STRUCTURAL ENGINEERING

I - Semester

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<tr>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Type</th>
<th>Credits</th>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>CE 601</td>
<td>Higher Numerical Analysis</td>
<td>DC</td>
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<td>3 0 1</td>
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**Unit 1**

**Unit 2**

**Unit 3**

**Unit 4**

**Text Books and Reference Materials**
1. Numerical Analysis: Goel & Mittal
2. Applied Numerical Analysis: Gerald & Wheatley
3. Numerical Methods for Engineers: Chapra & Canale
4. Introductory Methods of Numerical Analysis: Sastry, Numerical Methods: Jain and Jain
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<tbody>
<tr>
<td>CE 602</td>
<td>Theory of Elasticity and Plasticity</td>
<td>DC</td>
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**UNIT 1**
Theory of stresses, infinitesimal and finite strain, strain-displacement relationships, elastic constants

**UNIT 2**
Stress and displacements functions, plane problems in Cartesian and polar co-ordinates

**UNIT 3**
Elements of plasticity, failure and yield criteria, flow rule.

**UNIT 4**
Velocity field, plastic stress-strain relationships, incremental plasticity.

**Text Books and Reference Materials**
7. Plasticity for Structural Engineers by Chen & Han, Cengage Learning.
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<tbody>
<tr>
<td>CE 603</td>
<td>Plates and Shells</td>
<td>DC</td>
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**Unit 1 Background and basic concepts**
Basic concepts, governing equations and boundary conditions of plates.

**Unit 2 Solution of Plates**
Solution of rectangular and circular plates by classical methods: Navier’s and Levy’s methods.

**Unit 3 Membrane theory of cylindrical shells**
Introduction, types of shell surface, classification, basic concepts, equations of equilibrium, application of Fourier series for membrane stresses, numerical solutions, limitations of membrane theory.

**Unit 4 Bending theory of cylindrical shells**
Flugge’s differential equation, Donnell’s theory, D-K-J characteristic equation, Schorer’s theory, shell analysis using tables, design consideration.

**Text Books and Reference Materials**
3. Ramaswamy, G. S., Design and Construction of Concrete Shell Roofs, C.B.S. Publisher’s, (1986).
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<tr>
<td>CE 604</td>
<td>Advanced Structural Analysis</td>
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**Unit 1**  
Introduction to Matrix methods in skeletal structural analysis: force and displacement methods.

**Unit 2**  
Application of force method to plane and space frames problems.

**Unit 3**  
Application of displacement method to plane and space frames problems.

**Unit 4**  
Analysis of Frames, Organization of computation, programming considerations. Non-linear analysis due to plasticity in frames.

**Text Books and Reference Materials**
8. Web links to e-learning:nptel
9. Web based learning, Journal papers, etc.
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<tbody>
<tr>
<td>CE605</td>
<td>Advanced Concrete Design</td>
<td>DC</td>
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**Unit 1**
Limit state design: Basic concepts and philosophies, design of RC members in flexure, shear and torsion, members subjected to combined stresses, slender column, safety and serviceability, control of cracks and deflections, design of RC framed structures with ductile detailing.

**Unit 2**
Yield line analysis of slabs, yield line mechanism, equilibrium and virtual work methods, Hillerberg’s strip method.

**Unit 3**
Prestressed Concrete, Design of pre-stressed members for bending, shear, torsion and bond, End blocks.

**Unit 4**
Prestressed continuous beams and frames, slab and grid floor, tension and compression members, circular pre-stressing, pipes, tanks and special structures.

**Text Books and Reference Materials**
1. Karve and Shah “Limit State Theory and Design of reinforced Concrete” VGP, Pune, India.
2. Pillai and Menon “Reinforced Concrete Design” TMH, New Delhi, India.
3. Verghese, P. C. “Advanced Reinforced Concrete Design” PHI, Delhi, India.
5. Evans and Cook “Reinforced and Pre-stressed Concrete” TN, London, U.K.
8. Raju, N.K. “Pre-Stressed Concrete” TMH, Delhi, India.

**Selected B. I. S Codes**
1. I. S.:456-2000-Code of Practice for Plain and Reinforced Concrete, BIS, New Delhi, India.
2. I. S.:875 -1987(Part I & II)-Code of Practice for Design Loads(other than earthquake) for Building and Structures, BIS, New Delhi, India.
5. I.S.:13920- Ductile detailing of reinforced Concrete Structures subjected to Seismic forces, BIS, New Delhi, India.
7. S.P.:24 -Explanatory Hand Book of I.S. Code for Plain and Reinforced Concrete, BIS, New Delhi, India.
8. S.P.:34 - Hand Book of Concrete Reinforcement and Detailing, BIS, New Delhi, India.
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<tr>
<td>CE641</td>
<td>Advanced Soil Mechanics and Foundation Engineering</td>
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**Unit 1**
Soil Investigation: Soil exploration for hydraulic and buildings structures, SPT, Dynamic and Static cone penetration tests and Geophysical exploration techniques.

**Unit 2**

**Unit 3**
Deep Foundations: Design of deep foundations, Pile and pile groups, Pile caps.

**Unit 4**
Earth Retaining Structures: Lateral earth pressure, Design of retaining walls and sheet pile walls, Principles of design of cofferdams and diaphragm walls

**Text Books and Reference Materials**
5. BIS 2911 (Part 1 - 5), Bureau of Indian Standards for Pile Foundations.
6. BIS 2131, Bureau of Indian Standards for Soil Exploration.
7. BIS 1888, Bureau of Indian Standards for Plate Load Tests.
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<td>CE 606</td>
<td>Finite Element Analysis</td>
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**Unit 1 Introduction**

**Unit 2 Finite element analysis of one dimensional problem**
Generation of stiffness matrix by displacement and energy method, energy and variational approaches (Rayleigh-Ritz method), numerical solutions.

**Unit 3 Iso-parametric elements and shape functions**
Co-ordinate systems, Element shapes, Strain displacement matrix, Higher order elements: 1D, 2D and 3D.

**Unit 4 Finite element analysis of two dimensional problems**
Symmetry, Plane stress and plane strain problems, Bending of thin plates, Introduction to nonlinear FE analysis.

**Text Books and Reference Materials**
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<td>CE 607</td>
<td>Structural Dynamics</td>
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**Unit 1**
Types of Vibration and Ground motions, Undamaged and Damped Single Degree of Freedom System,
Response of SDOF System to Harmonic Loading.

**Unit 2**
Response to General Dynamic and Impulsive Loading, Duhamel's Integration, Fourier Analysis and
Response in the Frequency Domain.

**Unit 3**
Free Vibration of Lumped Multi Degree of Freedom System. Approximate Methods For Obtaining
Natural Frequencies and Mode Shapes. Frequency Domain Analysis Of Lumped Multi Degree Of
Freedom System Using Normal Mode Theory, Time Domain Analysis Using Numerical Integration
Scheme.

**Unit 4**
Principle of Virtual Work, Rayleigh's and Modified Rayleigh's Method, Dynamic Analysis of Systems
with Distributed Properties.

**Text Books and Reference Materials**

1. Structural Dynamics: Theory and Computation by Mario Paz, Kluwer Academic Publisher Group,
   Netherland.
2. Dynamics of Structures: Theory and Application to Earthquake Engineering by A. K. Chopra, Pearson
   Education, Inc.
3. Elements of Earthquake Engineering and Structural Dynamics by Andre Filiatrault, Presses Inter
   Polytechnic.
6. Web links to e-learning: nptel
7. Web based learning, Journal Papers, etc.
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<td>CE608</td>
<td>Advanced Steel Design</td>
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**Unit 1 Steel Bridges**
Loads, classification and design procedures, plate girder bridges and truss girder bridges.

**Unit 2 Steel Chimneys**
Analysis and design of steel chimneys and elevated steel water tanks.

**Unit 3 Towers**
Analysis and design of transmission line and microwave towers.

**Unit 4 Tubular Sections**
Structural behavior of tubular sections, analysis and design of tubular sections, brittle fracture and fatigue in steel structures, plastic design of steel structure.

**Text Books and Reference Materials**
1. Design of Steel Structures Vol - II, Dr. Ram Chandra and V. Gehlot, Scientific Publishers, India.
2. Unified Design of Steel Structures, Luis F. Greschwindner, John Wiley and Sons.
3. Ductile design of Steel Structures, Michel Bruneau, Chia-Ming Uang, Rafael E. Sabelli, McGraw Hill Professional.
5. Design of Steel Structures, M. Raghupati, TMH Pub., New Delhi.
12. IS: 805 - 1968, Code of Practice for Use of Steel in Gravity Water Tanks
13. Web links to e-learning: nptel
14. Web based learning, Journal Papers, etc.
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<tr>
<td>CE609</td>
<td>Construction Planning and Management</td>
<td>DC</td>
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**Unit 1 Construction organization**
Overview of construction, development and organization of projects, Construction organization structure, Construction finance management, scope of financial management, working capital management, capital investment decision.

**Unit 2 Construction materials management**
Economy in material management, inventory management and control, purchase and store management, specialized buying and vendors management.

**Unit 3 Construction equipment management**
Equipment performance characteristics, selection, planning and matching of construction equipment, equipment management, construction human resources management; introduction to human resource management, labor legislation, industrial relations, women in construction.

**Unit 4 Construction contract management**
Legal aspects of contract, contract procedures and document, important contract clauses, quality control during construction; Construction accounting; nature and role of accounting, accounting process and book of accounts, accounting conventions and final account, inventory valuation and depreciation.

**Text Books and Reference Materials**
4. Patil B. S., "Civil engineering contracts and estimates (vol-1 and vol-2)", Orient Longman limited, New Delhi, India.
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<tr>
<td>CE 642</td>
<td>Advanced Construction Materials</td>
<td>DE</td>
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**Unit 1**
Timber: Definition, Classification, Growth and Structure of timber, Characteristics, Defects, Seasoning, Preservation, Veneers, Plywood, Boards, IS Codes
Steel: Types, Composition and Properties of Structural Steel, Advantages and Disadvantages of Steel Structures, IS Codes
Gypsum: Occurrence, Physical Properties, Resources in India, Alabaster, Uses. Glass, Ceramic Tiles

**Unit 2**
Plastics: Definition, History, Classification, Polymerization, Properties of Plastics, Applications in Building Industry, IS Codes
Paints: Classification, Composition of Oil Paints, Characteristics of Good Paints, Defects in Painting, Enamel Paints, Distempers
Varnishes: Composition, Qualities of Good Varnish, Different Kinds of Varnish, French Polish or Spirit Polish, IS Code.

**Unit 3**
Fibre reinforced concrete: Fibres used in FRC, advantages and disadvantages of FRC over conventional reinforced concrete, factors effecting properties, relative fibre matrix stiffness, volume of fibres, aspect ratio of fibres, orientation of fibres, workability, size of coarse aggregate, mixing, application, Glass fibre reinforced cement: current developments in FRC, high fibre volume micro fibre system, slurry infiltrated fibre concrete, polymer concrete, behavior of FRC under Tension, compression and shear.

**Unit 4**
Ferrocement: Definition of ferrocement, applications of ferrocement, materials used in ferrocement, parameters and properties of materials used in ferrocement, cement mortar mix, skeletal steel, steel mesh reinforcement, fibre reinforced polymeric meshes, advantages of FRP, disadvantages of FRP, behavior of ferrocement in tension, advantages of ferrocement, difference between ferrocement and reinforced cement concrete: Physical and Mechanical properties, Concrete and other cementitious composite materials.

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<tr>
<td>CE 644</td>
<td>Tall Buildings</td>
<td>DE</td>
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**Unit 1 Structural Systems**
Types of structural systems; types of loads; methods of analysis; stability of tall structures; selection of foundation for tall buildings

**Unit 2 Wind Effects on Tall Structures**
Bluff body aerodynamics; aero-elastic phenomena; wind directionality effects; structural response and design considerations; standard provisions for wind loading.

**Unit 3 Earthquake Effects on Tall Structures**
Introduction to earthquake engineering and earthquake resistant design of buildings; earthquake motion and response; general principles and design criteria for buildings; codal provisions; aseismic design of structures; dynamic analysis; effect of torsion; design of stack like structures; earthquake forces in tall buildings.

**Unit 4 Shear Walls**
Shear in buildings; need of shear walls; location of shear walls in buildings; analysis and design of shear walls.

**Text Books and Reference Materials**

6. Analysis of Shear-walled Buildings, S. M. A. Kazimi and R. Chandra, Tor Steel Research Foundation in India, Calcutta.
7. IS: 875-1987 Part 1 Dead Load – Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, BIS.
12. IS: 13920-1993 – Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS.

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<tr>
<td>CE 701</td>
<td>Earthquake Resistant Design of Structures</td>
<td>DC</td>
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**Unit 1 Structural Systems**
Types of structural systems; types of loads; methods of analysis; stability of tall structures; selection of foundation for tall buildings

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Bluff body aerodynamics; aero-elastic phenomena; wind directionality effects; structural response and design considerations; standard provisions for wind loading.

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<tr>
<td>CE 780S</td>
<td>General Seminar</td>
<td>DC</td>
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Topics related to general interest of Civil Engineering particularly new inventions and new techniques used in modern construction. For instance, Green House Buildings in India, Techniques to Curb Landslides, New Runway Pavement Materials, Design of Containment Shell of Nuclear Power Plant, New Construction Techniques involved in Tunneling, Rocket Launching Pad, Use of Tuned Mass Dampers in High-rise Construction, Construction of Bunkers and Silos

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<tr>
<td>CE 791S</td>
<td>Lab/Project</td>
<td>DC</td>
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1. To calculate the depth of the vertical crack in a beam with the help of Portable Ultra Sonic Non-destructive Testing Indicator (PUNDIT).
2. To calculate the length of the inclined crack in a beam with the help of Portable Ultra Sonic Non-destructive Testing Indicator (PUNDIT).
3. To calculate the strength of the cube by testing under destruction and non-destructive testing by PUNDIT.
4. To calculate the Poison's ratio and modulus of elasticity of the concrete.
5. To study the behavior of timber section under pure bending.
6. To calculate stiffness, damping and logarithmic decrement of the spring system both in series and parallel.
7. Analyze a three span continuous beam (i) By moment redistribution method (ii) Analytically with the help of a software. Also compare the results.
8. Analyze a multi-storey building considering earthquake and wind also.

Text Books and Reference Materials
1. Lab manual.

Web based learning

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<td>CE 781S</td>
<td>Preliminary Dissertation Seminar</td>
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Any suitable research topic relevant to structural engineering from the following thrust areas such as:
Offshore Structures, Structural Dynamics, Computational Fluid Dynamics, Fibre Reinforced Concrete, Durability and Corrosion Resistance, Polymer Concrete Composites, Self
Compacting Concrete, Permeable Concrete, Fire Resistance of High Strength Concrete, Performance Based Design, Reliability Based Design, Seismic Strengthening of Heritage Buildings, soil-structure interaction, recycled concrete, etc. To study the behavior of timber section under pure bending.

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<td>CE 782S</td>
<td>Final Dissertation Seminar</td>
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<td>CE 798S</td>
<td>Dissertation</td>
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