CIPC2004 STRUCTURAL ANALYSIS (3-0-0)

Course Objectives:

The course in Structural Analysis aims to provide students with a comprehensive understanding of structural mechanics and analysis techniques. It seeks to develop advanced knowledge of determining structural stability, analyzing complex loading conditions, and applying sophisticated mathematical methods to evaluate structural performance. Students will learn to assess determinate and indeterminate structures, understand energy principles, and apply various analytical techniques for analyzing beams, trusses, and arches. The objective is to equip students with theoretical and practical skills in analyzing structural systems using advanced computational and graphical methods.

Module- I (8 hours)

Concept of determinate and indeterminate structures, determination of degree of static andkinematic indeterminacy in plane frame and continuous structures.

Methods of Analysis: Equilibrium equations, compatibility requirements, Introduction to force anddisplacement methods.

Analysis of propped cantilever by consistent deformation method, Analysis of fixed andcontinuous beams by Moment-Area method, Conjugate beam method and theorem of threemoments.

Module- II (8 hours)

Energy theorems and its application, Strain energy method, Virtual work method, unit loadmethod, Betti's and Maxwell's laws, Castigliano's theorem, concept of minimum potential energy.Theories of failure, Maximum normal stress theory, maximum normal strain theory, maximum shearing strain theory,maximum strain energy theory, maximum distortion energy theory, maximum octahedral shearingstress theory.

Module- III (8 hours)

Analysis of redundant plane trusses.Deflection of pin jointed plane trusses using strain energy method, unit load method. Analytical method and Williot –Mohr diagram.Introduction to space truss.

Arches: Introduction and classification of arches, Bending moment, shear and normal thrust of three hinged archesSuspension Cables: Three hinged stiffening girders

Module- IV (8 hours)

Rolling loads and influence lines for determinate structures, simply supported beams, cantilever, Influence Line Diagram for reaction, shear force and bending moment at a section, Influence Line Diagram for wheel loads, point loads and uniformly distributed loads, maximum bending moment envelope.Influence Line Diagram for Bending Moment, Shear Force, normal thrust and radial shear forthree hinged arches.

Course Outcomes:

CO1: Analyze determinate and indeterminate structures, demonstrating proficiency in calculating degrees of static and kinematic indeterminacy for plane frames and continuous structures

CO2: Apply advanced energy methods and theorems, including strain energy, virtual work, and Castigliano's theorem, to solve complex structural engineering problems

CO3: Evaluate different theories of failure, critically understanding and comparing maximum stress, strain, and energy-based failure criteria for structural materials

CO4: Analyze redundant plane trusses and arches using advanced analytical techniques, including strain energy methods, Williot-Mohr diagrams, and graphical approaches

CO5: Develop and interpret influence line diagrams for various structural elements, demonstrating ability to assess loading conditions, reactions, shear forces, and bending moments in structural systems

Text Book &Reference Books:

1. R. C.Hibbeler,Structural analysis,Pearson Prentice Hall
2. K. Leet,C. M. Uang &A. M. Gilbert, Fundamentals of structural analysis. McGraw-Hill Higher Education.
3. Louis F. Geschwindner&Harry H.West, Fundamentals of Structural Analysis.Wiley publication
4. L. S. Negi, Theory and Problems in Structural Analysis, Tata-McGraw Hill.
5. C. S. Reddy. Basic structural analysis. McGraw Hill Education. S.S. Bhavikatti, Structural Analysis.Vikas Publishing House