Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CE5610 - Finite Element Analysis

Credit Distribution: C:12 L:3 T:0 P:0 E:1 O:8 TH:

Course Type: Theory

Description: Basic Equations of Solid Mechanics Review of equilibrium conditions, Strain-displacement relations, Stress- Strain relations, Principle of Virtual work & Stationery potential energy and variational formulation. Approximate methods - Rayleigh-Ritz, Weighted residual (Galerkin) and finite difference methods. Finite Element Method: Displacement-model Shape functions- Lagrange and serendipity elements, Element - properties Isoparametric - elements numerical integration, technique, Assemblage of elements and solution techniques for static analysis. Analysis of framed Structures - 2D and 3D truss and beam elements and applications. Analysis of plane stress/strain and axisymmetric solids triangular, quadrilateral and isoparametric elements, incompatible models. Three dimensional stress analysis Isoparametric eight and twenty noded elements. Analysis of plate bending Basic equations of thin plate theory. ReissnerMindlin theory Plate elements and applications. Analysis of shells degenerated shell elements. Finite element programming and FEA Software

Course Content: CourseContent:1. Approximate solution to boundary value problems: Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions2. Basic finite element concepts: Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method3. Numerical integration: Newton-Cotes rules, Trapezium rule, Simpsonâ€™s rule, Error term, Gauss-Legendre rules, Changing limits of integration, Gauss-Leguerre rule, Multiple integrals4. Application: Axial element: Analysis of plane and space trusses, Displacement loading of trusses; Beam element: Two node beam element, stresses in beams, thermal stresses in beams; Frame element: Plane and space frame element; 2D boundary value problems using isoparametric triangular and quadrilateral elements: Shape functions, geometric mapping; 3D boundary value problems using Tetrahedral element, Brick element; Plane elasticity problems, Axisymmetric elasticity problems, Torsion of prismatic bars, buckling of columns, 3D elasticity problems; Ideal fluid flow; steady state heat flow

Text Books : NIL

Reference Books : NIL

Prerequisite: NIL

Prepared in January 2021