B.Tech IV Year	L	T	P	To	C
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CE431 FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Dept. Elective -III)

Course Description and Objective:

This course deals with the theory and application of the finite element methods for analyzing structural systems and other civil engineering problems. To equip the students with the Finite Element Analysis fundamentals. To enable the students to formulate the design problems into FEA.

Course Outcomes:

- *Develop shape functions and stiffness matrices for spring and bar elements*
- *Develop global stiffness matrices and global load vectors*
- *Apply natural and arial coordinate systems to constant strain triangle and linear strain triangle elements*

UNIT – I

Introduction: A brief history of FEM, Need of the Method, Finite Difference Method, Equilibrium equations, linear strain-displacement relations; linear constitutive relations– Plane stress and plane strain.

UNIT – II

Finite Element formulation technique: Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions, Potential energy; Principle of stationary potential energy

UNIT –III

Element Properties: One Dimensional FEM: Stiffness matrix for bar element - shape functions for one-dimensional elements – one-dimensional problems. Two Dimensional FEM: Different types of elements for plane stress and plane strain analysis – Displacement models – generalized coordinates – shape functions – convergent and compatibility requirements – Geometric invariance – Natural coordinate system – area and volume coordinates.

UNIT – IV

Direct Stiffness method and Solution Technique : Assemblage of elements– Obtaining Global stiffness matrix and Global load vector; Governing equilibrium equation for static problems; Application of boundary conditions; Solution to resulting simultaneous equations using Gauss elimination method.

UNIT – V

Solution to one- and two- dimensional problems: Solution to plane truss, plane-frame, plane-stress and plane-strain problems. Axis-symmetric analysis- Basic principles-Formulation of 4-node isoparamatric axis-symmetric element, Gauss Quadrature, Numerical integration

TEXT BOOKS:

1. C.S.Krishna Murthy, “Finite Element Analysis”, 2nd ed., Tata McGraw-Hill Publishing Company Ltd., 2009.
2. S. S.Rao, “The finite element method in engineering”, 3rd ed., Butterworth- Heinemann, New Delhi, 2000.

REFERENCE BOOKS :

1. S.S. Bhavakatti, “Finite element analysis”, 2nd ed., New age International Publishers, 2010.
2. Robert D. Cook et al, Concepts and Application of Finite Element Analysis, Fourth Edition, John Wiley &jons (Asia) Pte. Ltd.,.