



GATE Syllabus

Civil Engineering



tutorialspoint

SIMPLY EASY LEARNING

www.tutorialspoint.com



<https://www.facebook.com/tutorialspointindia>



<https://twitter.com/tutorialspoint>

CIVIL ENGINEERING

Subject Code: CE

Course Structure

Sections/Units	Topics
Section A	Engineering Mathematics
Unit 1	Linear Algebra
Unit 2	Calculus
Unit 3	Ordinary Differential Equation (ODE)
Unit 4	Partial Differential Equation (PDE)
Unit 5	Probability and Statistics
Unit 6	Numerical Methods
Section B	Structural Engineering
Unit 1	Engineering Mechanics
Unit 2	Solid Mechanics
Unit 3	Structural Analysis
Unit 4	Construction Materials and Management
Unit 5	Concrete Structures
Unit 6	Steel Structures
Section C	Geotechnical Engineering
Unit 1	Soil Mechanics
Unit 2	Foundation Engineering
Section D	Water Resources Engineering
Unit 1	Fluid Mechanics

Unit 2	Hydraulics
Unit 3	Hydrology
Unit 4	Irrigation
Section E	Environmental Engineering
Unit 1	Water and Waste Water
Unit 2	Air Pollution
Unit 3	Municipal Solid Wastes
Unit 4	Noise Pollution
Section F	Transportation Engineering
Unit 1	Transportation Infrastructure
Unit 2	Highway Pavements
Unit 3	Traffic Engineering
Section G	Geomatics Engineering

Course Syllabus

Section A: Engineering Mathematics

Unit 1: Linear Algebra

- Matrix algebra
- Systems of linear equations
- Eigen values and Eigen vectors

Unit 2: Calculus

- Functions of single variable
- Limit, continuity and differentiability
- Mean value theorems
- Local maxima and minima
- Taylor and Maclaurin series
- Evaluation of definite and indefinite integrals
- application of definite integral to obtain area and volume

- Partial derivatives
- Total derivative
- Gradient
- Divergence and Curl
- Vector identities
- Directional derivatives
- Line
- Surface and Volume integrals
- Stokes
- Gauss and Green's theorems

Unit 3: Ordinary Differential Equation (ODE)

- First order (linear and non-linear) equations
- higher order linear equations with constant coefficients
- Euler-Cauchy equations
- Laplace transform and its application in solving linear ODEs
- Initial and boundary value problems

Unit 4: Partial Differential Equation (PDE)

- Fourier series
- separation of variables
- solutions of one dimensional diffusion equation
- First and second order one-dimensional wave equation and two-dimensional Laplace equation.

Unit 5: Probability and Statistics

- Definitions of probability and sampling theorems
- Conditional probability
- Discrete Random variables
- Poisson and Binomial distributions
- Continuous random variables
- Normal and exponential distributions
- Descriptive statistics - Mean, median, mode and standard deviation
- Hypothesis testing

Unit 6: Numerical Methods

- Accuracy and precision; error analysis
- Numerical solutions of linear and non-linear algebraic equations
- Least square approximation
- Newton's and Lagrange polynomials
- numerical differentiation
- Integration by trapezoidal and Simpson's rule
- Single and multi-step methods for first order differential equations

Section B: Structural Engineering

Unit 1: Engineering Mechanics

- System of forces, free-body diagrams, equilibrium equations
- Internal forces in structures
- Friction and its applications
- Kinematics of point mass and rigid body
- Centre of mass
- Euler's equations of motion
- Impulse-momentum
- Energy methods
- Principles of virtual work

Unit 2: Solid Mechanics

- Bending moment and shear force in statically determinate beams
- Simple stress and strain relationships
- Theories of failures
- Simple bending theory, flexural and shear stresses, shear centre
- Uniform torsion, buckling of column, combined and direct bending stresses

Unit 3: Structural Analysis

- Statically 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
- Stiffness and flexibility methods of structural analysis

Unit 4: Construction Materials and Management

- Construction Materials:
 - Structural steel – composition
 - Material properties and behavior
- Concrete - constituents:
 - Mix design
 - Short-term and long-term properties
 - Bricks and mortar
 - Timber
 - Bitumen
- Construction Management:
 - Types of construction projects
 - Tendering and construction contracts
 - Rate analysis and standard specifications
 - Cost estimation
 - Project planning and network analysis - PERT and CPM

Unit 5: Concrete Structures

- Working stress, Limit state and Ultimate load design concepts
- Design of beams, slabs, columns
- Bond and development length
- Prestressed concrete
- Analysis of beam sections at transfer and service loads

Unit 6: Steel Structures

- Working stress and Limit state design concepts
- Design of tension and compression members, beams and beam- columns, column bases
- Connections – simple and eccentric, beam-column connections, plate girders and trusses
- Plastic analysis of beams and frames

Section C: Geotechnical Engineering

Unit 1: Soil Mechanics

- Origin of soils, soil structure and fabric
- Three-phase system and phase relationships, index properties
- Unified and Indian standard soil classification system

- Permeability - one dimensional flow, Darcy's law
- Seepage through soils - two-dimensional flow, flow nets, uplift pressure, piping
- Principle of effective stress, capillarity, seepage force and quicksand condition
- Compaction in laboratory and field conditions
- One dimensional consolidation, time rate of consolidation
- Mohr's circle, stress paths, effective and total shear strength parameters, characteristics of clays and sand

Unit 2: Foundation Engineering

- Sub-surface investigations:
 - Scope
 - Drilling bore holes
 - Sampling
 - Plate load test
 - Standard penetration
 - Cone penetration tests
- Earth pressure theories - Rankine and Coulomb
- Stability of slopes:
 - Finite and infinite slopes
 - Method of slices
 - Bishop's method
- Stress distribution in soils:
 - Boussinesq's and Westergaard's theories
 - 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:
 - Types of piles
 - Dynamic and static formulae
 - Load capacity of piles in sands and clays
 - Pile load test
 - Negative skin friction

Section D: Water Resources Engineering

Unit 1: Fluid Mechanics

- Properties of fluids, fluid statics
- Continuity, momentum, energy and corresponding equations
- Potential flow, applications of momentum and energy equations
- Laminar and turbulent flow
- Flow in pipes, pipe networks
- Concept of boundary layer and its growth

Unit 2: Hydraulics

- Forces on immersed bodies
- Flow measurement in channels and pipes
- Dimensional analysis and hydraulic similitude
- Kinematics of flow, velocity triangles
- Basics of hydraulic machines, specific speed of pumps and turbines
- Channel Hydraulics:
 - Energy-depth relationships
 - Specific energy
 - Critical flow
 - Slope profile
 - Hydraulic jump
 - Uniform flow and gradually varied flow

Unit 3: Hydrology

- Hydrologic cycle
- Precipitation
- Evaporation
- Evapo-transpiration
- Watershed
- Infiltration
- Unit hydrographs
- Hydrograph analysis
- Flood estimation and routing
- Reservoir capacity
- Reservoir and channel routing
- Surface run-off models
- Ground water hydrology - steady state well hydraulics and aquifers
- Application of darcy's law

Unit 4: Irrigation

- Duty, delta, estimation of evapo-transpiration
- Crop water requirements
- Design of lined and unlined canals, head works, gravity dams and spillways
- Design of weirs on permeable foundation
- Types of irrigation systems, irrigation methods
- Water logging and drainage
- Canal regulatory works, cross-drainage structures, outlets and escapes

Section E: Environmental Engineering

Unit 1: Water and Waste Water

- Quality standards, basic unit processes and operations for water treatment
- Drinking water standards:
 - Water requirements
 - Basic unit operations and unit processes for surface water treatment
 - Distribution of water
- Sewage and sewerage treatment, quantity and characteristics of wastewater
- Primary, secondary and tertiary treatment of wastewater, effluent discharge standards
- Domestic wastewater treatment:
 - Quantity of characteristics of domestic wastewater
 - Primary and secondary treatment
- Unit operations and unit processes of domestic wastewater:
 - Sludge disposal

Unit 2: Air Pollution

Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits

Unit 3: Municipal Solid Wastes

- Characteristics
- Generation
- Collection and transportation of solid wastes
- Engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal)

Unit 4: Noise Pollution

- Impacts of noise
- Permissible limits of noise pollution
- Measurement of noise
- Control of noise pollution

Section F: Transportation Engineering

Unit 1: Transportation Infrastructure

- Highway alignment and engineering surveys
- Geometric design of highways:
 - Cross-sectional elements
 - Sight distances
 - Horizontal and vertical alignments
- Geometric design of railway track
- Airport runway length, taxiway and exit taxiway design

Unit 2: Highway Pavements

- Highway materials - desirable properties and quality control tests
- Design of bituminous paving mixes
- Design factors for flexible and rigid pavements
- Design of flexible pavement using IRC: 37-2012
- Design of rigid pavements using IRC: 58-2011
- Distresses in concrete pavements

Unit 3: Traffic Engineering

- Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data
- Microscopic and macroscopic parameters of traffic flow, fundamental relationships
- Control devices, signal design by Webster's method
- Types of intersections and channelization
- Highway capacity and level of service of rural highways and urban roads

Section G: Geomatics Engineering

- Principles of surveying
 - Errors and their adjustment
 - Maps - scale, coordinate system
 - Distance and angle measurement - Levelling and trigonometric levelling
 - Traversing and triangulation survey
 - Total station
 - Horizontal and vertical curves
- Photogrammetry:
 - Scale, flying height
 - Remote sensing - basics, platform and sensors, visual image interpretation
 - Basics of Geographical information system (GIS) and Geographical Positioning system (GPS)