Finite Element Analysis - Web course

COURSE OUTLINE

The target audience of the course is the Post Graduate / Final year Undergraduate students from areas such as Civil, Mechanical, Aerospace, Naval Architecture etc.
The objective of the course is to apprise the students about the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems in solid mechanics. Different application areas will be dealt with after introducing the basic aspects of the method.
However, major emphasis will be on the solution of problems related to Civil Engineering.
It is intended to cover the analysis methodologies for 1-D, 2-D and 3-D problems with the advantages and disadvantages clearly spelt out.
It is expected that once the students are exposed to the course, they will be in a position to develop computer codes for any physical problem using Finite Element technique.

COURSE DETAIL

Sl. No.	Topic
1	**Module 1: Introduction to Finite Element Analysis** • Lecture 1: Introduction • Lecture 2: Basic Concepts of Finite Element Analysis • Lecture 3: Introduction to Elasticity • Lecture 4: Steps in Finite Element Analysis
2	**Module: 2 Finite Element Formulation Techniques** • Lecture 1: Virtual Work and Variational Principle • Lecture 2: Galerkin Method • Lecture 3: Finite Element Method: Displacement Approach • Lecture 4: Stiffness Matrix and Boundary Conditions
3	**Module 3: Element Properties** • Lecture 1: Natural Coordinates • Lecture 2: Triangular Elements • Lecture 3: Rectangular Elements • Lecture 4: Lagrange and Serendipity Elements • Lecture 5: Solid Elements • Lecture 6: Isoparametric Formulation • Lecture 7: Stiffness Matrix of Isoparametric Elements • Lecture 8: Numerical Integration: One Dimensional

NP-TEL

NPTEL

http://nptel.ac.in

Civil Engineering

Pre-requisites:

Since this course is a Masters level course, it is expected that the students should be exposed to Structural Analysis, Matrix Algebra & Basic Mathematics courses.

TEXT

- Concepts in Finite Element Analysis - R.D. Cook, Plesha & Malkus.
- Finite Element Analysis - C. S. Krishnamoorthy
- Finite Element Analysis - S. S. Rao

Additional Reading:

1. A large amount of literature is available in the area. Students should get exposed to the same.

Coordinators:

Dr. D. Maity

	• Lecture 8: Numerical Integration: One Dimensional • Lecture 9: Numerical Integration: Two and Three Dimensional • Worked out Examples
4	**Module 4: Analysis of Frame Structures** • Lecture 1: Stiffness of Truss Members • Lecture 2: Analysis of Truss • Lecture 3: Stiffness of Beam Members • Lecture 4: Finite Element Analysis of Continuous Beam • Lecture 5: Plane Frame Analysis • Lecture 6 Analysis of Grid and Space Frame
5	**Module 5: FEM for Two and Three Dimensional Solids** • Lecture 1: Constant Strain Triangle • Lecture 2: Linear Strain Triangle • Lecture 3: Rectangular Elements • Lecture 4: Numerical Evaluation of Element Stiffness • Lecture 5: Computation of Stresses, Geometric Nonlinearity and Static Condensation • Lecture 6: Axisymmetric Element • Lecture 7: Finite Element Formulation of Axisymmetric Element • Lecture 8: Finite Element Formulation for 3 Dimensional Elements • Worked out Examples
6	**Module 6: FEM for Plates and Shells** • Lecture 1: Introduction to Plate Bending Problems • Lecture 2: Finite Element Analysis of Thin Plate • Lecture 3: Finite Element Analysis of Thick Plate • Lecture 4: Finite Element Analysis of Skew Plate • Lecture 5: Introduction to Finite Strip Method • Lecture 6: Finite Element Analysis of Shell
7	**Module 7: Additional Applications of FEM** • Lecture 1: Finite Elements for Elastic Stability • Lecture 2: Finite Elements in Fluid Mechanics • Lecture 3: Dynamic Analysis

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References:

- C. S. Krishnamoorty, *Finite Element Analysis,* Tata McGraw-Hill
- David V. Hutton, *Fundamentals of Finite Element Analysis,* McGraw Hill
- D. Maity, *Computer Analysis of Framed Structures,* I. K. International Pvt. Ltd. New Delhi
- Erik G. Thompson, *Introduction to the Finite Element Method: Theory, Programming and Applications,* John Wiley
- H. C. Martin and G. F. Carey, *Introduction to Finite Element Analysis - Theory and Application,* NewYork, McGraw-Hill
- Irving H. Shames, Clive L. Dym, *Energy and Finite Element Methods in Structural Mechanics;* New Age International
- K. J. Bathe, *Finite Element Procedures,* Prentice-Hall of India, New Delhi, India
- M. Mukhopadhyay, *Matrix, Finite Element, Computer and Structural Analysis,* Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, India
- O. C. Zienkiewicz and Y. K. Cheung, *The Finite Element Method in Structural and Soild Mechanics,* McGraw Hill, London
- P. E. Ceruzzi, *A History of Modern Computing,* The MIT Press, Cambridge, MA, 1998.
- R. D. Cook, *Concepts and Applications of Finite Element Analysis* , Wiley
- S. S. Rao, *Finite Element Analysis,* Elsevier Butterworth-Heinemann
- W. Weaver Jr. and J. M. Gere, *Matrix Analysis of Framed Structure,* CBS Publishers & Distributors, New Delhi, India