Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CE7730 – ADVANCED FINITE ELEMENT ANALYSIS

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:0

Course Type: Theory

Description: To solve boundary value problems accounting for large deformations or material nonlinearity or both, using finite element techniques.

CourseContent:1. Review of Continuum Mechanics: Kinematics, Balance laws, Constitutive theory, Large deformation elasticity, classical plasticity; Tensor algebra, fourth order tensor; Tensor calculus 2. Formulation: Total and Updated Lagrangian formulation; Geometric nonlinear analysis; Material nonlinear analysis; Reduced integration; Mixed finite element formulation; meshless methods 3. Solution Techniques: Newton-Raphson, modified Newton-Raphson; Risks method; Stress Update algorithms; Minimization techniques 4. Elements: 2D/3D truss, beam, frame; Plane stress/strain, plate, shell 5. Error estimates: Discretization, approximation and truncation error estimates, error minimization techniques

Textbooks:

1. Wrigglers, P., Nonlinear Finite Element Methods, Springer, 2008

2. De Borst, R., Crisfield, M.A., Remmers, J.J.C. and Verhoosel, C.V., Nonlinear Finite Element Analysis of Solids and Structures, Wiley, 2012.

Reference Books:

1. Kim, N.H., Introduction to Nonlinear Finite Element Analysis, Springer, 2014.

2. Reddy, J.N., An Introduction to Nonlinear Finite Element Analysis: With Applications to Heat Transfer, Fluid Mechanics, and Solid Mechanics, Oxford University Press, 2015.

Prerequisite: CE5610 and CE6780 or COT

Prepared in January 2021