FINITE ELEMENT METHOD WITH STRUCTURAL APPLICATIONS

Course Code: 15CE2212 **L P C**
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Course Outcomes: At the end of the course, the student will be able to:
CO1: Discuss the basics of FEM.
CO2: Explain the shape functions and stiffness matrix.
CO3: Prepare stiffness matrix for 2D elements.
CO4: Describe the use and concepts of iso-parametric elements.
CO5: Analyse beams, 2D & 3D structural systems.

UNIT- I (10-Lectures)

Elasticity: Analysis of stress and strain, Definition of stress and strain at a point, Equilibrium and compatibility equations.

Plane stress and plane strain: - Simple two dimensional problems in Cartesian and polar co-ordinates.

Introduction to FEM: Concept of Finite Element Method - Merits and demerits, applications, relevant software's. Steps involved in FEM as applicable to structural mechanics problems. Discretization interpolation model, Convergence criteria.

UNIT-II (10-Lectures)

Shape Functions - Methods of Determination

Element Stiffness matrix Equation - Derivation of stiffness matrix based on Principle of minimization of total potential energy.

Assemblage of Element Stiffness Matrices – Assembly procedure, solution of nodal displacement, Element Stresses and Strains, Interpretation of results, Post processing, Static condensation.

UNIT- III (10-Lectures)

2D Analysis using FEM: Stiffness Matrix for a Two noded bar/Truss Element, Three noded Truss Element and Two noded Beam Element in Local, and Global (2D)

Stiffness Matrix for a three noded Constant Strain Triangular (CST) Four noded rectangular element for Plane Stress and Plane Strain Condition.

UNIT- IV (10-Lectures)

Isoparametric Formulation: Isoparametric, sub-parametric and super parametric Elements, Procedure for Formulation of stiffness equation, Advantages of Isoparametric Elements, Transformation of axes, Co-ordinate systems in FEM - Jacobian relevance to FEM.

UNIT-V (10-Lectures)

Application of F.E.M to Structural Mechanics Problems:

Analysis of 2D –Truss for Initial Strain/Rise in Temperature, External loads, Analysis of Propped Cantilevers, Fixed beams, Continuous beams.

TEXT BOOKS

1. Chandrupatla. T. R., Belegunde A.D, *"Introduction to Finite Elements in Engineering",* 3rd edition, PHI, 2010.
2. S.S. Bhavikatti, *"Finite Element Analysis"*, 2nd edition, New age international, 2010.

REFERENCES

1. Klaus-Jurgen Bathe, *"Finite Element Methods",* 2nd edition, Prentice Hall, 2010
2. Reddy, J.N., *"Introduction to Finite Element Method",* 3rd Edition, Mc Graw Hill, 2002
3. Desai Y.M., Eldho TI, Shah A.H, *"Finite Element methods with application in Engineering",* 1stedition, Pearson, 2011