CE6111E FINITE ELEMENT METHOD

L	T	P	O	Cr
3	0	0	6	3

Prerequisite : Nil

Total Lecture Sessions: 39

Course Outcomes:

CO1: To formulate finite element model of a physical system

CO2: To derive element stiffness matrix for a given problem

CO3: To write a computer code and analyse a structure using the finite element method

CO4: To sufficiently equip to use latest commercial FE software

Introduction: Finite element analysis, Problem classification, Modelling and discretization, interpolation, elements, nodes and D.O.F, Example applications, History of FEA.

One-Dimensional Elements: Bar element, Beam element, Bar and beam elements of arbitrary orientation, Assembly of elements, Properties of stiffness matrices, Boundary conditions, Exploiting sparsity, Mechanical loads, Thermal loads, Stresses, Structural symmetry.

Basic Elements: Interpolation and shape functions, Linear triangle, Bilinear rectangle, Rectangular solid element, Nodal loads, Stress calculation, Nature of finite element solution.

Formulation Techniques: Variational Methods: Principle of stationary potential energy, Problems having many D.O.F., Potential energy of an elastic body, Rayleigh-Ritz method, Strong and weak forms, Finite element form of Rayleigh-Ritz method, Convergence of finite element solutions.

Formulation Techniques: Galerkin and Other Weighted Residual Methods: Methods of weighted residuals, Galerkin FEM in one dimension, Integration by parts, Galerkin FEM in two dimensions.

Isoparametric Elements: Bilinear quadrilateral, Quadrature for obtaining [k] by numerical integration, Quadratic isoparametric elements, Hexahedral isoparametric elements, Stress calculation, Patch test, Validity of isoparametric elements.

Isoparametric Triangles and Tetrahedra: Reference coordinates, shape functions, analytical integration, area and volume coordinates, numerical integration.

Coordinate Transformation and Selected Topics: Displacement, strain, stress, material property and stiffness matrix transformations, Changing the direction of restraints, Connecting dissimilar elements, Structural modification, Reanalysis.

Modelling Considerations: Repetitive symmetry, Static condensation, Substructures.

References

1. Cook, R.D., et al, Concepts and Applications of Finite Element Analysis, John Wiley, 2003
2. Krishnamoorthy, C.S., Finite Element Analysis–Theory and Programming, Tata McGraw Hill, 1996
3. Bathe, K.J., Finite Element Procedures, Prentice Hall of India, 1996
4. Desai, C.S., Elementary Finite Element Method, Prentice Hall of India, 1998
5. Zienkiewicz, O.C., and Taylor, R.L., The Finite Element Method, Vol. I and II, Mc Graw Hill, 1991
6. Buchanan, G.R., Finite Element Analysis, Schaum's Outlines, Tata McGraw-Hill, India, 1995
7. Rajasekaran, S., Finite Element Analysis in Engineering Design, Wheeler Pub, 1998