FINITE ELEMENT ANALYSIS

(Professional Core)

Course Code: 19CE2207

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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 isoparametric elements.
CO5: Analyse beams, 2D & 3D structural systems.

UNIT-I (10-Lectures)

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

LO1: Understand the concept of FEM.

LO2: Analyse beams using Rayleigh Ritz Method and Galerkin method.

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.

LO1 : Determination of shape functions.

LO2: Derive stiffness matrix.

LO3: Assemble element stiffness matrix.

UNIT-III **(10Lectures)**

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.

LO1: Analyse two noded bar /truss element / beam element using FEM.

LO2: Analyse three noded bar truss element using FEM.

LO3: Analyse four noded element using FEM.

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.

LO1 : Understand concept of Isoparametric elements.

LO2: Formulate the stiffness equation for Isoparametric elements.

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.

LO1: Analyse 2D truss due to rise in temperature change.

LO2: Analyse indeterminate beams using FEM.

Text Books

1. Daryl L Logan , A First Course in the Finite Element Method, 5th Edition, Cengage, 2012

2. Chandrupatla.T.R., Belegunde A.D, *"Introduction to Finite Elements in Engineering",* 3rdedition, PHI,2010.

References

1. C.S. Krishnamurthy, Finite element analysis: Theory and programming, 2nd edition, Mc Graw Hill, 2007
2. S.S. Bhavikatti, *"Finite Element Analysis"*, 2nd edition, New age international, 2010.
3. Reddy, J.N., *"Introduction to Finite Element Method",* 3rd Edition, McGraw Hill, 2002.