roads—culvert structures.</p> <p>Pavement distress and strengthening by overlays.</p> <p>Traffic surveys and their application in traffic planning—Typical design features for channelized, intersection rotary, etc.—signal designs—standard Traffic signs and markings.</p>

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Topics	Sub-Topics
Hydrology, Water Resources, and Engineering	
Hydrology	Hydrological cycle, precipitation, evaporation, transpiration, infiltration, overland flow, hydrograph, flood frequency analyses, flood routing through a reservoir, channel flow routing—Muskingum method.
Groundwater Flow	Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquitards, radial flow into a well under confined and unconfined conditions.
Water Resources Engineering	Ground and surface water resources, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, and reservoir sedimentation.
Irrigation Engineering	<p>Water requirements of crops: consumptive use, duty and delta, irrigation methods and their efficiencies.</p> <p>Canals: Distribution systems for canal irrigation, canal capacity, canal losses, alignment of main and distributary canals, most efficient section, lined canals, their design, regime theory, critical shear stress, and bed load.</p> <p>Waterlogging: causes and control, salinity.</p> <p>Canal structures: Design of head regulators, canal falls, aqueducts, metering flumes, and canal outlets.</p> <p>Diversion head work: Principles and design of weirs on permeable and impermeable foundation, Khosla's theory, energy dissipation.</p>

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Topics	Sub-Topics
	<p>Storage works: Types of dams, design, and principles of rigid gravity stability analysis.</p> <p>Spillways: Spillway types, energy dissipation.</p> <p>River training: Objectives of river training, methods of river training.</p>
Environmental Engineering	
Water Supply	Predicting water demand, impurities of water and their significance, physical, chemical, and bacteriological analysis, waterborne diseases, and standards for potable water.
Intake of Water	Water treatment: principles of coagulation, flocculation, and sedimentation; slow-, rapid-, pressure, filters; chlorination, softening, removal of taste, odour, and salinity.
Sewerage Systems	Domestic and industrial wastes, store sewage—separate and combined systems, flow through sewers, design of sewers.
Sewage Characterisation	BOD, COD, solids, dissolved oxygen, nitrogen, and TOC. Standards of disposal in normal water courses and on land.
Sewage Treatment	Working principles, units, chambers, sedimentation tank, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of wastewater.
Solid Waste	Collection and disposal in rural and urban contexts, management of long-term ill-effects.
Environmental Pollution	Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, and river valley projects. Air pollution. Pollution Control Acts.