

I YEAR M. TECH (MACHINE DESIGN) SECOND SEMESTER

17MEMD2T3 FINITE ELEMENT METHODS IN ENGINEERING Credits 4

Lecture: 4 periods/week

Internal assessment: 40 marks

Tutorial: - -

Semester end examination: 60 marks

COURSE OBJECTIVE:

- To introduce the concepts of finite element method to solve engineering problems.

COURSE OUTCOMES:

Student will be able to

1. Apply variational and weighted residual methods to solve differential equations.
2. Analyze 1-D bar, Truss, beam and Frame problems using finite element method.
3. Develop finite element formulations and solve 2-D structural problems using triangular and quadrilateral elements.
4. Analyze vibration problems for frequencies and mode shapes.

UNIT-I

FORMULATION TECHNIQUES:

Methodology, engineering problems and governing differential equations, variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, weighted residual methods.

FINITE ELEMENT METHOD: Concepts of discretization, types of elements, interpolation function, node numbering scheme, assembly and boundary conditions.

UNIT-II

ANALYSIS OF BARS:

Element shape functions, stiffness matrix, load vectors, determination of displacements, reaction, stresses, temperature effects.

ANALYSIS OF TRUSSES: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

ANALYSIS OF BEAMS AND FRAMES: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT-III

TWO DIMENSIONAL PROBLEMS: Analysis of 2-D problems using constant strain triangle element, axi-symmetric formulations.

ISOPARAMETRIC FORMULATIONS: Sub, iso and super parametric elements, four noded quadrilateral element, numerical integration – Gaussian Quadrature approach.

UNIT-IV

FINITE ELEMENTS IN STRUCTURAL DYNAMICS: Dynamic equations, eigen value problems, and their solution methods, simple problems.

CONVERGENCE: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle.

Learning Resources

Text Books:

1. Introduction to Finite Elements in Engineering by Tirupathi R. Chandraputla, Ashok D. Belegundu, Prentice Hall, 2011
2. The Finite Element Methods in Engineering (4th Edition) by SS Rao, Pergamon.

Reference Books:

1. An introduction to Finite Element Method (3^{ed} Edition) by JN Reddy, McGraw-Hill,.
2. Finite Element Analysis -Theory and Programming (2nd Edition) by C. S. Krishnamurthy, Tata Mc Graw Hill,
3. A first course in finite element method by Daryl L Logan, Cengage Learning.
4. Finite element procedures by K. J. Bathe, Prentice-Hall, 1996