FINITE ELEMENT ANALYSIS

PROFESSIONAL ELECTIVE – II

VI Semester:

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
A5AE41	PEC	3	-	-	3	30	70	100

COURSE OBJECTIVES:

The objectives of the course are to enable the student;

1. Introduction of Finite Element Method (FEM) which is one of the Numerical Methods with which solutions can be obtained for problems with complex geometries, material properties and boundary conditions.
2. Utility of FEM as engineering solution tool to problems (both vector and scalar involving various fields for Design Analysis and Optimization.
3. Development of Mathematical Model (Governed by Differential equations) for physical problems and concept of discretization of continuum.
4. Ability to understand, to improve or refine the approximate solution by spending more computational effort by using higher interpolation continuities unlike expensive experimental methods / exact solutions.

UNIT-I INTRODUCTION TO FEM

INTRODUCTION: Basic concept, application of FEM, general description, Stress, strain relations, Strain, Displacement relations.

ONE DIMENSIONAL PROBLEM: Finite element modeling coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions.

UNIT-II ANALYSIS OF TRUSSES

ANALYSIS OF TRUSSES: Stiffness Matrix for plane truss, stress calculations.

ANALYSIS OF BEAMS: Hermite shape functions-Element stiffness matrix for two nodes, two degrees of freedom pernode beam element, load vector, deflection, stresses.

UNIT-III 2-D PROBLEMS

2-D PROBLEMS: CST-Stiffness matrix and load vector, Isoparametric element representation, Shape functions,convergence requirements, Problems.

FINITE ELEMENT MODELLINGof Axisymmetric solids subjected to Axisymmetric loading with triangular elements.Two dimensional four noded isoparametric elements.

UNIT-IV STEADY STATE HEAT TRANSFER ANALYSIS

STEADY STATE HEAT TRANSFER ANALYSIS: one dimensional analysis of a fin and two dimensional analysis of thin plate.

UNIT-V DYNAMIC ANALYSIS

DYNAMIC ANALYSIS: Formulation of finite element model, element matrices, Lumped and consistent mass matrices-evaluation of Eigen values and Eigen vectors for a stepped bar for free vibrations

Text Books:

1. R. Tirupathi Chandrapatla (2011), Introduction to Finite Elements in Engineering, 4rd edition, Pearson Education, India.
2. V. David. Hutton (2010), Fundamentals of finite elements analysis, 1st edition, Tata McGraw-Hill education (P) Ltd, New Delhi, India

Reference Books:

1. J. N. Reddy (2010), Anintroduction to Finite Element Method, 3rd edition, Tata McGraw hill education (P) Ltd, New Delhi, India.
2. Chennakesava R. Alavala (2009), Finite elements methods, 1st edition, second reprint, Prentice Hall of India publishers, New Delhi, India.

COURSE OUTCOMES:

1. Develop elastic equations, formulate and solve the axially loaded bar structures using FEM.
2. Apply finite element method to truss and beam analysis.
3. Implement finite element method to solve two dimensional problems and apply numerical integration to one and two dimensional problems.
4. Solve and analyze heat transfer problems using FEM.
5. Apply FEM to dynamic analysis of one dimensional bars and beams.