Gautam Buddha University; Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech.	Finite Element Methods and Analysis	MEE 503	SM+MT+ET 25+25+50
Semester	**Credits**	**L-T-P**	**Exam.**
I	3	3-0-0	3 Hours

Unit - I

Introduction: Basic concept; Historical background; Engineering applications; General description; Comparison with other methods; Integral formulation and variation methods; Need for weighted-integral forms; Relevant mathematical concepts and formulate; Weak formulation of boundary value problems; Variation methods; Rayleigh-Ritz method and weighted residual approach. FEM – elements and coordinate system; Interpolation polynomials; Element and global matrices; Local and natural coordinate systems; Von Mises stress. **(08 Hours)**

Unit - II

Fundamentals of Finite Element Techniques: Module boundary value problem; Finite element decartelization; Co-ordinates and shape functions; Quadratic shape functions; Potential energy approach; Galerkin approach; Element shapes; Sizes and node locations; Interpolation functions; Penalty approach; Derivation of element equations; Connectivity; Boundary conditions; Plane trusses stress calculation; Three dimensional trusses; Lagrange and Hermit polynomials. **(08 Hours)**

Unit - III

Applications to Solid and Structural Mechanics Problems: External and internal equilibrium equations; One-dimensional stress-strain relations; Plane stress and strain problems; Axis symmetric and three dimensional stress strain

problems; Strain displacement relations; Boundary conditions compatibility equations. **(08 Hours)**

Unit - IV

Applications to Beams and Frames: Potential-Energy approach; Galerkin approach; Element stiffness; Direct approach; Shear force and bending moment; Beams on elastic supports; Load vector; Plane frames; Problem modeling and boundary conditions. **(07 Hours)**

Unit - V

Applications to Heat Transfer Problems: Variational approach; Galerikn approach; One dimensional and two dimensional steady state problems for conduction; One and two dimensional formulation of fin; Transient problems.
(07 Hours)

Unit - VI

Applications to Fluid Mechanics Problems: Inviscid incompressible flow; Potential function and stream function formulation; Incompressible viscous flow; Stream function; Fluid flow in ducts. **(07 Hours)**

Recommended Books:

1. An Introduction to the Finite Element Method; J.N. Reddy; Tata McGraw Hill; 3rd Ed.; 2007
2. The Finite Element Method in Engineering; Singiresu S Rao; Elsevier Butterworth Heinemann; 4th Ed; 2005
3. Introduction to Finite Elements in Engineering; R. Tirupathi; Chandrupatla; Ashok D. Belagundu; Prentice- Hall India; 3rd Ed; 2002.
4. Concepts and Applications of Finite Element Analysis; Robert Cook. et al.; John Wiley & Sons; 4th Ed.; 2003
5. Applied Finite Element; G. Ramamurthy; I K International; New Delhi; 2nd Ed; 2010