

Finite Element Methods

Basic Concepts: Introduction, Weak formulations, Weighted residual methods, Variational approaches, Element types. One-Dimensional Analysis: Basis steps, discretization, element equations, linear and quadratic shape functions, assembly, local and global stiffness matrix and its properties, boundary conditions, applications to solid mechanics, heat and fluid mechanics problems, axisymmetric problems. Plane Truss: Local and global coordinate systems, stress calculations, example problems. Beams: Introduction, Euler-Bernoulli beam element, numerical problems. Scalar Field Problems in 2-D: Triangular and rectangular elements, constant strain triangle, isoparametric formulation, higher order elements, six node triangle, nine node quadrilateral, master elements, numerical integration, computer implementation, Numerical problems. Plane Elasticity: Review of equations of elasticity, stress-strain and strain-displacement relations, plane stress and plane strain problems

Suggested books:

1. The Finite Element Method for Engineers- Huebner K.H., Dewhirst, D. L., Smith, D. E., and Byrom, T. G., 4th Ed., John Wiley and Sons 2001
2. The Finite Element Method in Engineering- S. S. Rao, 4th Ed., Elsevier Science 2005
3. An Introduction to Finite Element Methods - J.N.Reddy, 3rd Ed., Tata McGraw-Hill 2005
4. A First Course in Finite Elements – J.Fish and T. Belytschko, 1st Ed., John Wiley and Sons